Strategic Environmental Assessment of Shale Gas Development in the Central Karoo

Phase 3:
Decision Support Tools Report

June 2017

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Authors:	Greg Schreiner (CSIR), Luanita Snyman-van der Walt (CSIR) and Megan de Jager (CSIR)
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Additional report contributions from:	Domitilla Raimondo (SANBI), Michelle Hamer (SANBI), Ismail Ebrahim (SANBI)
Reviewed by:	Paul Lochner (CSIR)
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List of acronyms, abbreviations and units

°	Degrees
°C	Degrees Celsius
2-D	2-dimensional
3-D	3-dimensional
AEL	Air Emissions License
AGAA	Astronomy Geographic Advantage Act of 2007
ASSAf	Academy of Science of South Africa
bbl	barrel
BS	British Standard
CARA	Conservation of Agricultural Resources Act of 1983
CBA	Critical Biodiversity Area
CFB	Cape Fold Belt
CGS	Council for Geoscience
CO_2	Carbon dioxide
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
dB	Decibel
dBA	A-weighted decibel
DEA	Department of Environmental Affairs
DEA&DP	Western Cape Government Environmental Affairs And Development Planning
DMF	Decision-Making Framework
DMR	Department of Mineral Resources
DoE	Department of Energy
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMI	Electromagnetic interference
EMP	Environmental Management Plan
EMPR	Environmental Management Plan Report
EMPr	Environmental Management Programme
ER	Exploration Rights
EU	European Union
FEPA	Freshwater Ecosystem Priority Area
FOD	First Order Draft
GHG	Greenhouse Gas
GIS	Geographic Information System
GJ	Gigajoule
GN	Government Notice
GUMP	Gas Utilisation Master Plan
GVA	Gross Value Added
ha	Hectare

Ha/ LSU	hectares per livestock unit
HIA	Heritage Impact Assessment
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IRP	Integrated Resources Plan
ITU-R	International Telecommunications Union Recommendation
KCAAA	Karoo Central Astronomy Advantage Area
kg	kilogram
km	kilometre
km^2	square kilometre
kWh	kilowatt hour
LNG	Liquefied Natural Gas
LUPA	Western Cape Land Use Planning Act of 2015
M	Magnitude
m	metre
m^3	cubic metre
MC	Management Class
MIRs	Minimum Information Requirements
mm	millimetre
MPa	MegaPascal
MPRDA	Mineral and Petroleum Resources Development Act of 2002
MW	MegaWatt
NAAQS	National Ambient Air Quality Standard
NBA	National Biodiversity Assessment
NBSAP	National Biodiversity Strategy and Action Plan
NCPDA	Northern Cape Planning and Development Act of 1998
NCR	Noise Control Regulations
NDP	National Development Plan
NEM:AQA	National Environmental Management: Air Quality Act of 2004
NEM:WA	National Environmental Management: Waste Act of 2008
NEMA	National Environmental Management Act of 1998
NEMBA	National Environmental Management: Biodiversity Act of 2004
NHRA	National Heritage Resources Act
NORM	Naturally Occurring Radioactive Material
NPAES	National Protected Area Expansion Strategy
NWA	National Water Act of 1998
OES	One Environmental System
PASA	Petroleum Agency South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
PHRA	Provincial Heritage Resources Agencies
PV	Photovoltaic
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SALT	Southern African Large Telescope
SANBI	Southern African National Biodiversity Institute
SANS	South African National Standard
SARAS	South African Radio Astronomy Service

SAWIS	South African Waste Information System
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SEMA	NEMA Specific Environmental Management Act
SGMC	Shale Gas Monitoring Committee
SKA	Square Kilometre Array
SOD	Second Order Draft
SOEKOR	Southern Oil Exploration Corporation
SPLUMA	Spatial Planning and Land Use Management Act of 2013
t	Ton
Tcf	trillion cubic feet
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USA	Unites States of America
WHO	World Health Organization
WUL	Water Use Licence

1. BACKGROUND TO THE SEA

In 2010 the Department of Mineral Resources (DMR) received five Exploration Rights (ER) applications in terms of the Minerals and Petroleum Resources Development Act, 28 of 2002 (MPRDA) to explore for shale gas in the Central Karoo. One application was submitted by Falcon Oil & Gas Limited ("Falcon"), three by Shell Exploration Company B.V. ("Shell") and one by Bundu Gas and Oil Exploration (Pty) Ltd ("Bundu").

The potential economic and energy security benefits of a large shale gas resource in the Karoo Basin could be substantial; as are both the positive and negative social and environmental issues associated with a domestic gas industry. Shale gas exploration and production has already become a highly divisive topic, but one which is poorly informed by publically-available evidence.

To address this lack of critically-evaluated information, a Strategic Environmental Assessment (SEA) for shale gas exploration and production was commissioned in February 2015 by the Department of Environmental Affairs (DEA) of the Republic of South Africa, with the support of the National Departments of Energy (DoE), Mineral Resources (DMR), Water and Sanitation (DWS), Science and Technology (DST), and Agriculture, Forestry and Fisheries (DAFF); and the Provincial Departments of the Eastern, Western and Northern Cape Governments. The Council for Scientific and Industrial Research (CSIR) coordinated the SEA, in partnership with the South African National Biodiversity Institute (SANBI) and the Council for Geoscience (CGS).

The point of departure for the SEA is that South African Government, through Cabinet and various other decision-making institutions, has made high-level public commitments to shale gas exploration. If the exploration phase reveals economically-viable hydrocarbon deposits and gas-flow regimes, the Government will seriously consider permitting the development of those resources at significant scale. South African society, collectively comprising all levels of government, the private sector and civil society, needs to be in a position to make the decisions relevant to that choice in a timely and responsible manner.

Drawing from the National Development Plan (NDP), 2012, and the Constitution of South Africa (Act 108 of 1996), the overarching *Mission Statement* for exploration and production in South Africa was developed at the first Project Executive Committee (PEC) meeting held in February 2015. Guided by the principles of saliency, legitimacy and credibility[1], the mission is *to provide an integrated assessment and decision-making framework to enable South Africa to establish effective policy, legislation and sustainability conditions under which development of shale gas could occur.*

Note that the mission statement, developed in collaboration with government at the first PEC meeting, is phrased in the conditional - it does not presume that development will occur, since no modern exploration has been undertaken.

1.1 A Phased Approach

The SEA was undertaken as three distinct but overlapping Phases (Figure 1–1). Phase 1, beginning in February 2015 and extending to around October 2015, was the 'Preparation Phase'. The Preparation Phase included the necessary arrangements involving contracts and procurement arrangements, recruitment, convening project governance structures, collating literature, Geographic Information Systems (GIS) data libraries, identifying the multi-author expert teams, undertaking project team training (e.g. in managing and responding to conflict situations), arranging logistics and compiling the first draft of the Scenarios and Activities – which later came to form Chapter 1 of the Phase 2 Scientific Assessment and provide the material basis of the Phase 2 assessment.

Phase 2 of the SEA was the 'Scientific Assessment Phase', where data and information was organised and assessed by the multi-author expert teams. The Phase 2 process included two peer review rounds, initially by independent review experts appointed by CSIR, and then (following revision to produce the second draft) by stakeholders plus the experts who reviewed the first draft. Phase 2 commenced with the first multi-author expert workshop on 28 September 2015, and ended with the completed final Scientific Assessment, published on 15 November 2016 and available at http://seasgd.csir.co.za/scientific-assessment-chapters/

[1] ***Legitimacy*** refers to running an unbiased process which considers appropriate values, the concerns and perspectives of different actors, and corresponds with political and procedural fairness. ***Saliency*** is established by ensuring that the outcomes of the assessment are of relevance to the public and decision-makers and seeks to address quite specific questions. ***Credibility*** means meeting the standards of scientific rigor and technical adequacy. The sources of knowledge in an assessment must be considered trustworthy along with the facts, theories, and causal explanations invoked by these sources. Local and traditional knowledge should be included in the assessment where appropriate and possible. Involving eminent and numerous scientists as authors and ensuring that all reports undergo expert peer review are essential.

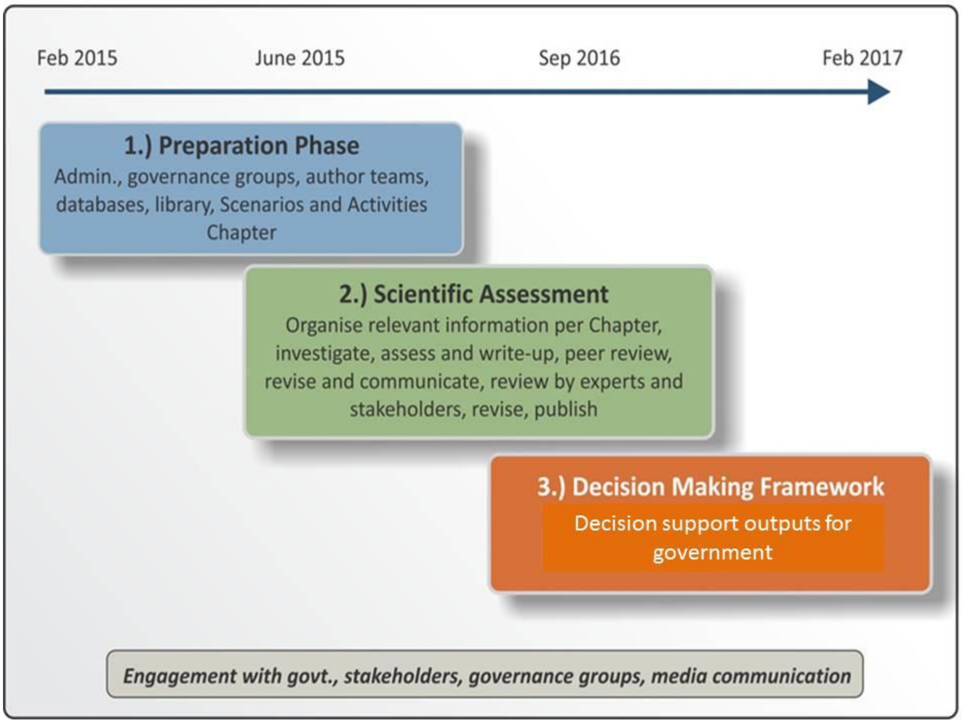


Figure 1–1: Shows the 3 overlapping phases of the SEA process and how the Scientific Assessment is used as the evidence base from which to develop an appropriate Decision Making Framework.

Phase 3 of the SEA, i.e. the contents of this report, translates the peer- and stakeholder reviewed Scientific Assessment into an operational Decision-Making Framework (DMF) for Government. This final phase of the SEA will conclude end May 2017 and will provide the framework for how site and activity specific assessment processes should be undertaken and provide Government with the necessary tools it needs to enable responsible decision-making into the future. This includes guidance on regulations, decision-making protocols, monitoring requirements and institutional arrangements. The separation between Phase 2 and Phase 3 is to honour the Scientific Assessment 'mantra' of being "policy relevant, but not policy prescriptive". The experts involved in Phase 2 were not asked to make decisions about the development of shale gas – this is a responsibility mandated to Government – but were asked to give an informed, evidence-based, scientifically-sound and balanced opinion on the consequences and opportunities of different scenarios and development options into the future and the best processes for future site specific assessments and mitigation actions. The ultimate decisions regarding authorisation processes for shale gas, whether at a national, provincial or local level, will be made by the authorities mandated to do so. In making these decisions they will be guided by the scientific evidence and decision support tools developed through the SEA process, and any other relevant and trusted sources of information that may have become available between the completion of the SEA and the time at which government needs to make decisions or implement policy - which may be years or decades into the future[2].

[2] Other such publications which were released at similar times as the Phase 2 Scientific Assessment include the Academy of Science South Africa (ASSAf) in collaboration with the South African Academy of Engineering who in October 2016 published a ret entitled '*South Africa's Readiness to Support the Shale Gas Industry'* (ASSAf, 2016) and 'Hydraulic Fracturing in the Karoo: Critical Legal and Environmental Perspectives' published by a large team of academics based out of South African research institutions (Glazewski & Esterhuyse, 2016).

1.2 Scope of the SEA

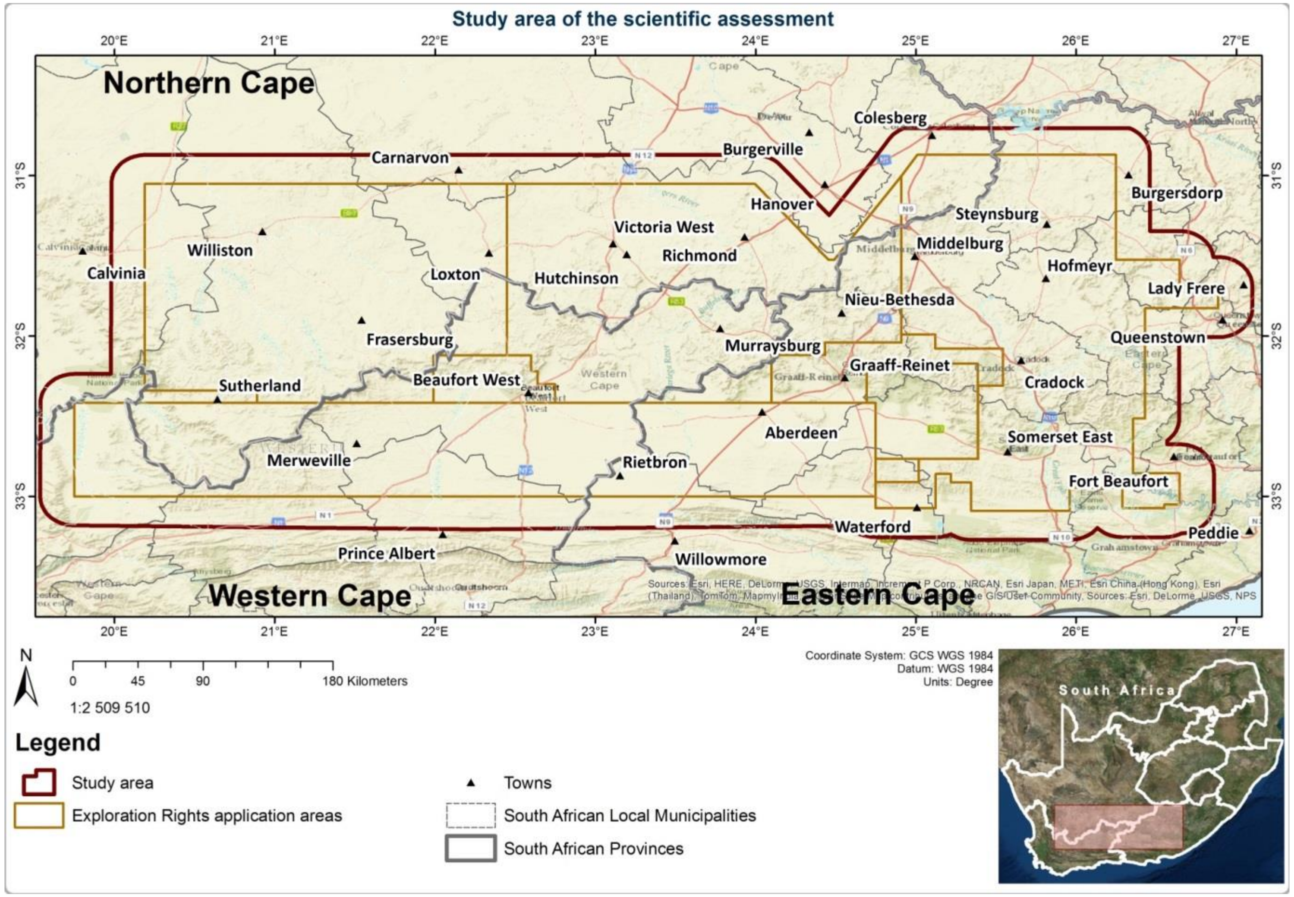


Figure 1–2: The SEA considered activities origination in the 171 811 km^2 region of the study area delimited by the applications for ER lodged by Shell, Falcon and Bundu, plus a 20 km extremity buffer. The assessment follows the consequences of shale gas exploration and production activities in this region to the point of material impact, even if that is outside the study area – as may be the case of impacts on vectors such as air or water which are not spatially static.

The geographic scope of the assessment was restricted to the potential impacts originating from shale gas exploration and production within the Central Karoo (Figure 1–3). This is not only the most promising gas prospect, but also the only region at the date of commencement of the SEA, for which ER applications (specifically for shale gas) had been accepted by the Petroleum Agency South Africa ("PASA" – the regulatory body representing DMR). While the ER applications were lodged with PASA in 2011, they are still currently under consideration with no decision yet made on the applications. Other types of unconventional gas reserves may exist in regions of the South African onshore and offshore territory, and would need separate consideration if their development was considered.

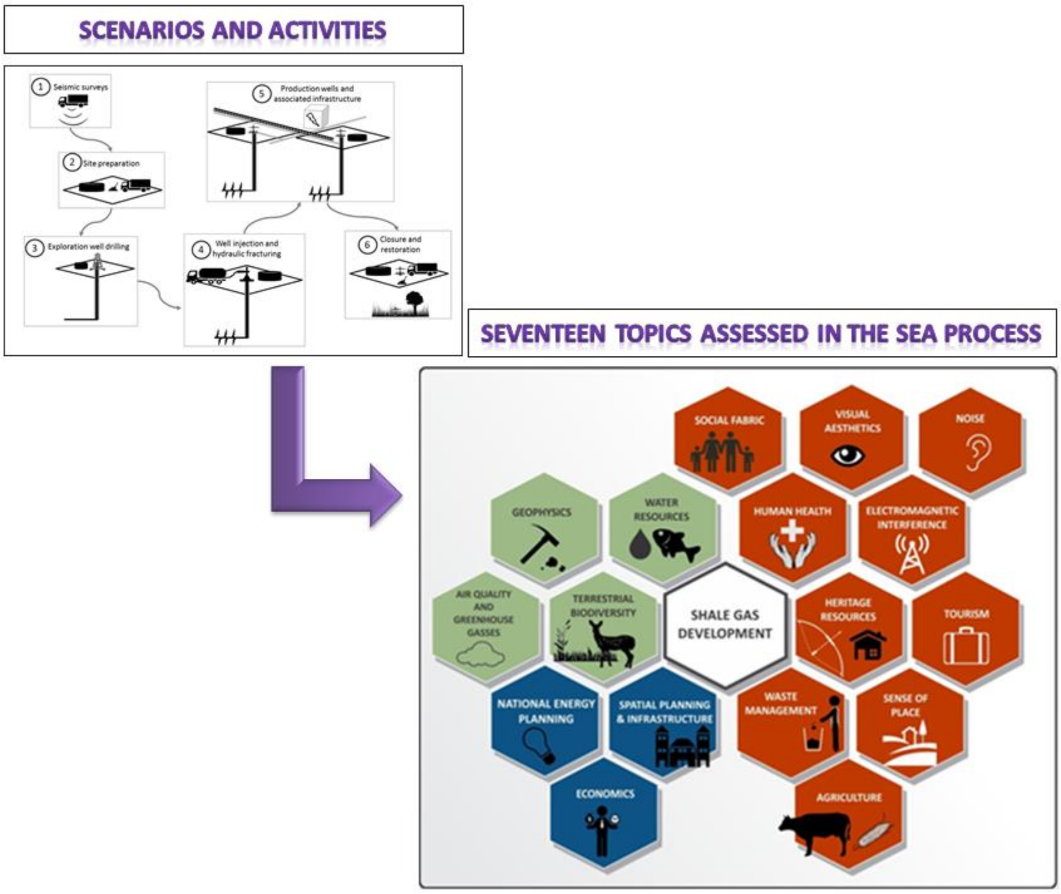


Figure 1–3: All seventeen topics where assessed within a common methodological framework and common point of departure as presented in the Scenarios and Activities document.

The scope of this SEA considered shale gas exploration, production and downstream related activities, up to and including eventual closure of facilities and restoration of their sites, and included a risk assessment of all the material social, economic and biophysical opportunities and consequences associated with the shale gas industry across its entire lifecycle, as described in detail in the Scenarios and Activities. This temporal scope extends, in some instances up to 40 years into the future. The scope of issues addressed in the SEA (Figure 1-4) was informed by an in-depth review of similar international assessments undertaken around the world; the development of a casual-loop model to aid in describing the Central Karoo as a dynamic system and trace relationships between social and ecological variables and proposed shale gas development; and by engagement with stakeholders (see Appendices 1 and 1a) and governance groups (see Section 1.3). Furthermore, the scope of the SEA was vetted by the governance groups and the stakeholders participating in the process.

1.3 Governance of the Process

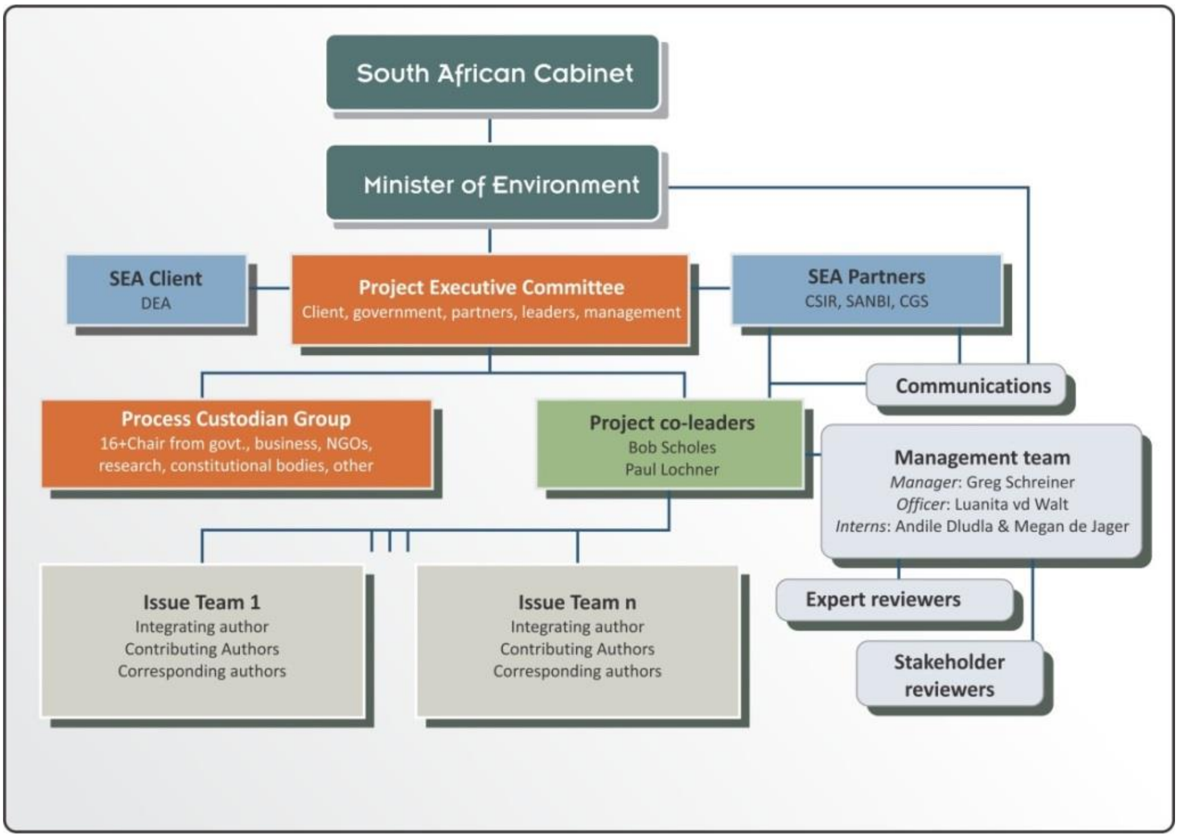


Figure 1–4: The project governance structure of the entire SEA process showing the interaction between the two governance groups, the SEA partners, the co-leaders and management team, the multi-authors teams, the peer review experts and stakeholders.

1.3.1 Project Executive Committee

The PEC comprised representatives of government who have been involved in all 3 phases of the SEA since its inception and up to its completion in 2017. The composition of the PEC is provided in Table 1-1 indicating organisational representation and delegate names.

Table 1–1: PEC members who participated in the shale gas SEA process.

Representing	Member name	Other members
DEA (Chair)	Dee Fisher	Simon Moganetsi, Surprise Zwane, Marlanie Sargonum Moodley, Sabelo Malaza, Wilma Lutsch, Patience Sehlapelo
DWS	Mkhevu Mnisi	Bayanda Zenzile, Alice Mabasa
DMR	Mosa Mabuza	Nonthanthla Jali
DoE	Muzi Mkhize	Mmarena Mphahlele, Stella Mamogale
DST	Somila Xosa	Mere Kgampe, Mmboneni Muofhe, Nametshego Gumbi
DAFF	Lydia Bosoga	Mary-Jean Gabriel, Edwin Mametja, Mpume Ntlokwana
Eastern Cape Department of Economic Development, Environmental Affairs and Tourism	Alistair McMaster	Gerrie Pienaar
Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)	Paul Hardcastle	Henri Fortuin
Northern Cape Department of Environment and Nature Conservation	Bryan Fischer	Natalie Uys
Agricultural Research Council	Garry Paterson	
SANBI	Jeffrey Manuel	Kristal Maze
CGS	Henk Coetzee	V.R.K. Vadapalli, Muvhuso Musethsho, Thato Kgari
CSIR	Bob Scholes and Paul Lochner (SEA co-leaders)	
Secretariat	Greg Schreiner (Project Manager), Luanita Snyman-Van der Walt (Project Officer), Megan de Jager and Andile Dludla (Project Interns)	

The key responsibilities of the PEC included the coordination and communication of information through the SEA process, both within government and in stakeholder engagement; ensuring that the project remained on scope, within timelines and budget; and that strategic and policy questions were adequately incorporated into the SEA process. Any feedback and questions raised by the PCG was referred to the PEC for deliberation and are reflected in detailed project notes as contained in Appendix 1a.

Table 1–2: The PEC met at the following key junctures and for the following purposes

Date	Meeting	Venue	Purpose of the meeting
12-13 Feb 2015	1	Main auditorium DEA, Environment House, Corner Steve Biko & Soutpansberg, Arcadia, Pretoria	Welcome and introductions; SEA approach; vision and objectives; governance; presentation on the report: *Opportunities and risks of Shale Gas Extraction in the Western Cape* (2012) (Paul Hardcastle); Presentation on the report: *Technical Evaluation and Socio-Economic Analysis of Shale Gas in the Eastern Cape* (Alistair McMaster); SEA strategic issues or 'topics'; approach to SANBI Bioblitz (Jeff Manual); project management and timelines; approach to media liaison and public engagement; process to launch the project in Parliament; agreement on scope; approach and timelines.
22 July 2015	2	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Confirm scope of the study; provide background to the SEA process, summary of outcomes from the Inception Workshop (12-13 February 2015); confirm governance mandates; provide an update on the SEA management and process, and on the SANBI Bioblitz; and discuss the shale gas regulatory environment with regards to changes and new developments.
22 October 2015	3	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Provide an update on SEA progress; provide and confirm SEA scope of work in terms of the Zero Order Draft; provide overview of planned public outreach (9-13 November 2015) and confirm roles and responsibilities for PEC members; convey key points from the 2nd PCG Meeting; and clarify other issues raised including PEC mandate; commissioning of SEA Process document, engagement between PEC and PCG.
04 May 2016	4	Demo Room, Building 22, CSIR Pretoria Campus	Provide an update on SEA progress with regards to public outreach programme; present the draft scenarios and activities report; Present peer review process to be followed; convey key findings on the identified topics in the First Order Drafts (FODs).
13 June 2016	5	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Discuss the key issues of concern in the Second Order Draft (SOD) Chapters of the Scientific Assessment prior to the release of the SOD; engagement with the Summary for Policy-Makers; and provide feedback and plans for public outreach.
26 September 2016	6	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Provide an update on SEA progress with regards to the Scientific Assessment process and its key findings, and the public outreach programme; discuss the DMF for Phase 3 of the SEA.
23 March 2017	7	ECD Boardroom, Building 23, CSIR Campus, Pretoria	Provide an overview of the key Scientific Assessment findings; discuss the approach to strategic mitigation, limits of acceptable change and the Minimum Information Requirements, specifically the splitting of "Exploration" and "Appraisal" into two regulatory processes. This approach was discussed with and approved by PASA.
17 May 2017	8	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Present draft Decision Support Tools Report to the PEC for comment. Final PEC meeting. Project closure.

1.3.2 Process Custodians Group

A key innovation, used specifically for the Scientific Assessment Phase, was the PCG. The PCG was designed to ensure that the Scientific Assessment was undertaken in an independent, thorough and balanced manner.

The PCG comprised eminent people, drawn approximately equally from government, non-governmental organisations, the private sector and the research community. The PCG met at key junctures during the Scientific Assessment to ensure that the process has been fair and rigorous. The PCG had no influence on the content of the Scientific Assessment, but acted as referees to ensure that the Phase 2 process had been undertaken in a legitimate, transparent and credible manner.

The organisations from which the PCG members were sourced were identified by the PEC as having credibility in their 'sectors' through having a mandate of some distinction, broad representation and a demonstrated interest in the topic of shale gas development. Members of the PCG were not appointed as 'representatives' of their organisation in a narrow sense, but were expected to reflect the breadth of opinion in their sectors.

The PCG was neither 'approving' nor 'disapproving' of shale gas development, nor did it have a say on the detail of the content of the Scientific Assessment. It was a trustworthy collective, tasked with ensuring that the process of evidence collection, evaluation and presentation was comprehensive and unbiased. This distinction remained critical especially for the non-governmental members of the PCG, as they and their respective organisations did not necessarily agree with every outcome of the Scientific Assessment.

The PCG provided feedback to the PEC, ensuring that the Scientific Assessment was followed within the prescribed process as approved in the SEA Process Document[3]. Their specific mandate was to evaluate the following five topics of the Scientific Assessment process:

1) Has the assessment process followed within the guidelines of the SEA Process Document?
2) Do the Chapter teams have the necessary expertise and show balance?
3) Does the assessment cover the material issues?
4) Are the identified expert reviewers independent, qualified and balanced?
5) Have the review comments received from expert and stakeholders been adequately addressed and have the responses been adequately documented?

[3] The SEA Process Document available at http://seasgd.csir.co.za/library/

Table 1–3: PGC members who participated in the shale gas SEA process

Sector	Organisational home of member	Member name	Other members
Chair	International Association for Impacts Assessment South Africa	Sean O'Bierne	-
Government	Department of Performance Monitoring and Evaluation	Rudi Dicks	Nkhensani Golele, Mukondi Masithi
Government	South African Local Government Agency	Intelligent Chauke	-
Government	Economic Development Department (EDD)	Andrew Matjeke	Khathutshelo Sikhitha
Government	DEA	Dee Fischer	Surprise Zwane, Marlanie Sargonum Moodley, Patience Sehlapelo
Government / Business	PetroSA	Jessica Courtoreille (withdrew from PCG)	Portia Manuel, Bongani Sayidini
Business	AgriSA	Wayman Kritzinger	Nic Opperman
Business	Onshore Petroleum Agency South Africa	Peter Price	Lizel Oberholzer/ Jane Blomkamp
Business	Business Unity South Africa	Marius Diemont	Laurel Shipalana
NGO	Treasure the Karoo Action Group	Jeanie le Roux	Jonathan Deal, Julius Kleynhans
NGO	World Wide Fund For Nature –South Africa	Morné du Plessis	-
NGO	South African Faith Communities Environment Institute	Stefan Cramer	-
NGO	Project 90 by 2030	David Fig	-
Research	Water Research Commission	Shafick Adams	Jo Burgess
Research	Human Sciences Research Council	Demetre Labadarios	Temba Masilela, Selma Karuaihe
Research	Square Kilometre Array (SKA)	Selaelo Matlhane	Adrian Tiplady (withdrew from PCG to become assessment author)
Research	Nelson Mandela Metropolitan University	Barry Morkel	Moctar Doucouŕe, Maarten de Wit (withdrew from PCG)
Constitutional Body	South African Human Rights Commission	Janet Love	Chantal Kisoon, Angela Kariuki, Nada Kakaza
Project team	SANBI	Jeff Manuel	Kristal Maze
Project team	CGS	Henk Coetzee	V.R.K. Vadapalli, Muvhuso Musethsho, Thato Kgari
Project team	CSIR	Bob Scholes and Paul Lochner (SEA co-leaders)	-
Project team	Secretariat	Greg Schreiner (Project Manager), Luanita Snyman-Van der Walt (Project Officer), Megan de Jager and Andile Dludla (Project	-

Sector	Organisational home of member	Member name	Other members
		Interns)	

Table 1–4: The PCG met at the following key junctures and for the following purposes

Date	Meeting no.	Venue	Purpose of the meeting
22 July 2015	1	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Introduction to the process and the process governance and mandates; project principles and principles for engagement; confirmed project approach and scope; mandate for the PCG; approach to the multi-author teams.
22 October 2015	2	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Provide an outline of the SEA in terms of objectives, study area and governance; Provide update on Status of SEA project and progress; Discuss comments and responses on Specialist/ Author Team composition and balance; Provide SEA Scope of Work in terms of the Zero Order Draft and Risk Assessment approach; Provide Public Outreach programme for November 2015; Discuss issues such as duration allocated for comment and review, feedback to PEC, and circulation of PCG comments prior to submission to Project Team.
3 May 2016	3	Demo Room, Building 22, CSIR Pretoria Campus	Provide an update on SEA progress with regards to Public Outreach feedback and programme, the SOD of the Scenarios and Activities Chapter, and the Peer Review Process to be followed for the FOD; Provide preliminary feedback on FODs.
26 September 2016	4	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Provide an update on SEA progress with regards to the Scientific Assessment process and its key findings, and the Public Outreach programme; Address questions on the process and other matters arising.

The final PCG meeting was undertaken on 26 September 2016. No objections to the Phase 2 process, as outlined in the mandate of the PCG, were registered before final publication of the Scientific Assessment on 15 November 2016. This was confirmed in formal correspondence from the PCG Chair (Sean O'Beirne) to the Project Manager (Greg Schreiner) on 10 November 2016. Since final publication, there have been no objections registered from any stakeholders regarding the integrity of the stakeholder review process and engagement undertaken.

2. SHALE GAS EXPLORATION AND PRODUCTION

2.1 International Context

Around 2010, when international enthusiasm for shale gas peaked, oil prices were in the region of $100 per barrel and horizontal drilling and gas extraction technologies were improving rapidly. The shale gas revolution in the United States of America (USA) sparked worldwide interest in the domestic development of shale gas to enhance economic beneficiation and sovereign energy security (Zuckerman, 2013). The United States Energy Information Administration issued a series of reports providing initial assessments of world shale gas resources which prompted local consideration of shale gas resources in numerous countries with potentially viable shale gas reserves (US EIA, 2013)

Experience elsewhere in the world with shale gas exploration and production has revealed some of the potential negative environmental impacts. For instance, there is credible evidence of leakage of gas from deep sources into surface aquifers following hydraulic fracturing (Brantley et al., 2014; Jackson et al., 2013; Kargbo et al., 2010; Myers, 2012; Osborn et al., 2011), generally attributed to inadequate sealing of the borehole in its upper sections; accidental and operational leakage of methane to the atmosphere during the extraction and transport; and that use of natural gas significantly reduces the climate change benefits of using gas as an energy source rather than coal (Allen et al.,2013; Howarth et al., 2011; Klausmann et al., 2011; Tollefson, 2012).

The surface disturbance from wellfield development such roads, traffic, drill pads, waste fluid holding lagoons and treatment works, gas storage and other transport infrastructure (such as pipelines) associated with a production-scale gasfield is not negligible (Drohan et al., 2012); neither are the sensory impacts in what are often previously non-industrial environments and the unintended social impacts of attracting non-local workers into formerly rural communities (U.S Department of Energy, 2009) – the 'Boomtown' phenomenon. As a result, internationally, countries have generally taken a risk averse and cautious approach to shale gas development with a number of countries undertaking large assessment processes and continuing to advance the research baseline prior to significant production of shale gas.

The USA has largely led the shale gas energy revolution. As a case study, it offers policy-makers in countries thinking about shale gas exploration, or production at significant scale, an insight into the consequences and opportunities associated with the impacts typical of the development life-cycle. In the USA, policy and regulation of shale gas extraction occurs at a federal, state and local level of government. Historic allocations of authority and the number of large exemptions made by federal government to states have prompted the latter to assume the role of active regulators of shale gas development, and thereby hold majority of the responsibility for shale gas governance risks. The regulation of oil and gas operations by local governments is prohibited in some states.

The state-specific regulation of shale gas exploration and production has resulted in disparities between the different states in the regulatory requirements for hydraulic fracturing operators (Boersma and Johnson, 2012). For instance, North Dakota is seemingly unconcerned about the environmental consequences of hydraulic fracturing which is evident from the environmental concessions granted in favour of the oil and gas industry with the purpose of promoting resource recovery, while states such as New York, Colorado and Pennsylvania have heightened regulatory requirements in place, such as the provision of site specific environmental information and full disclosure of hydraulic fracturing fluid composition prior to application approval (Ash, 2011).

In states such as Texas, a fragmented administrative structure exists whereby multiple commissions and authorities hold jurisdiction over resource regulation for minerals, water, land and air. In some cases a single resource is governed by a number of authorities. Despite overlapping jurisdiction over certain resources by a number of authorities, other important resources such as groundwater for drilling operations are devoid of a regulatory authority (Rahm, 2011). Similarly, the state regulation of shale gas extraction seems to be conducted in an isolated manner, as regulatory islands, which counteracts the protective intention of the three tiered government structure of regulatory requirements (Centner and Kostandini, 2014).

The general consensus is that shale gas development in the USA has outpaced both research and legislation (Souther et al. 2014; Robbins, 2013), leaving industry to spearhead the process of shale gas extraction and market developments (Boersma and Johnson, 2012, Wiseman, 2014). Despite no state in the USA having collected baseline data at each stage of the shale gas extraction process, theUSA Environmental Protection Agency (EPA), the most active governance institution at a federal level, have conducted a number of studies, after the fact; typically being initiated in response to public concerns regarding water- and air quality and contamination thereof (Rahm, 2011; Wiseman, 2009, 2014). Such public concern has also prompted policy-makers across the USA to adopt or update their regulation policies for the shale gas industry (Blohm et al. 2012).

The importance of baseline data, with particular reference to water quality, lies in the identification of pre-existing contamination, as well as that of the responsible party (or parties) should contamination occur; and avoids lengthy litigation procedures which may arise as a result (Adair et al. 2012; Stephens, 2015). Gathering scientific knowledge in areas earmarked for shale gas extraction prior to any development is preferential, as experience in the USAhas shown this task to become complicated by private landowner rights once development activities are underway, where private landowners own the mineral rights and therefore stand to benefit financially from utilisation of their land (Adair et al. 2012).

As more states begin to realise the necessity for baseline data, mandatory pre-drilling well testing programs are being implemented, as well as voluntary programs upon landowner's requests, and presumptive liability is being enforced on drilling operators to provide an incentive to conduct water quality tests within the area of presumptive liability prior to commencing drilling activities (Adair et al. 2012). An overarching lesson that can be learnt from the regulation of shale gas development practises in the USA, is that proactive regulations are required, which utilise the aphorism "do it right the first time"; as opposed to reactive regulations which are typically enforced in response to unacceptable and costly events such as spills (Ash, 2011).

Table 2–1: A summary of shale gas exploration and production progress in countries around the world other than the USAand South Africa (after ASSAf, 2016)

Country	Summary of shale gas exploration and production activities and policy regulations in selected countries
European Union (EU)	ERs should be the same across Europe, however the application of the directives established by the EU remains the responsibility of the Member States. The directives include aspects related to water (drinking and groundwater, and dangerous substances in water); air quality and noise pollution; ecological habitats and wild birds, all of which form part of the planning and regulation of shale gas development. The debate on shale gas in the EU is influenced by environmental issues and differs between the Member States, depending on each State's own political agenda, energy policies and energy security requirements.
United Kingdom (UK)	Natural gas already occupies a third of the UK energy mix, with the technically recoverable resources for shale gas estimated to be 26 tcf. Shale gas exploration and production are supported by the UK government due to its contribution to greater energy security, increased employment opportunities, tax revenue and overall economic growth. The relatively long standing practise of hydraulic fracturing in the UK has been absent of any negative environmental impact, and is reported to be effectively managed through the implementation of operational best practices and strict regulatory enforcement thereof. This is achieved by means of baseline monitoring and the public awareness of scientific knowledge, which is supported by national agencies and industry. The UK government provide financial benefits to all stakeholders through incentives offered to communities hosting energy sites.
Poland	The estimated technically recoverable resource for shale gas in Poland is uncertain with resource assessments varying between 1.3 tcf – 148 tcf. Due to Poland's' heavy reliance on indigenous coal and gas imports from Russia; the diversification of Poland's energy mix by means of shale gas production is a high political priority. In spite of the governments favourable stance on shale gas exploration and production, its active

Country	Summary of shale gas exploration and production activities and policy regulations in selected countries
	support for scientific research, and the strong public support for shale gas development, which involves regular dialogue and debates with stakeholders; the shale gas industry appears to have reached a stalemate. This is due to a lack of appropriate regulations, laws and framework required for the development of shale gas; coupled with bureaucratic indecision and unattractive investment opportunities. In 2015 Poland planned to introduce another regulation for shale gas designed to attract and accelerate investments.
Germany	Despite the longstanding and successful development of oil and gas in Germany 70% of the country's energy resources are imported, and only a quarter of its energy supply is produced domestically, mainly as coal. Germany plans to shut down all nuclear power plants by 2022, which will leave an energy gap to which natural gas could contribute. There are, however, several citizen initiatives and environmental organisations in opposition to shale gas, as well as other forms of energy production including geothermal and wind energy, despite the government supporting the use of renewable energy. The federal government has no clear policy on shale gas, and is prepared to continue to rely on imported oil and gas to supplement its current energy mix. A report by the German Federal Institute for Geosciences and Natural Resources stated that the extraction of shale gas is safe provided that best practices are implemented. A monitoring programme for a shale gas test well is envisaged which will investigate the impacts on the environment.
France	France has extensive shale gas resources, particularly shale oil in-place, with estimated technical recoverable resources around 137 tcf. However, the extractability of the resources is unknown. The future for shale gas exploration and production in France is uncertain. Following civil interest a ban of exploration and production of hydrocarbons by hydraulic fracturing in 2011 by means of political lobbying; while numerous pro-shale reports have been issued and debates continue as to the benefits of shale gas. Coincident with the ban on shale gas activity, which resulted due to environmental concerns, was the cancellation of already granted exploration permits.
Canada	Canada has an estimated 4 995 tcf total shale gas resources, of which 343-819 tcf is economically recoverable under current conditions. Consequently, Canada is the second major producer of commercially viable natural gas from shale formations in the world, with shale gas accounting for 15% of the country's total natural gas production in 2012. The public have expressed considerable concern regarding the negative impacts of hydraulic fracturing on the environment, human health and seismicity. The economic viability of projects has also come into question, particularly if the environmental costs are outweighed by the economic benefits. The development and application of regulations are informed by science-based environmental monitoring programmes, the transparency and credibility of which are essential for building public confidence, trust and social acceptance with regards to shale gas.
Australia	Despite the 396 tcf recoverable shale gas resources in Australia, commercial production is currently limited, mainly due to the limited economic viability of the resources. The relatively high costs of the exploitation techniques required and the absence of infrastructure and limited water availability at remotely located production sites are contributing factors. The transformation of Australia's energy market by the production of coal-seam gas coupled with the migration of mining activities closer to more densely populated areas over recent years had already triggered public scepticism over the risks of hydraulic fracturing, particularly the contamination of groundwater and the drawdown of aquifers. In Australia, shale gas production could be effectively managed and the impacts minimised provided that research of the Australian receiving environment be conducted in terms of the geological setting and related landscapes, water resources and ecosystems, and how they can be monitored. An important consideration in the

Country	Summary of shale gas exploration and production activities and policy regulations in selected countries
	Australian context is that sustainability principles are applicable to both largely unpopulated and highly populated areas.
China	China has the largest known shale gas resources in the world, estimated at 1 115 tcf. Despite this vast shale gas potential, the development of these resources has proven difficult due to the more complex geology and deeper shale targets compared to traditional USA shale plays. Furthermore, these more challenging geological conditions are not yet fully conducive to effective well spacing existing stimulation strategies. The Chinese government have produced a five year shale gas exploration and production plan which provides incentives for shale gas production, such as subsidies, financial control waivers and defined standards for the shale gas industry. Regulation states an Environmental Impact Assessment (EIA) is mandatory and must be filed with national and local regulators, and approval must be granted prior to application. In order to advance and improve China's shale gas technology, China is keen to acquire overseas assets and technology; however technological difficulties remain even after the introduction of a dedicated Shale Gas Industrial Policy in 2013. Resultantly, the cost of producing shale gas is double that of the USA's biggest projects. The lack of adequate infrastructure and water and competition for the latter has further constrained progress, while substantial effort will also be required to overcome regulatory hurdles including a flawed policy regime and divided administrative responsibility for the shale gas industry.

According to ASSAf (2016), South Africa has the following key learning experiences to draw from the international context:

- South Africa must learn from and build upon the shale gas experiences in the USA, Europe, Asia and Australia, fully utilising the wealth of published evidence made available by eminent scientific bodies and advance its own scientific research;
- An adaptive management approach should be adopted with the understanding that shale gas potential is not realised overnight and in South Africa a significantly long lead in period can be expected before production at any scale commences;
- There will be an element of 'learning-by-doing' during exploration, which if sufficiently planned and managed, should not result in disproportionally high risks to the Central Karoo environments and people; and
- Learning from both Poland and China demonstrates that managing public expectations is critical to developing a rational and robust national discourse on shale gas exploration and production and that in other countries in the EU, negative and alarmist media coverage has stalled exploration for a protracted period.

2.2 Energy Planning in South Africa

The South African energy system is currently based mainly on domestic coal complemented by imported oil and petroleum fuels. Smaller contributions from biomass/waste, natural gas, nuclear and imported hydro-power make up the remainder of South Africa's primary energy supply. In recent years, renewable energy mostly from solar and wind has been introduced. The largest energy supply sub-sector in South Africa is electrical power, about 90% of which is generated by burning coal.

Including more natural gas in South Africa's energy mix would make the energy system more resilient, efficient, cheaper and reliable. Natural gas, regardless of its source, has a desirable set of qualities that coal and oil do not possess. Natural gas can be used in almost all subsectors (power generation, heat, transport, chemicals manufacturing); is easily transported once professionally operated gas infrastructure is in place; is supported by a growing international market; is a more homogenous fuel than coal (thus more flexible and easier to handle); is less CO_2 intensive when burnt than coal (if leakage during production and transport is minimised); can be more efficiently used for power generation (more kWh per GJ); has high operational flexibility; and has an end-use cost structure that is capital- light and fuel-intensive, making it economically flexible.

Because of its high operational flexibility, shale gas could enable the integration of more renewables into the energy mix and reduce the portfolio costs of power generation. The use of relatively low-cost shale gas would enable the creation of a network of gas-fired power stations located in the Central Karoo These power stations have attributes complementary to solar photovoltaic (PV) and wind generation plants which are inherently variable. Thus a portfolio containing all three is cheaper to build and operate than any one alone, for now and into the foreseeable future. As such, shale gas finds would not change the selected planning scenario for the electricity sector, which already calls for more natural gas and renewables, but would likely make this mix cheaper and cleaner.

This is recognised in the NDP 2030, which was compiled by the National Planning Commission who was appointed by the President in 2010. The NDP does not reflect the views of any one department or office - it is a plan for South Africa that provides a broad strategic framework to guide key choices and actions. The plan, published in 2012, is composed of 15 chapters with 119 implementable actions to promote sustainable growth and development in South Africa. Specifically, related to shale gas Chapter 4, actions 16 and 17 state:

16. *Enable exploratory drilling to identify economically recoverable coal seam and shale gas reserves, while environmental investigations will continue to ascertain whether sustainable exploitation of these resources is possible. If gas reserves are proven and environmental concerns alleviated, then development of these resources and gas-to-power projects should be fast-tracked.*

17. *Incorporate a greater share of gas in the energy mix, both through importing Liquefied Natural Gas (LNG) and if reserves prove commercial, using shale gas. Develop infrastructure for the import of LNG, mainly for power production, over the short to medium term.*

From the high-level NDP, the Integrated Energy Plan (IEP) is the plan that links the different energy sectors and plans for the entire South African energy system in an integrated strategic planning framework. The Integrated Resource Plan (IRP) is the electricity plan for the country. The Gas Utilisation Master Plan (GUMP) is a strategic plan which provides a long term roadmap for the strategic development of natural gas demand and supply into South Africa's diversified future energy mix. Additional energy planning policy and legislation as it relates to shale gas development is discussed in Section 2.6.5.

DoE is at present finalising a GUMP for South Africa, which will analyse potential and opportunity for the development of South Africa's gas economy and sets out a plan of how this could be achieved. Currently, natural gas plays a very small part of South Africa's current energy mix and the GUMP will form a critical part of diversifying the energy mix by outlining the possible future paths for natural gas market development, including the potential to utilise shale gas.

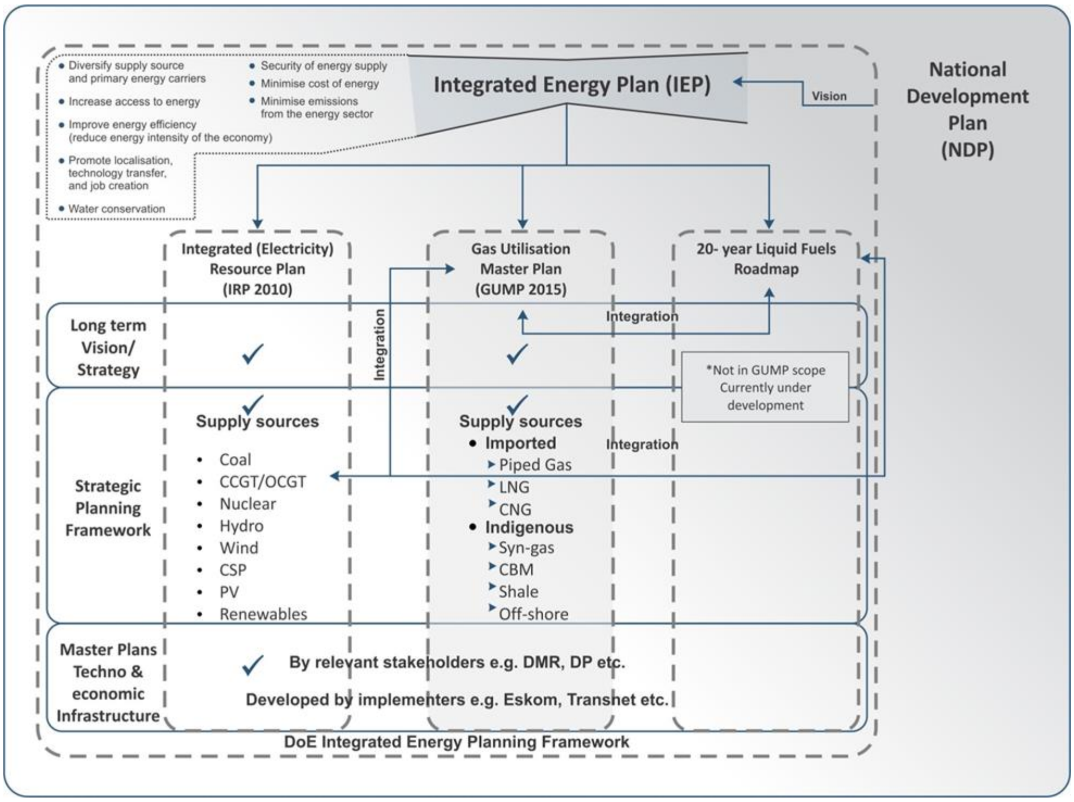


Figure 2–1: An extract from the draft IEP indicating the DoE Integrated Energy Planning Framework. The framework shows the envisioned integration between the principal energy plans of South Africa and the NDP 2030.

2.3 Petroleum Geology in the Karoo Basin

2.3.1 Geological features

The main Karoo Basin is filled with sedimentary formations of the Karoo Supergroup, and covers an area of approximately 700 000 km^2, representing more than half the surface of South Africa. Within the study area, ~87% of the surface area comprises intercalated arenaceous and argillaceous strata of the Beaufort Group (Figure 2-3 and Figure 2-4). From a flat-lying morphology in its northern part, the basin deepens and the sedimentary succession thickens towards the south-west, up to its interface with the northern margin of the mountains of the Cape Fold Belt (CFB) Mountains.

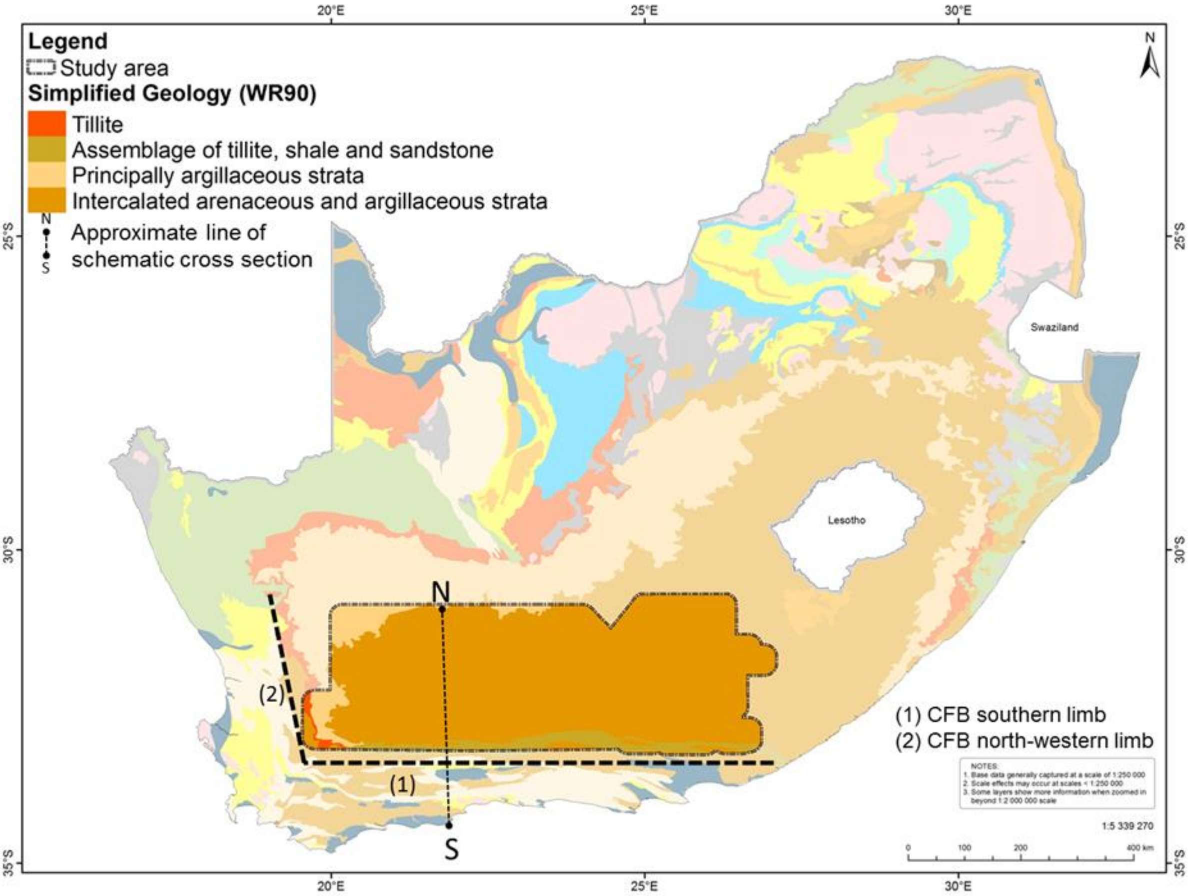


Figure 2–2: Simplified geology of South Africa showing the substantial extent of the main Karoo Basin (light brown areas) deepening from the north-eastern interior to the south-central interior where it abuts against the southern limb of the CFB; section line S-N through the study area marks the schematic profile in Figure 2-3.

The sedimentary formations are subdivided into groups that reflect variations in depositional environment, rock type, position in the geological record and age. At the base of the succession, and therefore the oldest, is the glacial deposit of the Dwyka Group. This is overlain in turn by mainly finegrained sediments of the Ecca Group and, with the inclusion of subordinate sandstone, the Beaufort Group (see Figure 2-2). The Ecca and Beaufort groups are themselves subdivided into formations on similar grounds that define the groups. Of direct relevance to this study area are the carbon-rich shales of the Prince Albert, Whitehill and Collingham formations at the base of the Ecca Group. The Whitehill Formation is black in colour, relatively rich in organic carbon and is around 40 m thick through the extent of the study area. The Whitehill Formation represents an attractive shale gas exploration target. For various technical reasons, the Prince Albert and Collingham Formations are considered less favourable targets for shale gas.

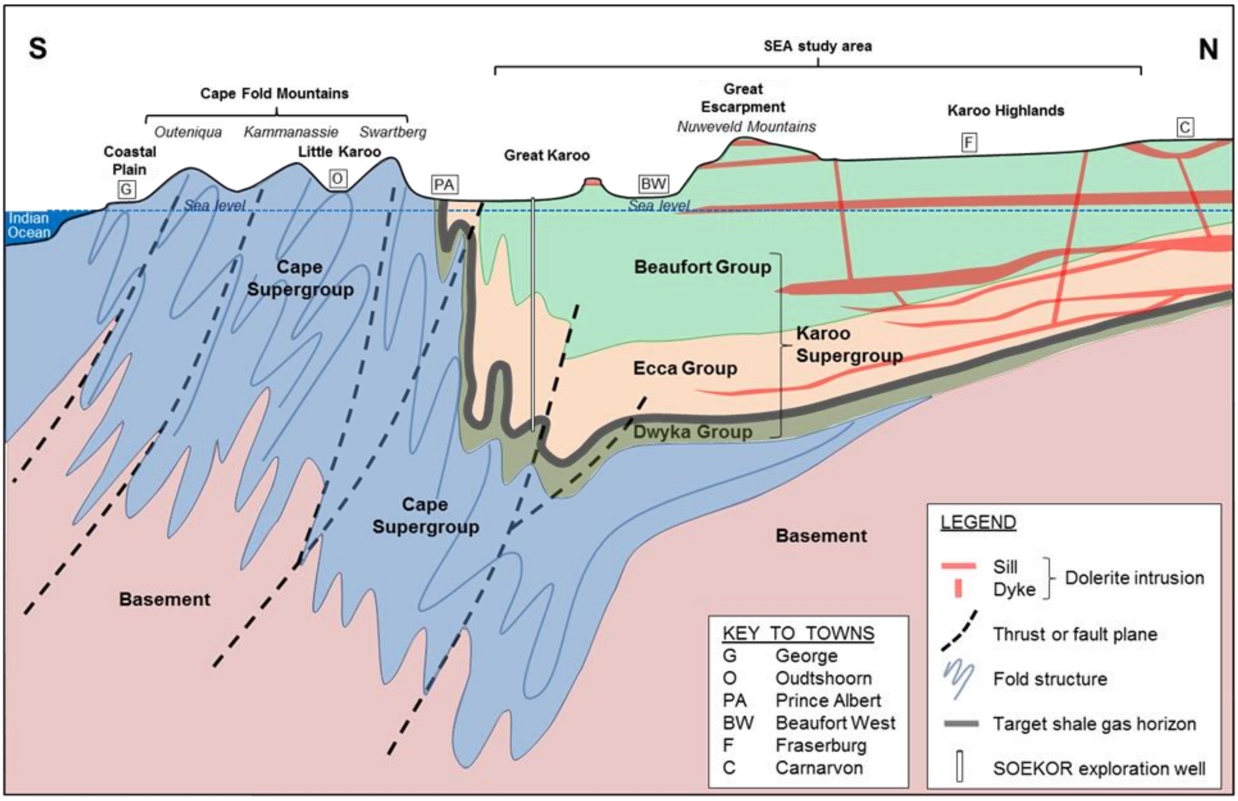


Figure 2–3: Schematic geological profile across the study area along the S-N section line in Figure 2-3, illustrating the basin-like stratigraphic succession of Karoo Supergroup sedimentary strata in the main Karoo Basin north of the Swartberg Mountains, the Great Escarpment formed by the Nuweveld Mountains, and the underlying Cape Supergroup rocks that pinch out northwards against basement rocks. The Prince Albert, Collingham and Whitehill formations of the Ecca Group include carbon-rich shales ranging in depth below surface from about 300 m to over 3 000 m.

The Prince Albert, Collingham and Whitehill Formation shales have been severely affected by intense thermal maturation associated with deep burial, the CFB folding processes and, in a large portion of the northern part of the study area, by intrusion of igneous dolerite as shown in Figure 2-4 as red sills and dykes penetrating the Beaufort and Ecca Groups. The dolerite structures represent the main targets for groundwater exploration. Dykes in particular are the feature most commonly targeted by landowners for successful water borehole siting, whereas more prominent sill complexes are typically targeted for larger-scale municipal water supply to towns such as at Victoria West.

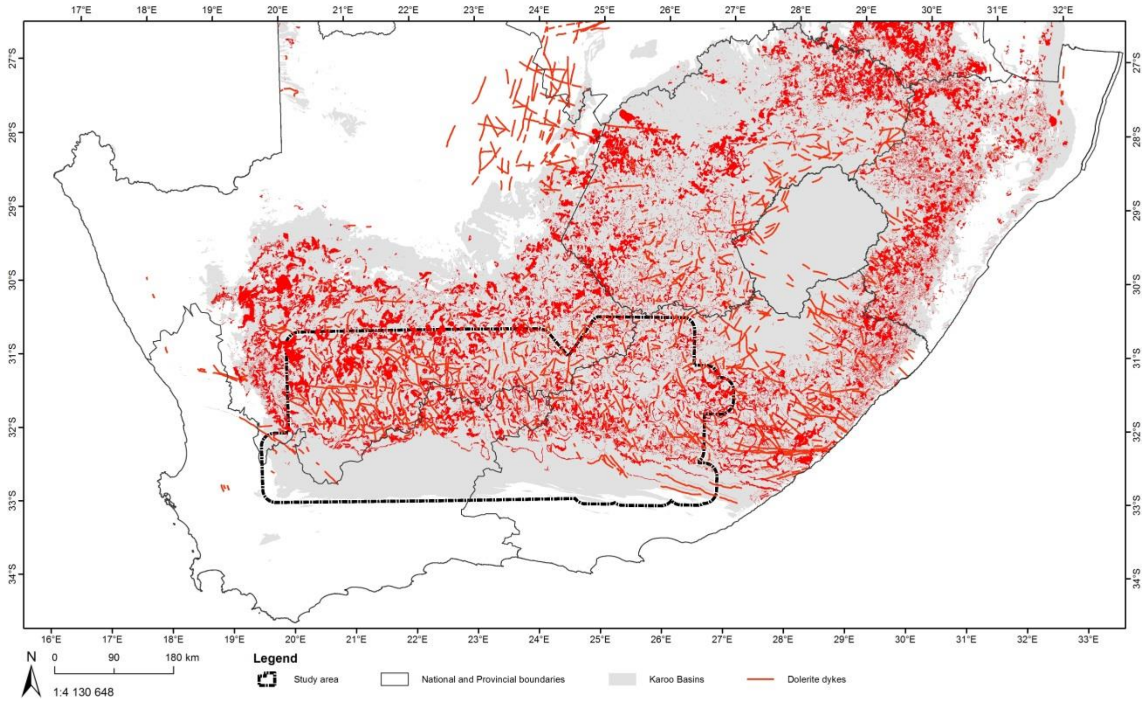


Figure 2–4: Distribution of dolerite dykes and sills in the main Karoo Basin

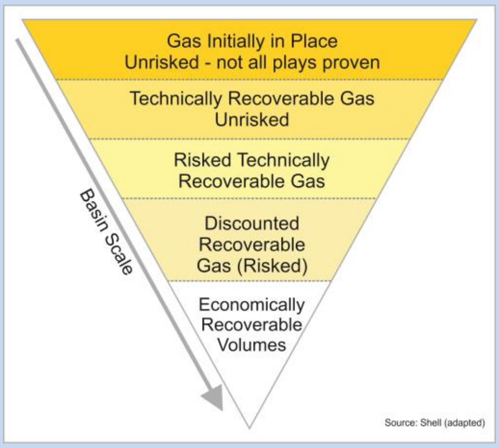
One of the overriding factors used in defining the potential reserves the shale gas has been the perceived negative effect on gas retention of dolerite sills and dykes, especially in the Whitehill Formation. These effects are additional to the loss of shale gas that will have occurred along faults during periods of rebound and decompression associated with the CFB structures. An effect of these factors has been to severely reduce the capacity of the shales to generate gas.

2.3.1.1 A History of Petroleum Exploration

The Southern Oil Exploration Corporation (SOEKOR) was established in 1965 with the mandate to prove or disprove the existence of economic amounts of oil and gas in South Africa. Seismic surveys were initiated in the southern part of the Main Karoo Basin, and between 1965 and 1972 a total of some 13 000 km of data was acquired. Exploration drilling that was undertaken in the same period demonstrated the presence of gas within the Ecca shales, with minor high pressure, low volume gas shows having been encountered in most of the 12 wells drilled in the southern part of the Karoo Basin.

In 1976 a comprehensive study was initiated by the Council for Geoscience to investigate the oil-shale potential of the Whitehill Formation on the western flank of the Karoo Basin. Sixteen cored boreholes were drilled in the area between Strydenburg and Hertzogville. The study was subsequently extended to include all available borehole logs and cores over the whole extent of the Whitehill Formation, with the logs of 48 borehole and petroleum exploration wells that intersected the Whitehill Formation having been considered. It is these data that form the basis of the majority of shale gas resource estimates for the Karoo Basin that have been made to date. In 2006, the PASA focused on locating and assembling the geological and geophysical data relating to the southern part of the main Karoo Basin.

Box 1 Technically Recoverable Resources Versus Economically Recoverable Resources



Gas in Place Unrisked *is the total volume of hydrocarbon stored in a reservoir prior to production excluding factors determining extraction such as existing technology.*

(Unrisked and Risked) Technically Recoverable Gas *resources represent the volumes of oil and natural gas that could be produced with current technology, regardless of oil and natural gas prices and production costs. A large number of direct sub-surface measurements (depth, mineralogy, total organic content, thermal maturity, etc.) gathered by current drilling technology need to be undertaken to quantitatively calculate technically recoverable gas reserves.*

Economically Recoverable Gas *resources are those that can be profitably produced under current market conditions. The economic recoverability of oil and gas resources depends on three factors: the costs of drilling and completing wells, the amount of oil or natural gas produced from an average well over its lifetime, and the prices received for oil and gas production.*

2.3.2 Shale gas reserve models

The shale gas reserve model developed the Scientific Assessment was based on a consolidated review of previous resource assessments undertaken by:

1) Kuustraa et al. (2011);
2) Kuustraa et al. (2013);
3) Decker and Marot (2012);
4) Cole (2014b);
5) Geel et al. (2015); and
6) Mowzer and Adams 2015).

The different approaches adopted for the respective reserve assessments made direct comparison of the results difficult. However, to the extent that this is possible, there is reasonable agreement between the results, in that much the same range of shale ‘Gas in-Place’ and ‘Technically Recoverable’ reserve quantities are presented. Accounting for the study area, where the depth to the top of the Whitehill Formation is at least

1 500 m, a reserve estimate can be made for this formation, ranging between 17 tcf and 81 tcf of Technically Recoverable gas. To this volume of gas can be added what might be contained within the underlying Prince Albert Formation for the same area, which could range between 54 tcf and 72 tcf of Technically Recoverable gas. Thus, for both formations within the study area, where the depth to the top of the Whitehill Formation exceeds 1 500 m, the total Technically Recoverable shale gas reserve could range between 71 and 153 tcf. Applying roughly a 10% recovery factor to estimate Economically Recoverable volumes of shale gas in the study means that the Small Gas and Big Gas scenarios considered for the SEA were 5 and 20 tcf, respectively[4]. The area most likely to be targeted, certainly initially for exploration, might include the central and eastern/north-eastern parts of the study area within areas of high (red) and medium (beige) prospectivity. The reserve models used to develop Figure 2-5 are based on historical data collected through the SOEKOR historical exploration campaigns. As such, they are merely indicative of how shale gas may be distributed through the Central Karoo. Modern exploration practices are the only ways of determining to any greater detail the magnitude and distribution of the gas reserves.

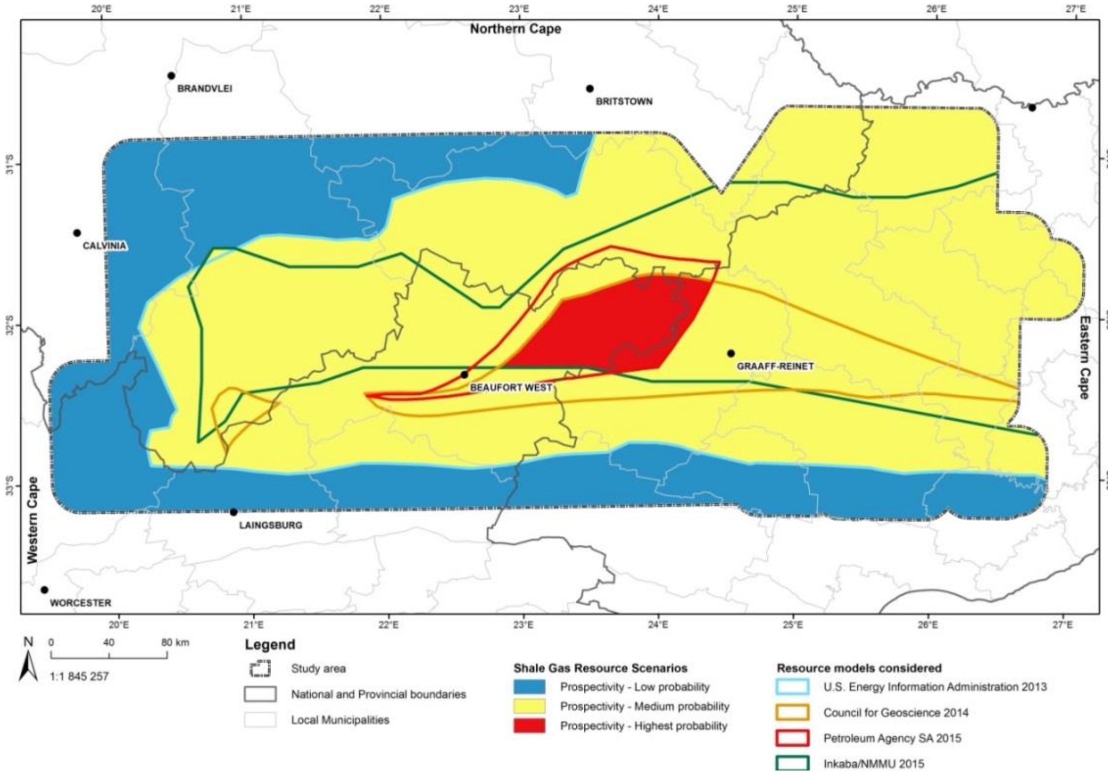


Figure 2–5: Shale gas prospectivity map for the study area generated by overlaying four existing reserve models. Based on this overlay approach, the solid red polygon, followed by the yellow/beige-shaded area, is considered most likely to yield technically recoverable shale gas (Burns et al., 2016).

[4] South Africa's draft unpublished GUMP suggests a conservative estimate for Economically Recoverable reserves of shale gas of 9 tcf. The range assumed for the SEA (5-20 tcf) spans the GUMP estimate and demonstrates policy alignment with the scenarios.

To put into context the significance of Economically Recoverable shale gas assumed for the scenarios, reference can be made to recent discoveries of conventional gas in Mozambique and Tanzania. Mozambique holds over 100 tcf of proved natural gas reserves, up from 4.5 tcf a few years ago. This positions the country as the third-largest proved natural gas reserve holder in Africa, after Nigeria and Algeria. There have been several major natural gas discoveries made in offshore southern Tanzania since 2010. The country has proven reserves totalling about 50 tcf of gas. The volumes of Economically Recoverable shale gas assumed are considerably lower than that of the proven reserves of conventional gas in Mozambique and Tanzania.

2.4 SEA Scenarios

Based on the Economically Recoverable reserve estimates, four scenarios were developed. Scenarios provide plausible and relevant stories about how the future could unfold. They originate on the assumption that the future is fundamentally unpredictable, but acknowledge that complexity and uncertainty can be reduced to within logical parameters. Scenarios provide the qualitative and quantitative information from which assessments can be made about future activities which cross spatial and temporal range (see Burns et al., 2016 for full description of the scenarios and activities).

The scenarios developed in the shale gas assessment followed an incremental approach which had two main stages: 1.) Identifying the major concerns; and 2.) Determining the major uncertainties. The major concerns related to the nominal risk associated with increasing shale gas development activities in the sensitive receiving environment of the Central Karoo and the major uncertainty related to the volumes of Economically Recoverable gas reserves (Figure 2-6).

Three ‘development’ scenarios (“Exploration”, “Small Gas” and “Big Gas”) were generated with a Reference Case where no shale gas development occurs but regional trends in the region continue on observed trajectories (Table 2-2). A reference scenario is usually a plausible and relatively nonthreatening scenario, featuring no surprising changes to the current environment and continued stable growth. All the development scenarios are cumulative in the sense that they would hypothetically occur with, and in addition, to the preceding scenarios (Figure 2-6).

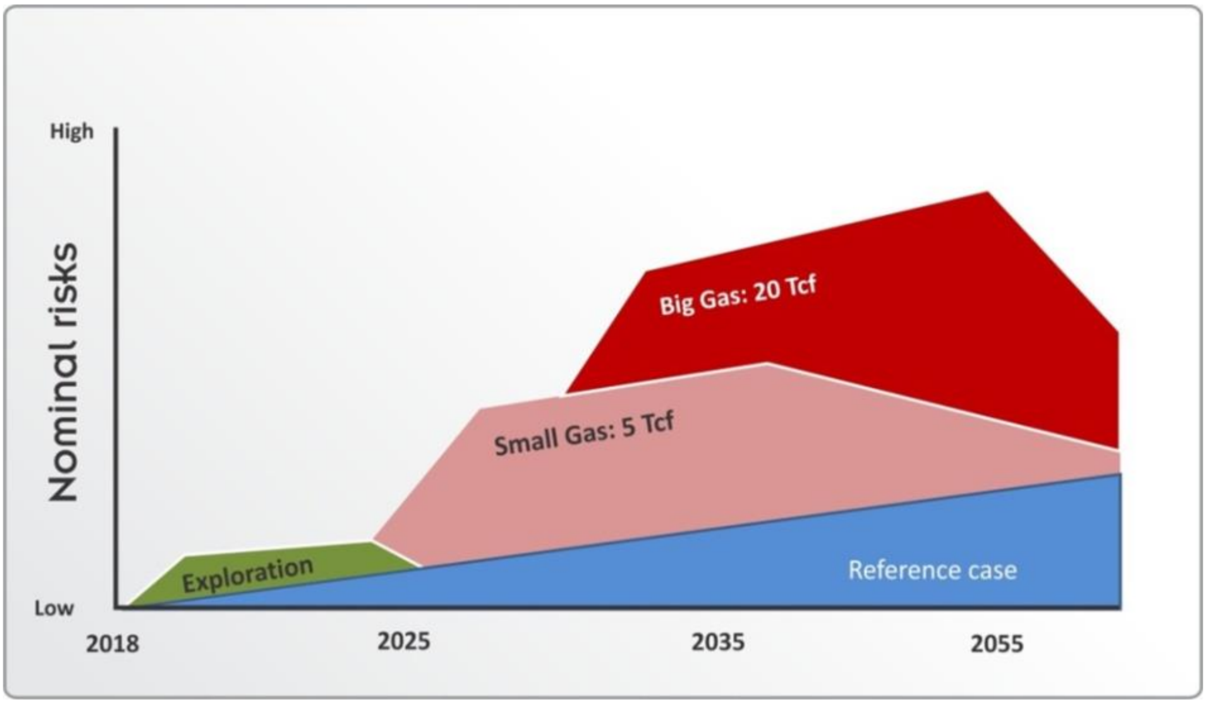


Figure 2–6: The four incremental scenarios. Note that the scenarios are cumulative: Exploration Only includes the Reference Case; Small Gas includes Exploration Only and the Reference Case; and Big Gas includes all three of the preceding scenarios. Thus they extend from 2018 to beyond 2055.

The scenarios were 'co-designed' - while the scenario team led the process, multiple content generation points were sourced. This was undertaken through a collaborative process of expert engagement workshops consisting of more than 60 experts from the oil and gas industry, petroleum geologists, engineers, energy planners; and natural and social scientists. Qualitative information was presented as narrative descriptions of future developments in the form of storylines and images. Quantitative information expanded on numerical estimates of future developments and was presented as tables, graphs and maps (see Table 2-2).

Table 2–2: A summary of the activity metrics described in the three shale gas exploration and production scenarios.

Unit	Exploration Only	Small Gas	Big Gas
Trillion cubic feet (Tcf)	-	5	20
Production block/s [30 x 30 km well field]	-	1	4
Combined cycle gas turbine [1 000 MW]	-	1	-
Combined cycle gas turbine [2 000 MW]	-	-	2
Gas-to-liquid plant [65 000 bbl]	-	-	1
Number of wellpads [2 ha each]	30	55	410
New roads (km) [unpaved, 5 m wide]	30	58	235
Total area of wellpads and new roads (ha)	75	199	998
Percentage spatial coverage of study area	< 0.0001	0.0002	0.0009

Unit	Exploration Only	Small Gas	Big Gas
Total number of truck visits	45 000	365 000	2 177 000
Industry water needs (m^3) [assuming no re-use of fluids]	*488 250	**9 212 625	***65 524 500
Industry water needs (m^3) [assuming re-use of 50% drill fluid + 30% frack fluid]	*319 110	**6 056 160	***43 087 235
Flowback waste (m^3) [sludge + brine + water]	*101 400	**5 573 900	***40 356 400
Other hazardous waste (t) e.g. oil, grease	*85	**635	***4 185
* For five exploration drilling campaigns, each with six exploration wells = total 30 wells over lifetime of Exploration Only ** For 55 wellpads, each with 10 wells, total 550 wells over lifetime of a Small Gas *** For 410 wellpads, each with 10 wells, total 4 100 wells over lifetime of a Big Gas Note: gas production pipelines assumed to be located within the road reserves			

The purpose of the scenarios and activity metrics was to describe the scale and type of activities assumed for the three shale gas exploration and production scenarios of increasing magnitude. The scenarios served as a common point of departure for the topics comprising the assessment which estimate, for the issues on which they focus, the levels of risk associated with each of the scenarios and their main defining activities.

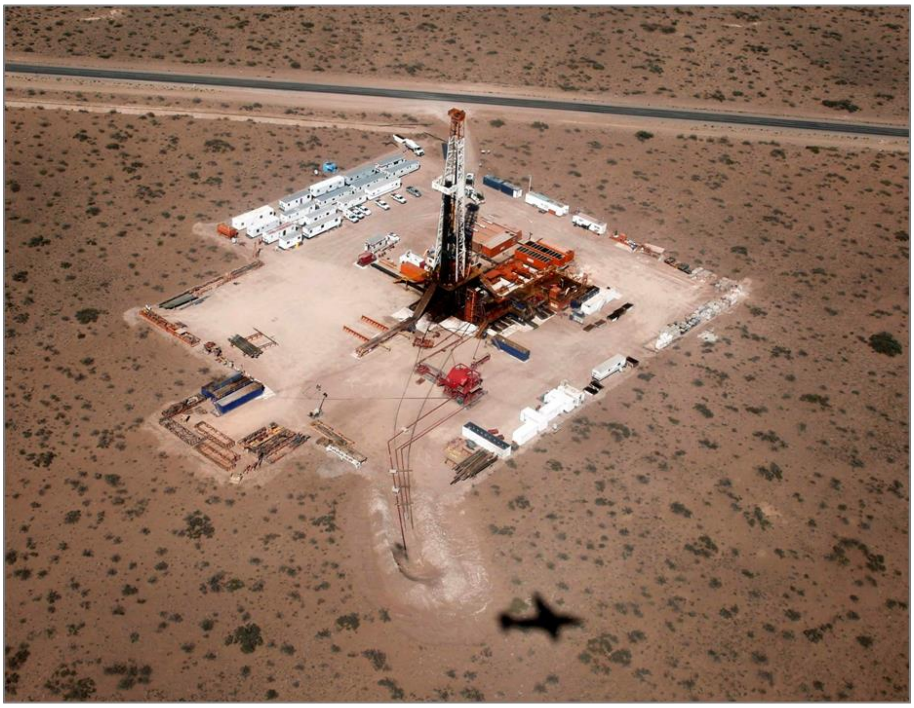


Figure 2–7: A typical wellpad layout with drilling and supporting infrastructure in place within an arid environment in Argentina, similar to what may be encountered in the Central Karoo. Each wellpad in 1-2 ha in size and during production is supported by a range of infrastructure such as roads, pipelines, water treatment facilities, gas compressors stations. For the Small Gas scenario, 55 of these wellpads are considered. For the Big Gas scenario 410 wellpads are required to extract 20 tcf over the lifespan of wellfield production.

2.5 South African Exploration in Context

2.5.1 Background

In 2010 the DMR received five ER applications. One application was submitted by Falcon, three by Shell and one by Bundu (Figure 2-8). Collectively, the scope of the ER applications include exploration campaigns involving seismic surveys, the drilling of vertical boreholes to depths of 1 – 5 km, and horizontal drilling to around 2 km in length with test hydraulic fracturing (Golder Associates, 2011, 2015; SRK, 2015).

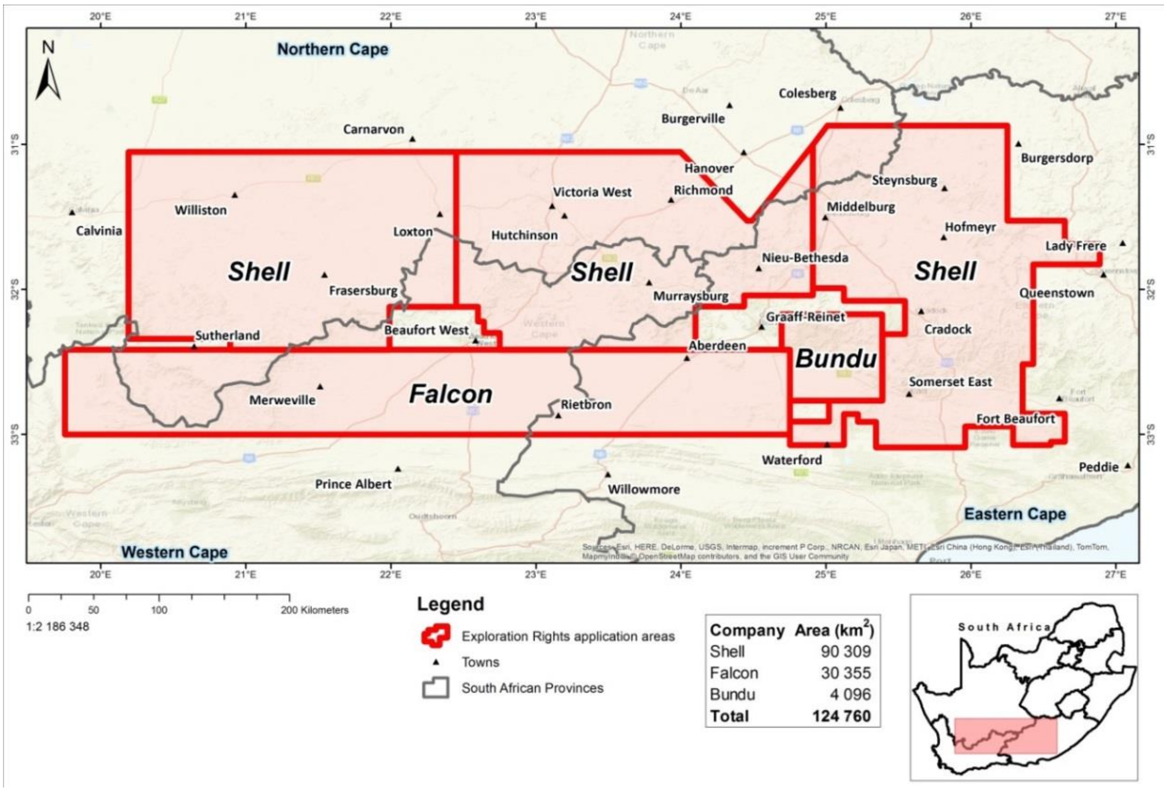


Figure 2–8: The location and extent of the ER applications made by Shell, Bundu and Falcon in the Central Karoo. The Exploration Rights application areas cover 124 760 km^2 and affect 26 local municipalities in the Western, Northern and Eastern Cape Provinces of South Africa.

Bundu submitted the first application for an ER in May 2010, with Falcon Oil and Gas following suit a few months later in August. Shell decided to submit three applications for ERs in December of 2010, after poor progression in terms of their Technical Coordination Permits. The Environmental Management Plan Reports (EMPR) required in terms of section 39 of the Mineral and Petroleum Resources Act were compiled shortly thereafter, with Bundu Gas' EMPR (compiled by Golder and Associates) submitted in October of 2010, Falcon's EMPR (compiled by SRK) submitted in January 2011, and Shell's EMPRs (compiled by Golder and Associates) submitted in April of 2011.

In April 2011, the South African Cabinet imposed a moratorium on all decisions related to the ER applications to provide an opportunity to establish the necessary regulatory framework, as well as conduct a preliminary assessment. Following the publication of the preliminary assessment undertaken by an inter-governmental task team led by DMR, the moratorium was lifted in November 2013, with the recommendation to “authorise hydraulic fracturing....under an augmented regulatory framework” (DMR, 2012: 8).

In 2014, restrictions promulgated by the Minister of Mineral Resources resulted in a two year hiatus on the granting of new applications. The inclusion of a requirement for existing applications to consider regulations that had not yet been promulgated (a version of which had been published for comment in October of 2013) effectively suspended the five applications accepted prior to the 1st of February 2011.

The technical regulations for petroleum exploration and exploitation were subsequently promulgated on the 3rd of June 2015 (“the technical regulations”), enabling the three existing applicants to continue with the requisite process. These regulations have since been legally contested by the Treasure the Karoo Action Group, who submitted the related documentation to the North Gauteng High Court in November of 2015.

After the ensuing hiatus caused by the 2011 moratorium, the DMR requested applicants to update their EMPRs in November of 2014 in preparation of recommencing the processing of existing applications. Both Bundu Gas and Falcon Gas and Oil reviewed their EMPRs and submitted the updated EMPR at the end of February 2015. Shell engaged in an information sharing process in terms of Section 39(5) of the MPRDA. The DMR has not yet decided on any of the existing ER applications, and no applications for Environmental Authorisation (EA) in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998) have been submitted to date.

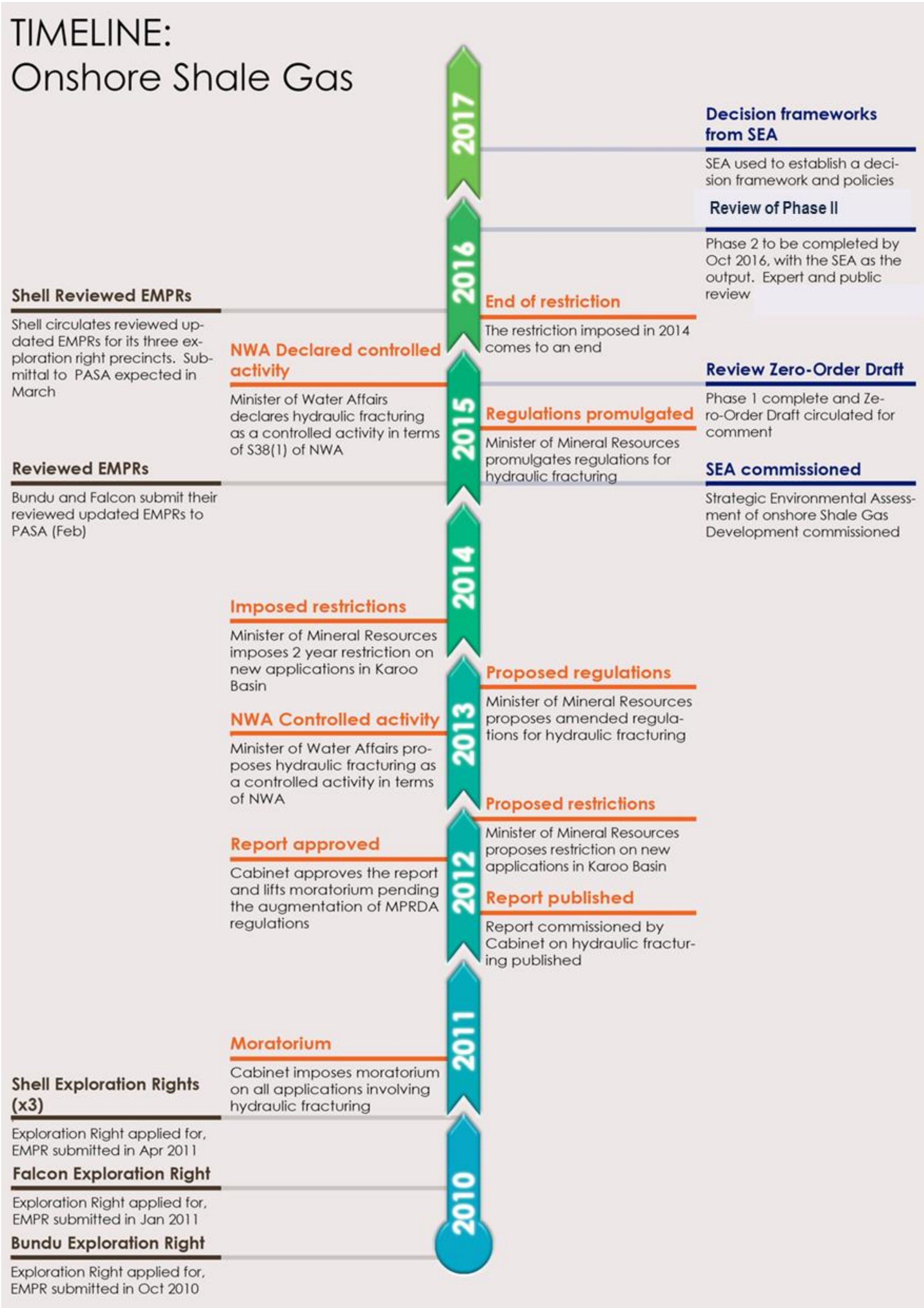


Figure 2–9: Exploration Rights application process, key policy and regulatory decisions intersection with SEA process steps (image courtesy of John Wilson from DEA&DP)

2.5.2 Shell's Exploration Programme

Shell's exploration program would entail three broad steps (Golder, 2011; Golder, 2013):

1. Gathering geophysical data. This data acquisition process is largely non-intrusive and does not involve drilling or significant excavation. The process will take place largely on existing roads.
2. Drilling of vertical exploration wells of between 1 000 m and 5 000 m deep to identify the shale layer. Horizontal boreholes may be drilled from the base of a vertical hole extending up to 2 km in length into the shale layer. During this stage of exploration, geological samples from the target shale formations would be subject to a variety of tests to confirm whether unconventional gas exists within the shale formation. If the shale layer cannot be found or no hydrocarbons are detected, fewer wells may be drilled.
3. Gas stimulation (hydraulic fracturing and testing) which would only take place should exploration drilling, logging and coring, indicate that intercepted shale layers contain gas and/or liquid hydrocarbon.

Based on these tests, if the exploration proves unsuccessful, the gas exploration wells will be decommissioned. Figure 2-10 below show "potential Areas of Interest" where Shell might concentrate their initial exploration drilling efforts. These areas were selected considering resource prospectivity and also overlaying a range of surface and subsurface GIS layers such as landscape features, proximity to existing infrastructure and people, water resources and other social and ecological sensitivity considerations (Golder Associates, 2013). The potential Areas of Interest are not the areas where Shell will exclusively locate their exploration activities - these areas merely indicate the locations that companies will target their initial activities, based on current information. As new information as gathered, these Areas of Interest will be revised.

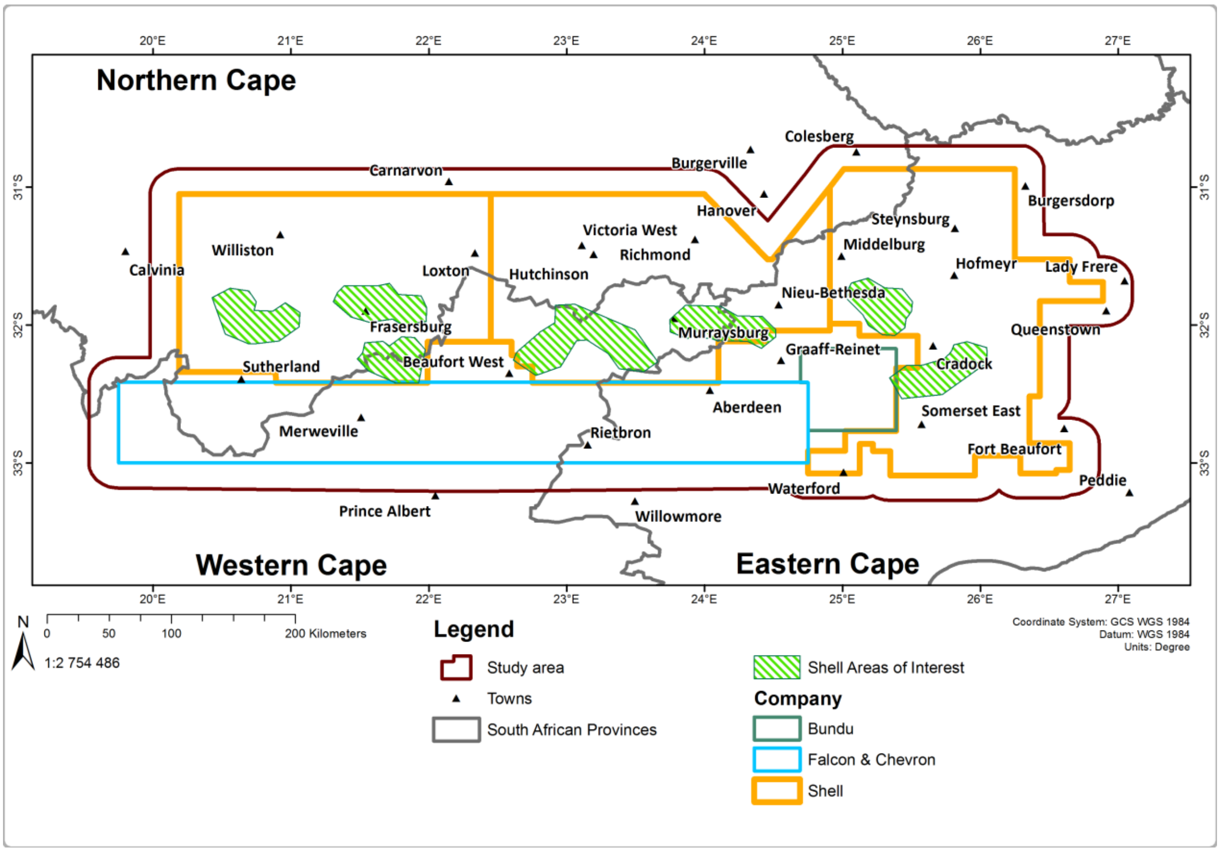


Figure 2–10: Shell "potential Areas of Interest" for exploration activities in the study area. Note that these areas merely indicate the locations that companies will target their initial activities, based on current information. As new information as gathered, these Areas of Interest will be revised.

2.5.3 Bundu's Exploration Programme

Bundu will focus their exploration activities specifically on seismic data analysis, geological investigations, hydrocensus and core drilling activities. The Bundu exploration programme includes drilling of up to 3 exploration boreholes with a drill pad of approximately half a hectare in size, including lay down areas for casing. The location of the possible core holes is not yet known (Golder, 2015).

2.5.4 Falcon's Exploration Programme

Falcon's exploration campaign will focus on seismic exploration and will rely on analysis of existing (historical) seismic and well information and from studying published field data. Falcon has identified preliminary corridors for the seismic surveys. The preliminary seismic survey lines were compiled to follow, as far as possible, existing roads, railway lines and other linear routes identified through a desktop assessment of aerial photographs and topocadastral maps (Figure 2-11) (SRK, 2015).

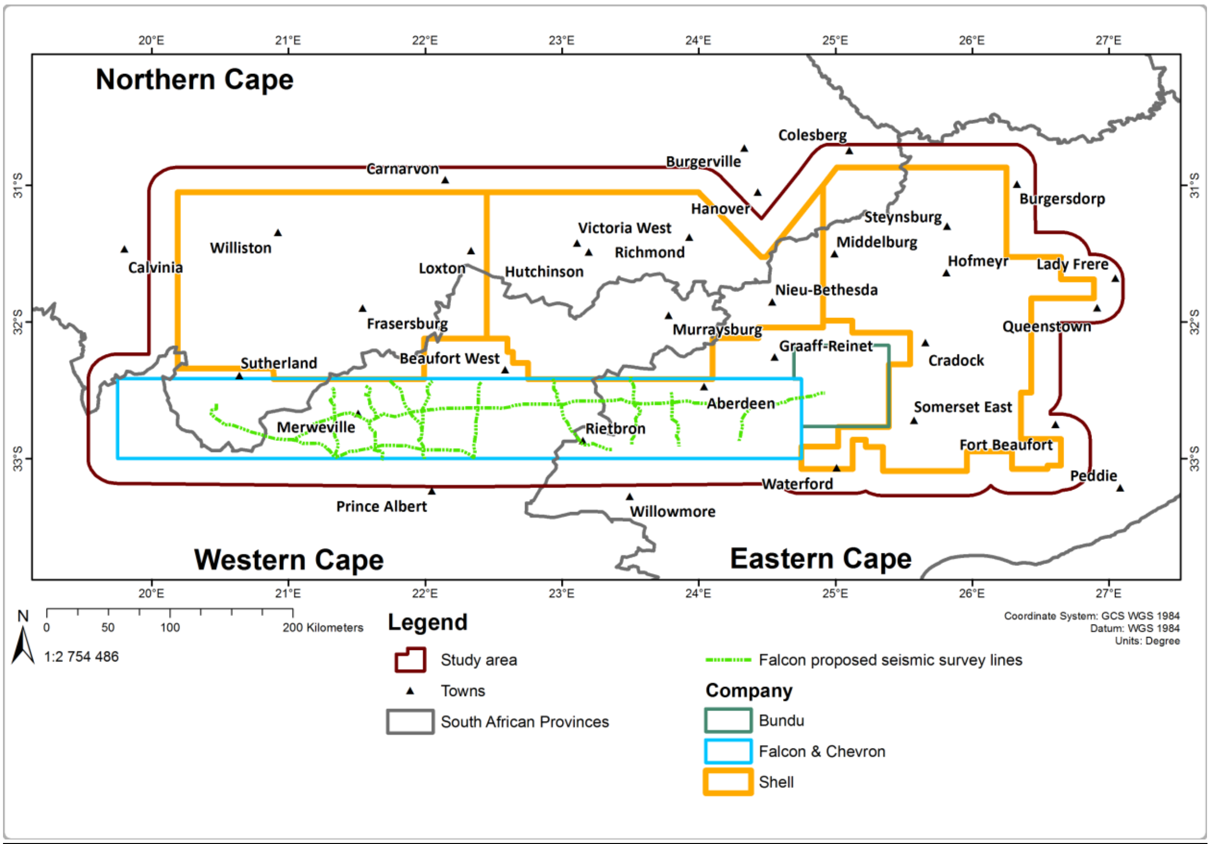


Figure 2–11: Proposed corridor locations for Falcon's seismic surveys

2.6 Overarching Regulatory Framework

2.6.1 The Constitution and Integrated Governance

In Section 24 (b) (iii), the Constitution provides that everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Chapter 3 of the NEMA requires co-operative governance, which would be important if shale gas exploration and production is to be managed effectively between different spheres of government. In this regard: "All spheres of government and all organs of state within each sphere must" –

(g) Exercise their powers and perform their functions in a manner which does not encroach on the geographical, functional or institutional integrity of government in another sphere.

There is case law precedence to illustrate that the national government's competence to regulate mining does not supersede local government's functional competence of municipal planning (ASSAf, 2016).

2.6.2 The MPRDA and Technical Regulations

The MPRDA is the primary legislative enactment regulating minerals and petroleum resources and their exploitation. The Act grants custodianship of all such resources to the State, whose obligations, among others, are to ensure equitable access to these resources and to expand opportunities for the historically disadvantaged people to enter the sectors and to benefit from resource exploitation. The Act is required to give effect to the environmental right, as contained within Section 24 of the Constitution (Esterhuyse et al., 2014)

Shale gas exploration and production activities are regulated by Chapter 6 of the MPRDA. Thus, any person wishing to engage in such activities will need to obtain an ER, followed by a Production Right, in order to extract shale gas. In addition, an EA and Environmental Management Programme (EMPr) are required before any such activities can commence (Esterhuyse et al., 2014).

The technical regulations drafted under the MPRDA are the central legislation governing the extraction and development of shale gas resources. They were published for comment in October 2013 and subsequently promulgated on the 3rd of June 2015, enabling the three existing shale gas ER applicants to continue with the requisite process. The regulations have since been legally contested by the Treasure the Karoo Action Group, who submitted the related documentation to the North Gauteng High Court in November of 2015.

The technical regulations indicate that the central institution to oversee the regulations is the so-called 'designated agency', which is currently the PASA. The technical regulations are broad-ranging and cover aspects relating to monitoring and best-practice mitigation of risk associated with water contamination and other environmental or geophysical concerns (ASSAf, 2016).

While the exploration and production of petroleum resources is legislated for in MPRDA, all environmental management aspects are dealt with in terms of the "One Environmental System" (OES) which became effective on 14 December 2014.

2.6.3 The NEMA and One Environmental System

The DEA administers the NEMA as well as a suite of related laws dealing with waste management, air quality, biodiversity and protected areas. The notion of sustainable development underpins the NEMA, supported by the NEMA principles as contained in Section 2 of the Act. In this regard, NEMA promotes that "development must be socially, environmentally and economically sustainable and that sustainable development requires the consideration of all relevant factors, including the following":

i. *That the disturbance of ecosystems and loss of biological diversity are avoided; or, where they cannot be altogether avoided, are minimised and remedied;*
ii. *that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;*
iii. *that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;*
iv. *that waste is avoided, or where it cannot be altogether avoided, is minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;*
v. *that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;*
vi. *(vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;*
vii. *that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.*

The principles in Section 2 of the NEMA also apply to the MPRDA. In this regard, an important principle is the precautionary approach, specifying that a risk-averse cautious approach is applied to development ("the precautionary principle"), which takes into account the limits of current knowledge about the consequences of decisions and actions. Another important principle is that the costs for remedying pollution, environmental degradation and consequent adverse health effects must be paid for by those responsible for harming the environment (the "polluter pays principle") (Hobbs et al., 2016).

To meet many of the requirements of the NEMA principles as they relate to mining and to accelerate progress toward reducing poverty, inequality and joblessness as required in the NDP. The National

Planning Commission called for a more coherent and predictable regulatory framework which reduced red tape and the cost of compliance. Specifically it identified the need for integration in decision making between the departments responsible for mining, water and environmental issues (DEA, 2015).

Applicable legislation to shale gas exploration and production in South Africa has been promulgated by the DMR, the DWS and the DEA. The DMR is responsible for the sustainable development of South Africa's mineral and petroleum resources within the framework of national environmental policy, norms and standards; while promoting economic and social development. The DEA is the lead agent for the protection of the environment and waste management while the DWS is the public trustee of the nation's water sources (Oelofse et al., 2016).

The OES was introduced as a synchronised system for environmental authorisation between the National Water Act (NWA) of 1998, the MPRDA, the NEMA, and the NEMA Specific Environmental Management Acts (SEMAs which include the NEM: Air Quality Act (NEM:AQA) and NEM: Waste Act (NEM:WA)). It is envisages that the OES regulatory system runs in parallel and that decisions regarding mining, water and environment are issued simultaneously within the prescribed 197 days fast track / 247 days slower track (in the case of a Basic Assessment); or 300 days fast track / 350 days slower track (in the case of a full-scoping EIA) as contemplated in the 2014 EIA Regulations (DEA, 2015).

The OES is designed to streamline environmental authorisation processes so that companies can simultaneously apply for EAs, Mining Rights and Water Use Licences (WULs) (van Zyl et al., 2016). Prior to the establishment of the OES, the environmental provisions of the MPRDA and the NEMA would be invoked to assess and manage environmental impacts of petroleum resource extraction (Glazewski & Esterhuyse, 2016). Under the OES, the environmental management function will remain with the DMR, but will be governed under NEMA. The DMR will assess applications based on NEMA and associated regulations with the Minister of Environmental Affairs becoming the competent authority if there is an appeal lodged by a stakeholder during the EA process (van Zyl et al., 2016).

In accordance with the OES, the Minister of Environmental Affairs has the power to determine the regulatory framework to be applied to environmental management aspects of any proposed exploration and production programme. The Minister of Environmental Affairs may make regulations on the consultation with landowners/lawful occupiers, financial provisioning and assessment and monitoring requirements, amongst others (Glazewski & Esterhuyse, 2016).

For example, the technical regulations for petroleum production and exploitation stipulate in 86(3) that when submitting an application in terms of the NEMA 2014 EIA Regulations for EA related to shale gas exploration or production, an applicant must comply with the "NEMA Minimum Information Requirements" (MIRs). At present, MIRs refer back to 2014 EIA Regulations, simply meaning that any EA application for shale gas exploration and production is subject to the 2014 EIA Regulations. One of the purposes of this report is to expand on the MIRs and outline and clear and structured process for environmental monitoring, assessment and decision-making related to shale gas exploration (see Appendix 3).

To this end, the Minister of Environmental Affairs May: 1.) Identify activities which may proceed subject to compliance with norms and standards and 2.) Prohibit or restrict the granting of an environmental authorisation by a competent authority for a specific listed activity in a specified area if this is necessary to ensure the protection of the environment, the conservation or resources or sustainable development (Glazewski & Esterhuyse, 2016).

Table 2–3: Decision-making mandates and permit requirements under the Constitution and OES for exploration and production related activities

Decision	Competent Authority	Legislation	Regulatory process
Exploration and Production Rights	DMR and PASA	MPRDA	EMPr initial submissions made to PASA in 2010 and 2011. DMR requested EMPrs to be updated in November 2014. DMR has not yet decided on any of the existing ER applications.
Environmental Authorisation	DMR and PASA[5]	NEMA	No applications for EA in terms of the NEMA have been submitted to date. Applications would be guided by the NEMA Minimum Information Requirements (MIRs) amongst other legislation. DMR is the competent authority with DEA providing decision on appeals.
Atmospheric Emission Licence	DEA	NEM:AQA	Integrated into the EA process with the establishment of the OES. DEA remain the competent authority.
Waste License	DMR	NEM:WA	Integrated into the EA process with the establishment

[5] In terms of the OES the Minister of Mineral Resources is the competent authority to grant environmental authorisations for shale gas development. The Minister must however delegate the task of evaluating environmental reports submitted by the project proponents. Presently, there is uncertainty regarding the particular state agency to which such task would be delegated. In the case of environmental applications for petroleum-related activities, the MPRDA indicates that the task would be undertaken by a 'designated agency' namely the PASA, however, the MPRDA Bill shifts this responsibility to the regional offices.

Decision	Competent Authority	Legislation	Regulatory process
			of the OES. DMR are the competent authority.
Water Use License	DWS	NWA	Integrated into the EA process with the establishment of the OES. DWS are the competent authority. The Catchment Management Agencies will process all applications but the final authority to issue the license will be National Office – currently the Director General possibly later the Deputy-Director General of Water Sector Regulation.
Municipal Planning Decision	Relevant local authority	Spatial Planning and Land Use Management Act (SPLUMA) of 2013, Western Cape Land Use Planning Act (LUPA) of 2015 and By-laws	For non-invasive 3-D seismic surveys, it is thought that rezoning will not be required. For the development of well pads, regional services, infrastructure servitudes, waste water treatment works, housing developments, camps, gravel pits, landfill sites, roads, the subdivision of farm land etc., these will require rezoning. These will require a Municipal Application to be submitted to the municipality or in some cases (if the general welfare of the inhabitants of the region are affected) the land development applications could require provincial approval and in other instances when the activity is considered a national interest, the national Minister responsible for SPLUMA then has decision-making oversight.
Provincial Planning Decision	Provincial competent authority	SPLUMA and LUPA	

2.6.3.1 Environmental Authorisation

Section 32 of the Mineral and Petroleum Resources Amendment Act 2008 (Act No. 49 of 2008) inserted a new Section 38B into the MPRDA which reads:

"(1) An environmental management plan or environmental management programme approved in terms of this Act before and at the time of the coming into effect of the National Environmental Management Act, 1998, shall be deemed to have been approved and an environmental authorisation been issued in terms of the National Environmental Management Act, 1998.

(2) Notwithstanding subsection (1), the Minister may direct the holder of a right, permit or any old order right, if he or she is of the opinion that the prospecting, mining, exploration and production operations is likely to result in unacceptable pollution, ecological degradation or damage to the environment, to take any action to upgrade the environmental management plan or environmental management programme to address the deficiencies in the plan or programme.

(3) The Minister must issue an environmental authorisation if he or she is satisfied that the deficiencies in the environmental management plan or environmental management programme in

subsection (2) have been addressed and that the requirements in Chapter 5 of the National Environmental Management Act, 1998, have been met."

According to Proclamation No. 14 of 2013 issued on 31 May 2013, the Act 49 of 2008 would have come into operation on 7 June 2013, but in terms of Proclamation No. 17 of 2013 issued on 6 June 2013, Proclamation No. 14 of 2013 was amended so that certain sections of the Act would not come into operation on 7 June 2013. Section 38B was one of the sections which did not come into operation on 7 June 2013 (or since then)[6].

Section 12(7) of the National Environmental Management Amendment Act (Act No. 62 of 2008), which was amended by Section 26 of the National Environmental Management Laws Amendment Act (Act No. 25 of 2014), states that an application for a right or permit in relation to prospecting, exploration, mining or production in terms of the MPRDA that was pending on 8 December 2014, must be dispensed of in terms of the MPRDA as if the MPRDA had not been amended.

The current shale gas ER applications in terms of the MPRDA, which were pending on 8 December 2014 must accordingly be dispensed with in terms of the MPRDA as if the MPRDA was not amended.

Section 12(4) of the National Environmental Management Amendment Act (Act No. 62 of 2008), which was amended by Section 26 of the National Environmental Management Laws Amendment Act (Act No. 25 of 2014), states that an Environmental Management Plan (EMP) or EMPr approved in terms of the MPRDA before 8 December 2014 must be regarded as having been approved in terms of NEMA.

The applications for ERs in terms of the MPRDA by Falcon & Chevron, Bundu Gas and Shell, were still pending on 8 December 2016. Even if an EMPR associated with these applications is approved, this will happen after 8 December 2014. As such, approval of any of these EMPRs, even if regarded to have been approved in terms of NEMA, does not constitute an Environmental Authorisation in terms of NEMA.

[6] In Mineral Sands Resources, the court also held that "MSR's counsel did not argue that, in terms of the legislative regime prevailing prior to 8 December 2014 (which may have remained in force in respect of pending matters), the obtaining of approvals under the Mining Act made it unnecessary for MSR to obtain environmental authorisation in terms of NEMA for any listed activities which the mining company would be undertaking. That any such suggestion would be unsound is clear from the judgment of the Constitutional Court in Maccsand (Pty) Ltd v City of Cape Town & Others 2012 (4) SA 181 (CC)." In Mineral Sands Resources (Pty) Ltd v Magistrate for the District of Vredendal, Kroutz NO and Others ("Mineral Sands Resources") the Western Cape High Court held that section 38B was nonsensical for the following reasons "NEMA came into effect on 21 January 1999. The Mining Act came into force on 1 May 2004. Accordingly it would be impossible for there to have been any EMPs approved in terms of the Mining Act as at 21 January 1999. The lawmaker may have intended to refer to NEMA as amended with effect from 8 December 2014. If so, the new s 38B(1) would be a repetition of s 12(4) of Act 62 of 2008." (Par 37 of the judgment)

The above was confirmed in Mineral Sands Resources court case, where the court held that "The effect of s 12(4) is that a Mining EMP approved prior to 8 December 2014 is to be regarded as an EMP approved in terms of s 24N of NEMA." The court furthermore held that "the DMR's approval of the amended Mining EMP did not simultaneously constitute an environmental authorisation". "The process for obtaining an environmental authorisation is more rigorous than for an amendment of a Mining EMP."

Regulation 54 of the 2014 NEMA EIA Regulations states that an application submitted in terms of the previous MPRDA Regulations for a permit, right, approval of an EMPR or amendment to such permit, right, or EMPR which was pending on 8 December 2014, must despite the repeal of those Regulations be dispensed with in terms of the those previous MPRDA regulations, as if those previous MPRDA Regulations were not repealed. However, an application submitted after 8 December 2014 for an amendment of an EMPR approved in terms of the MPRDA must be dealt with in terms of the 2014 NEMA EIA Regulations.

The current shale gas ER applications in terms of the MPRDA Regulations were pending on 8 December 2014 and must accordingly be dispensed with in terms of the MPRDA Regulations, as if the MPRDA Regulations were not amended.

On 4 December 2014, the Minister of Environmental Affairs promulgated the 2014 NEMA EIA Regulations and Listing Notices in terms of Chapter 5 of the NEMA6. These Regulations came into effect on 8 December 2014 and repealed the 2010 EIA Regulations.

The gas exploration operations proposed in the ER applications in terms of the MPRDA, trigger one or more of the following listed activities in terms of the 2014 NEMA EIA Regulations:

- Activity 20 of Listing Notice 1: "Any activity including the operation of that activity which requires a prospecting right in terms of section 16 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource, including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)."
- Activity 18 of Listing Notice 2: "Any activity including the operation of that activity which requires an exploration right as contemplated in section 79 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including associated infrastructure, structures and earthworks."
- Listed activities pertaining to watercourses, river crossings, vegetation removal and or construction of roads should also be considered.

Where the above activities apply, EA will be required from the relevant authority prior to the undertaking of the said activities.

It is also important to note that the proposed National Environmental Management Laws Amendment Bill, 2016, (“the Bill”) contains the following provisions:

“Transitional provisions for mining applications submitted before 8 December 2014

75. (1) An environmental management plan or environmental management programme approved in terms of the Mineral and Petroleum Resources Development Act, 2002 on 8 December 2014, or before 8 December 2014, or after 8 December 2014 in the case of applications that were pending on that date, shall be deemed to have been approved and an environmental authorisation issued in terms of the National Environmental Management Act, 1998.

(2) Subsection (1) does not apply in the instances where an application for an environmental authorisation in relation to activities ancillary to exploration, prospecting, mining, or primary processing was not obtained, was refused or there was failure to obtain an environmental authorisation in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989) for activities that required such an environmental authorisation in terms of that Act, or for activities identified or specified under section 24(2) of National Environmental Management Act, 1998, or a waste management licence has not been obtained, was refused or not obtained for any activity listed in terms of section 19 of the National Environmental Management: Waste Act, 2008.”

The above provision in the Bill confirms that, even if these proposed amendments are brought into effect, the requirement that Environmental Authorisation is required for the listed activities (contained in the 2014 NEMA EIA Regulations) shall remain in effect.

The transitional arrangement provided for in Regulation 53(3) of the 2014 NEMA EIA Regulations (GN No. R. 982 of 4 December 2014 refers) states that, where an application submitted in terms of the previous NEMA Regulations, was pending on 8 December 2014, in relation to an activity of which a component of the same activity was not identified under the previous NEMA notices, but is identified in terms of section 24(2) of the Act in terms of the 2014 NEMA Listing Notices, the competent authority must dispense of such application in terms of the previous NEMA Regulations, but may authorise the activity identified in terms of the 2014 NEMA Listing Notices as if it was applied for on condition that all impacts of the newly identified activity and requirements of the 2014 NEMA EIA Regulations have also been considered and adequately assessed. However, it must be noted that no application for EA has been submitted to date by any of the shale gas applicants. As such, the above-mentioned transitional provisions of the 2014 NEMA EIA Regulations are not applicable.

In summary, current legal interpretation suggests:

- No one may commence with an activity identified in terms of Section 24(2)(a) of NEMA unless EA in terms of NEMA has been obtained for the activity.
- An approval of an EMPR in terms of the MPRDA does not constitute an Environmental Authorisation in terms of NEMA. Furthermore, an EMPR, even if regarded to be approved (as an EMPR) in terms of NEMA, does not constitute an EA in terms of NEMA - Section 12(4) of the National Environmental Management Amendment Act (Act No. 62 of 2008).
- The applications submitted by Falcon & Chevron, Bundu Gas and Shell for ERss in terms of the MPRDA, prior to 8 December 2014, are pending and no application for EA in terms of NEMA has been submitted to date. As such, applications for EA are required prior to the commencement of any activities listed in the 2014 NEMA EIA Regulations (including Activity 20 of Listing Notice 1 and Activity 18 of Listing Notice 2).

2.6.4 Regulations Governing Mine Closure

The mining industry generally distinguishes between three distinct stages in a project lifecycle: The *exploration phase*, *the production phase* and the *closure phase*. In planning for the closure phase, Section 41 of the MPRDA states that applicants for prospecting rights, mining rights or mining permits must make financial provisions for the rehabilitation or management of negative environmental impacts.

The technical regulations developed under the MPRDA include provisions on well abandonment and closure which must be read in conjunction with Section 43 of NEMA which provides that: “the holder of a prospecting right, mining right, retention permit, mining permit, … or previous owner of works that has ceased to exist, remains responsible for any environmental liability, pollution, ecological degradation, the pumping or treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure thereof until the Minister [of Environmental Affairs] has issued a closure certificate in terms of this Act…”. This conforms to the tenets of the pollute pays principle.

A number of further environmental provisions relevant to closure have been transferred from the MPRDA to the NEMA, including sections titled “Financial provision for remediation of environmental damage; Monitoring and performance assessment; Mine closure on environmental authorisation". The new financial provisioning regulations require companies to provide comprehensive itemisation of all the costs associated with annual and final rehabilitation, decommissioning and closure as well as the costs associated with remediating long-term latent or residual impacts i.e. impacts that may only become visible in the future with a particular emphasis on potential water related threats.

A permit or right holder or applicant must calculate and make provision for the availability of sufficient rehabilitation and closure funds, which the DMR Minister must approve. Importantly the regulations specify that, at any point, the funds available for latent and residual effects must be able to cover the actual costs of implementation for at least ten years after closure. Financial provisions can be made through a financial guarantee, a deposit to a specific account administered by the DMR Minister or a combination of both. A trust fund can only be used for the purposes of financial provisions for residual or latent impacts subject to conditions set out in the Act. This marks a change from previous regulation which allowed for a trust to be used for other impacts.

The regulations prohibit the deference of "provisioning liability to assets at the mine closure or the mine infrastructure salvage value" and require the verification of registration of a financial institution in the case of a guarantee. In the case of residual or latent impacts, provisions must be ceded to the DMR Minister once a closure certificate has been issued. Companies are further required to review, assess and adjust all financial provisions and the assessment must be audited by an independent auditor. EMPs are required to be publically accessible. Companies can be placed under care and maintenance subject to specific requirements and Ministerial approval but cannot operate under care and maintenance for more than five years.

2.6.5 Other Policy, Plans, Regulations and Standards

Table 2–4: A summary of the national policy, plans and legislation application to shale gas exploration and production activities. Note that there are numerous other policy, plans, regulations and standards that could apply to shale gas exploration and production, the list contained here is comprehensive but not exhaustive.

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
Energy Planning. Integrated Energy Plan, Integrated Resources Plan, Gas Utilisation Masterplan and National Development Plan discussed in reference to the DoE Integrated Energy Planning Framework in Section 2.2	Energy Policy White Paper of the Republic of South Africa of 1998, NEMA: EIA Regulations, 2014	Security of energy supply for South Africa through energy supply diversity. Natural gas identified as a viable source of complementary primary energy supply to the existing mix.
	National Energy Act of 2008, Electricity Regulation Act of 2006, NEMA: EIA Regulations, 2014	Prescribes that energy planning in South Africa must be conducted in an integrated manner and that the Energy Minister has the mandate and the obligation to conduct such planning. The Act is very explicit in that it prescribes an IRP to precede any implementation of new power generation capacity.
	Gas Act of 2001, NEMA: EIA Regulations, 2014	Promulgated with the broad objective to stimulate the natural gas industry and explicitly introduces a number of new gas technologies e.g. gas liquefaction and regasification. Seeks to promote the orderly development of the piped gas industry and to establish a national regulatory framework.
	Eskom Transmission Development Plan, Strategic Grid Plan of 2015, NEMA: EIA Regulations, 2014	Outlines how the electric transmission system needs to be developed over the next 10 years. Indicates financial commitments required by Eskom in the short to medium term. This is inclusive of grid infrastructure required to integrate new gas-fired power plants. The Eskom Strategic Grid Plan outlines where new transmission grid development is needed.
	Transnet Long-term Strategic Framework of 2015, NEMA: EIA Regulations, 2014	Provides a long-term and broader view of transportation networks required, including expansions of existing transportation infrastructure. Specifically, natural gas infrastructure planning and pipeline developments include the possibility of domestic onshore gas finds.
Air Quality and Greenhouse Gas (GHG) Emissions	United Nations Framework Convention on Climate Change (UNFCCC) of 1992, the National Development Plan of 2012, the National Climate Change Response White Paper	In 2015, all countries signed an agreement under the UNFCCC, for the first time committing each one to reduce their GHG emissions. South Africa's contribution to the collective climate challenge is framed by our National Development Plan and the National Climate Change Response White Paper.

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
	of 2011, NEMA: EIA Regulations, 2014	
	National Environmental Management: Air Quality Act of 2004 (NEM:AQA), NEMA: EIA Regulations, 2014	Air quality is governed by the NEM:AQA. Municipalities are responsible for generating and maintaining air quality management plans. Emission limits have been set for the petroleum industry, but no subcategory yet exists for shale gas. Any legal person undertaking shale gas exploration or production will require an Air Emissions License (AEL), if they have an incinerator capacity of 10 kg or more of waste processed per hour. Six GHG are being declared 'priority pollutants' under the NEMAQA; companies which directly emit over 100 000 tonnes of GHG (expressed as a CO_2 equivalent) annually must produce a regular 'pollution prevention plan'. The regulatory institutions and mechanisms available under NEM:AQA should be assessed and the most relevant options applied to shale gas exploration and production.
	National ambient air quality standards of 2009 (NAAQS), NEMA: EIA Regulations, 2014	The NAAQS are community exposure standards which are implicitly health-based, being largely based on the World Health Organisation (WHO) guidelines for the ambient limit values of the major pollutants, with some local adaptations.
	Hazardous Chemical Substances regulations of the Occupational Health and Safety Act of 1993, NEMA: EIA Regulations, 2014	Occupational exposure standards will apply on both the well drilling sites and downstream processing facilities. The regulations specify the allowed exposure limit over eight hour shifts. These are based on the guidelines produced by the American Conference of Governmental Industrial Hygienists. Because the South African regulations have not been updated for some time, it would be prudent to consider a revision of the regulations, taking into account good practice internationally.
	Regulations for Petroleum Exploration and Production of the MPRDA of 2015, NEMA: EIA Regulations, 2014	The technical regulations include a section on "management of air quality". Specifically paragraph 127 requiring license holders to minimise fugitive emissions, including natural gas during hydraulic fracturing operations by various means, or if those are not feasible, to flare the gas. These regulations seek to avoid venting methane to the atmosphere and to minimise flaring.
Seismicity	Regulations for Petroleum Exploration and Production of the MPRDA of 2015, NEMA: EIA Regulations, 2014	The regulations include requirements on how to conduct assessments of related seismicity (regulation 89) which must be undertaken by PASA, mechanical integrity tests and monitoring processes (regulation 112), the contents of a post-hydraulic fracturing report (regulation 120), a 'general' section prohibiting deep well injection of waste fluids (regulation 124), well decommissioning and closure procedures (regulation 132). Provide a sound basis for discussions between regulators and developers of shale gas wells. Several of the clauses might require clarification, be too stringent or unnecessarily prescriptive. For example, the meaning of the phrase "fracture behaviour of targeted formations" (sub-regulation 89 (1) (b)) should be explained; while the stipulation that an array of accelerometers must be installed in a monitoring well (sub-regulation 112 (8) (b))

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		should be reviewed, as it is possible that satisfactory measurements could be obtained from a far cheaper surface array using modern location algorithms. Other regulations relevant to seismicity, are contained in Chapter 8 titled "Well design and construction", specifically regulations 94 (Well risk identification and assessment), 95 (well design) and 96 (well construction standards) and 97 – 100 (on different types of casing to be used during well construction). Due to the high levels of technical specification, these regulations should be amended as exploration progresses, more geological and seismic information is gathered and hydraulic fracturing technologies develop further.
Water Resources, including surface and groundwater	National Water Act 36 of 1998, NEMA: EIA Regulations, 2014	Ensures that the nation's water resources are protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner. DWS has invoked Section 38 of the NWA to declare hydraulic fracturing a controlled activity, thus exploration and/or production will require a WUL. The NWA provides for the determination of a Reserve and related matters (Section 16 to 18), before the issuing of a license on groundwater and surface water. Sections 19 and 20 of the NWA require shale gas operators to prevent pollution incidents and emergency incidents and outlines how operators should act in the case of an emergency incident. Chapter 14 of the NWA (Section 137 to 145) requires monitoring, recording, assessing and disseminating information on water resources. In this regard, the Minister of Water and Sanitation must establish national monitoring systems and national information systems, each covering a different aspect of water resources, such as a national register of water use authorisations, or an information system on the quantity and quality of water resources. Key regulations important for hydraulic fracturing under the NWA, includes Government Notice (GN) 704 (GN 704/1999 in Government Gazette of 4 June 1999) where the following is relevant: • Regulation 4: No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 m from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked. • Regulation 5: No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource. • Regulation 6: Capacity requirements for clean and dirty water systems; and • Regulation 7: Specific requirements for the protection of water resources.

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		Other relevant regulations are GN 1199 (18 December 2009), which specifies conditions for impeding or diverting flow or altering the bed, banks, course or characteristics of a watercourse to persons using water under Sections 21 (c) and (i) of the NWA. In these regulations, no water use is allowed within a 500 m radius from the boundary of a wetland. Also, altering the bed, banks, course or characteristics of a watercourse is not allowed within the 1:100 floodline or within the riparian habitat, whichever is the greatest.
	The Water Services Act of 1997, NEMA: EIA Regulations, 2014	Governs the provision of water services and promotes effective water resource management and conservation. Municipalities must ensure that water of a specific quality is provided (see quality standards below), must ensure assurance of supply and must ensure sanitation. If shale gas development occurs in a specific area, there may be an additional strain on the infrastructure. Treatment of waste water will not be possible at existing Waste Water Treat Works as the waste streams are significantly different from what is currently treated there.
	The South African Water Quality Guidelines (DWAF, 1996), NEMA: EIA Regulations, 2014	Serve as the primary source of information for determining the water quality requirements of different water uses and for the protection and maintenance of the health of aquatic ecosystems. Recognising that suitable quality may differ for different water users, separate guidelines are provided for domestic, recreational, industrial and agricultural (irrigation and livestock watering) use, as well as for maintenance of aquatic ecosystems. As the name implies, these are guidelines for best practice and are not legally binding.
	South African National Standards (SANS) for drinking water and waste streams, NEMA: EIA Regulations, 2014	In contrast, standards for drinking water and purification of waste waters are legislated. The SANS specifies the minimal quality of drinking water, defined in terms of microbiological, physical, chemical, and taste-and odour parameters at the point of delivery to the consumer. The Water Services Act of 1997, updated as SANS (2015a: 2015b), requires that water provided by water services authorities meets the specified standards. It should be noted that these standards apply only to water to be delivered to the consumer, and not to water in rivers or aquifers, where only the relevant guidelines apply. Standards are drawn from: • SANS. 2015a. SANS 241-1. Drinking water. Part 1: Microbiological, physical, aesthetic and chemical determinands. Edition 2. Standards South Africa. • SANS. 2015b. SANS 241-2. Drinking water. Part 2: Application of SANS 241-1. Edition 2. Standards South Africa. Standards were also set in the 1956 Water Act for some 23 constituents in effluents and waste waters entering a stream. While the updated version modifies the legal limits of some constituents, no additional constituents are considered. The values set for most or all of the constituents listed in the current list are derived from the South African Guidelines for Aquatic Ecosystems.
Waste	Regulations for Petroleum	Makes specifications for site underlay systems (regulation 91); material safety datasheets for drilling fluids (

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
	Exploration and Production of the MPRDA of 2015, NEMA: EIA Regulations, 2014	regulation 109); tagging of proppants with radioactive isotopes and addition of tracers in fracture fluids (regulation 112); fracturing fluid disclosure including prohibition of substances listed in Schedule 1; a risk management plan for fracturing fluids (regulation 115); management of flowback through an approved waste management plan (regulation 116); the requirement of a fluid transportation plan (regulation 117); requirements for storage of fluids and re-use at the well pad (regulation 118 &123); waste disposal in accordance with applicable legislation (sub-regulation 124(1)); radioactive materials management in accordance with National Radioactive Waste Disposal Institute Act of 2008 (sub-regulation 124(2)); liquid waste must be disposed of at an approved waste treatment facility in accordance with relevant legislation and disposal of liquid waste at domestic waste water treatment facilities must only take place after prior consultation with the department responsible for water affairs (sub-regulation 124(3)); deep well injection and annular disposal of drill cuttings or fluids is not permitted (sub-regulation 124(4&6)); discharge of fracking fluids, fracking flowback, and produced water into surface water courses is prohibited (sub-regulation 124(5)); drill cuttings and waste mud must be temporarily stored in above-ground tanks (sub-regulation 127(7)); solid waste generated during operations must be categorised and disposed of accordingly at a licensed landfill site or treatment facility (sub-regulation 124(8)); a waste management plan must be prepared and approved as part of the application for Environmental Authorisation (regulation 125). The existing legislated waste management provisions in the technical regulations are largely adequate to reduce the waste-related risks of shale gas development to low, if rigorously enforced. NEMA Section 30 and 30A establish the framework for dealing with emergency situations. Waste management activities that are likely to have a detrimental effect on the environment as listed in Regulation 921 of 29 November 2013 are subject to the EIA Regulations made under Section 24(5) of NEMA as part of a Waste Management Licence application under the NEM:WA.
	National Environmental Management Act of 1998 (NEMA), NEMA: EIA Regulations, 2014	NEMA Section 30 and 30A establish the framework for dealing with emergency situations. Waste management activities that are likely to have a detrimental effect on the environment as listed in Regulation 921 of 29 November 2013 are subject to the EIA Regulations made under Section 24(5) of NEMA as part of a Waste Management Licence application under the NEM:WA.
	National Environmental Management: Waste Act of 2008 (NEM:WA), NEMA: EIA Regulations, 2014	At present waste is pre-classified as hazardous waste in terms of Schedule 3 of the Waste Act. There is an amendment to the schedule in the pipeline as present "Category A: Residue deposits and residue stockpiles included) waste from drilling muds and other drilling operations" which will mean that drill cuttings are not pre-classified as hazardous waste. South Africa has an integrated pollution and waste management policy, driven by the vision of environmentally sustainable economic development by preventing and minimising, controlling and

<table>
<tr><th>Issue</th><th>National policy, plans and legislation</th><th>Relevance to shale gas exploration and production and comments on the existing regulatory framework</th></tr>
<tr><td></td><td></td><td>remediating pollution and waste to protect the environment. Waste management in South Africa is informed by the waste management hierarchy which outlines waste management options covering the lifecycle of waste, in descending order of priority: waste avoidance (prevention and minimisation), re-use and recycling, recovery, waste treatment and disposal as last resort. Waste management activities that may require a licence in terms of NEM:WA are listed in Regulation 921 of 29 November 2013 and Regulation 633 of 24 July 2015. These activities include: storage of general waste, recycling of waste, treatment of waste, disposal of waste, construction, expansion or decommissioning of waste facilities and the establishment or reclamation of a residue stockpile or residue deposit. Depending on the size, handling capacity and the type of waste to be managed, a basic assessment or full EIA set out in the EIA will be required as part of the licence application process. All hazardous waste management facilities will require a full EIA. Applicable regulations under NEM:WA include:
• Waste Information Regulations (Regulation 625 of 13 Aug 2012) – every person generating more than 20 kg of hazardous waste per day or disposing of any amount of hazardous waste to landfill must register on the South African Waste Information System (SAWIS) and submit actual quantities of waste into the SAWIS.
• Waste Classification and Management Regulations (Regulation 634 of 23 Aug 2013) - All waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 and a safety data sheet prepared for each waste stream as prescribed.
• National Norms and Standards for the Assessment of Waste for Landfill Disposal (Regulation 635 of 23 Aug 2013).
• National Norms and Standards for Disposal of Waste to Landfill (Regulation 636 of 23 Aug 2013).
• List of Waste Management Activities that have or are likely to have a detrimental impact on the Environment (GN 921 of 29 Nov 2013).
• National Norms and Standards for Storage of Waste (GN 926 of 29 Nov 2013).
• National Norms and Standards for Remediation of Contaminated Land and Soil (GN 331 of 2 May 2014).
• Regulations regarding the planning and management of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation (Regulation 632 of 24 July 2015).
• Amendments to the list of waste management activities that have or are likely to have a detrimental effect on the environment (Regulation 633 of 24 July 2015).
The Minister or MEC may identify investigation areas, direct site assessments to be done and issue remediation</td></tr>
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Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		orders for the remediation of contaminated land. All costs associated with the assessments and remediation will be for the account of the owner of the land or company responsible for shale gas exploration and production in line with the "polluter-pays-principle". Recovery of drilling muds and hydraulic fracturing fluids will require a waste management license in terms of the Waste Act of 2008. It is recommended that shale gas development wastes be added to the list of pre-classified hazardous waste streams in Annexure 1(2) of waste Regulation 634. The DEA have indicated their intention to amend schedule 3 of NEM:WA which currently pre-classify wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals as hazardous waste. If this pre-classification of waste from shale gas development changes, then it is possible that the waste may be classified as Type 1, 2 or 3. Most municipal landfill sites in the study area would at best be Class C or D sites and will not be able to receive Type 1, 2, or 3 wastes. Although norms and standards for waste classification and containment barrier system designs at landfill sites is prescribed; there is no requirement for operational and groundwater monitoring requirements. Possible contact between the waste from shale gas development and humans is also not regulated.
	National Water Act of 1998, NEMA: EIA Regulations, 2014	Provides regulatory and market based instruments to manage the impacts on water quality. These instruments include licensing of water uses, including disposal of waste, which may impact on water resources and waste discharge charges.
	National Nuclear Regulator Act of 1999, NEMA: EIA Regulations, 2014	Regulates Naturally Occurring Radioactive Material (NORM) waste. The National Nuclear Regulator document RD-004 'Requirements Document on the Management of Radioactive waste associated with waste products from facilities handling NORM (2007)' describes how NORM waste must be managed.
	National Road Traffic Act of 1996, NEMA: EIA Regulations, 2014	Vehicles transporting dangerous goods (including hazardous waste) must adhere to SANS 10228 in terms of identification and classification of goods. In terms of Section 76 the following standards are deemed to be regulations: • SANS 10228: Identifies and classifies each of the listed dangerous goods and substances and set out information including the United Nations Number, the correct shipping name, hazard class assigned and other information. • SANS 10229: Contains information on acceptable packaging for dangerous goods and substances and also include requirements for the testing of packaging and the correct marking and labelling of packages. • SANS 10230: Includes statutory vehicle inspection requirements for all vehicles conveying dangerous goods. This code stipulates the safety aspects of both the vehicle and the goods containment. Minimum inspection requirements by both in-house and outside agencies are listed.

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		• SANS 10231: This code of practice prescribes the operation rules and procedures for transporting Dangerous Goods and Hazardous Materials. It also includes the prescribed responsibilities of the owner/operator of the dangerous goods vehicle. It outlines the information required and who will have to supply information for the safe conveyance of dangerous goods. The requirements for the drafting and formulating of an operational agreement are also specified. This code also requires the owner/operator or vehicle to be registered as dangerous goods carrier. It is also prescribed that the owner operator has available adequate insurance cover for civil liability as well as pollution and environmental rehabilitation cover in the event of an incident. • SANS 10232-1: 2007: This code includes details of new placarding requirements for vehicles transporting dangerous goods and the individual or substance exempt quantities and the compatibility requirements of mixed loads. Part 3 of this code contains information on the Emergency Response Guides to be used in case of an incident or accident.
	Disaster Management Act, 2002 (Act 57 of 2002), NEMA: EIA Regulations, 2014	This act provides for an integrated and coordinated disaster management policy that focuses on preventing or reducing the risk of disasters (natural or human induced) mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery.
Biodiversity	The National Environmental Management: Biodiversity Act (NEMBA) of 2004, as amended, NEMA: EIA Regulations, 2014	Provides for the management and conservation of biodiversity, the protection of species and ecosystems that warrant national protection, and the sustainable use of indigenous biological resources.
	The National Environmental Management: Protected Areas Act of 2003, NEMA: EIA Regulations, 2014	Provides for the protection and conservation of ecologically viable areas representative of natural landscapes. The Act provides for protected areas to be declared on private or communal land, with the landowner retaining title to the land.
	National Biodiversity Strategy and Action Plan (NBSAP), NEMA: EIA Regulations, 2014	South Africa is obliged to develop a National Biodiversity Strategy and Action Plan (NBSAP). Strategic objectives of the NBSAP include that the management of biodiversity assets and their contribution to the economy, rural development, job creation and social wellbeing is enhanced.
	National Biodiversity Assessment (NBA), the National Protected Area Expansion Strategy (NPAES),	All plans undertake spatial assessment and prioritisation of biodiversity regions based on the principles of systematic biodiversity planning. These principles include the need to conserve a viable representative sample of all ecosystems and species, as well as the ecological and evolutionary processes that allow biodiversity to persist over time. At the provincial level, provincial environmental affairs departments are often the authority

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
	Atlas of Freshwater Ecosystem Priority Areas of South Africa (FEPA), and provincial spatial biodiversity plans, NEMA: EIA Regulations, 2014	for permitting or authorising for a range of activities, and they provide comments on mining-related authorisations. Provincial spatial biodiversity plans identify Critical Biodiversity Areas (CBAs) and Ecological Support Areas which guide such authorisations and comments.
Agriculture	The Conservation of Agricultural Resources (Act 43 of 1983) (CARA), NEMA: EIA Regulations, 2014	Prevents the degradation of the agricultural potential of soil and requires the protection of land against waterlogging and salinisation of soils by means of the construction and maintenance of suitable soil conservation works. The sustainable utilisation of marshes, water sponges and watercourses on agricultural land is also regulated in terms of the Act. CARA was promulgated more than three decades ago, and did not anticipate all of the current potential impacts of new developments on agricultural resources. CARA could be augmented drawing from principles contained in international best practice documentation such as the International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability that became effective on 1 January, 2012.
	The National Water Act (Act 36 of 1998) (NWA), NEMA: EIA Regulations, 2014	Is concerned with the quality and quantity of water used, including for agriculture. Any impacts caused by shale gas activities on the volume and quality of water available for authorised agricultural water use, will be an infringement of this Act.
Tourism	National Development Plan (NDP) (2012), NEMA: EIA Regulations, 2014	The NDP identifies tourism as an essential part of our economy into the future.
	Medium Term Strategic Framework for 2014 – 2019, NEMA: EIA Regulations, 2014	Tourism is a key sector contributing to Outcome 2 regarding “decent employment through economic growth”.
	National tourism plans, NEMA: EIA Regulations, 2014	At the national level, guidance is provided by the Marketing Tourism Growth Strategy for South Africa (2010) and the National Tourism Sector Strategy (DoT, 2011). The Rural Tourism Strategy (DoT, 2012) highlights the importance of rural areas for tourism and emphasises the fact that rural areas contain important tourism attractions. These plans are implemented by different authorities and government agencies, a situation that is adding to management complexity.
	Provincial and regional tourism plans, NEMA: EIA Regulations, 2014	At provincial and regional level there are: an Integrated Tourism Development Framework (Western Cape Department of Economic Development and Tourism, 2006), an Eastern Cape Tourism Master Plan (Eastern Cape Department of Economic Development and Economic Affairs, 2009) and a Northern Cape Tourism

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		Master Plan Review (Grant Thornton, 2014). The Karoo Development Foundation (2012) produced a Karoo Tourism Strategy and Kyle Business Projects (2009) produced a Camdeboo Responsible Tourism Sector Plan. In essence the strategies of these communicated in the planes are to develop and market unique tourism products, grow domestic and international tourism arrivals and spend, create sustainable economic benefits and to protect the environment.
Micro and macroeconomics	The Industrial Policy Action Plan 2015/16 – 2017/18, NEMA: EIA Regulations, 2014	Proposes a Long Term Strategic Framework to leverage the opportunities presented by petroleum and gas resources. The Department of Trade and Industry has also recently announced that it will be establishing a unit to manage gas industrialisation that intends replicating the success of the Independent Power Producer programme unit of the DoE.
Social fabric	The Social Assistance Act of 2004, NEMA: EIA Regulations, 2014	Creates a broad social protection strategy. Several types of grants are available: Grants for Older people, Disability grants, War veterans' grants, Foster care grants, Child support grants and Grants in Aid. Poor people also have access to other developmental initiatives such as the National Schools Nutrition Programme, the Expanded Public Works Programme, the Municipality Infrastructure Grant , municipal services subsidies, and the Umsobomvu Youth Fund.
Human health	National Environmental Management Act of 1998 (NEMA), NEMA: EIA Regulations, 2014	Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.
	National Water Act, Act 36 of 1998 (NWA), NEMA: EIA Regulations, 2014	Sustainability and equity identified as central guiding principles in the protection, use, development, conservation, management and control of water resources. These guiding principles recognise the basic human needs of present and future generations, the need to protect water resources, the need to promote social and economic development through the use of water and the need to establish suitable institutions in order to a thieve the purpose of the Act.
	Regulations for Petroleum Exploration and Production of the MPRDA of 2015, NEMA: EIA Regulations, 2014	"Well examination schemes" are required to by competent and independent persons to assess "risks to the health and safety of persons from the well or anything in it, or from strata, to which the well is connected, have been assessed and are within acceptable levels." During hydraulic fracturing, a permit holder must: • prevent well design risks to health and safety of persons from the well or anything in the well, or in strata to which the well is connected. • address hydraulic fracturing fluids management to ensure assessment of potential environmental and health risks of fluids and additives in both diluted and concentrated form.

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		• conduct operations in a manner that does not pose a risk to public health, life, property and the environment. The protection of human health, with particular reference to the Health Act of 2003, is missing from the MPRDA technical regulations.
	Health Act (Act No. 61 of 2003), NEMA: EIA Regulations, 2014	Supports the Constitution in terms of everyone having a right to an environment not harmful to health and well-being (Section 24). Water quality monitoring is referenced in terms of municipal health services provisions, there is no other mention of water.
Sense of Place	The National Environmental Management Act (NEMA) of 1998, NEMA: EIA Regulations, 2014	Sustainable development requires the consideration of all relevant factors including…"that decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognising all forms of knowledge, including traditional and ordinary knowledge".
	National Heritage Resources Act (NHRA) of 1999, NEMA: EIA Regulations, 2014	Describes the reasons a place or object may have cultural heritage values; some of these speak directly to the cultural landscapes. "Cultural significance" means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The concept of 'sense of place' has been used to legally block developments locally and internationally. For example, the development of a shopping mall was blocked at Princess Vlei, in Cape Town in 2009, and the development of mining was blocked at St Lucia in KwaZulu-Natal in 2002.
Visual aesthetics	The National Environmental Management: Protected Areas Act of 2003, NEMA: EIA Regulations, 2014	The Minister/MEC may restrict or regulate development in a 'protected environment' that may be inappropriate for the area given the purpose for which the area was declared. Local authority zoning schemes can be used to protect natural and cultural heritage resources through 'Conservation Areas', 'Heritage Overlay Zones' and 'Scenic Overlay Zones' including scenic routes.
	National Heritage Resources Act of 1999, NEMA: EIA Regulations, 2014	Includes protection of national and provincial heritage sites, as well as areas of environmental or cultural value, and proclaimed scenic routes.
Heritage	National Heritage Resources Act (NHRA) of 1999, NEMA: EIA Regulations, 2014	Defines and governs heritage resources. Section 38 prescribes the manner in which an impact assessment should be carried out. It provides triggers for various activities that would require an impact assessment, however, under Section 4(b)(iii) of the National Environmental Management Act (NEMA) No. 107 of 1998, 1998) one is required to include an assessment of the impacts to the National Estate into any impact assessment triggered by the provisions of that act. Under the NHRA, Section 34 protects structures older than 60 years; Section 35 protects archaeology, palaeontology and meteorites; Section 36 protects burial grounds and graves; and Section

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
		37 protects public monuments and memorials. The definitions mentioned above provide specific details of what is included within each of these categories. Under Section 28 heritage resources authorities may provide a measure of protection to certain areas over and above the basic provisions of Sections 34-37, while Section 29 allows the authorities to provisionally protect a heritage resource in order to allow for the consideration of further protection as may be required, often when the resource is under threat. In the context of shale gas development, Heritage Impact Assessments (HIAs) produced under NEMA and according to the guidelines of Section 38(3) should be submitted to the relevant heritage authorities for comment. In the event of free-standing HIAs being conducted (if a development application fails to trigger NEMA), then the heritage resources authorities would be the decision-making authority. The heritage management system anticipated by the NHRA is not fully operational. As things stand at present, the following applies in each province under the NEMA process: • Western Cape: Heritage Western Cape is fully functional and applications within Western Cape would be commented on by them; • Eastern Cape: Although the Provincial Heritage Resources Authority (PHRA) of the Eastern Cape is formally functional, it is poorly resourced and has limited capacity to respond to applications; and • Northern Cape: The Northern Cape PHRA, Ngwao-Boswa Ya Kapa Bokoni, is functional but also poorly resourced. Powers in terms of the NHRA for built environment and landscape matters have been devolved to the PHRA, but not those relating to archaeology and palaeontology (South African Heritage Resources Agency (SAHRA) handles those aspects on its behalf).
	World Heritage Convention Act (No. 49 of 1999, 1999), NEMA: EIA Regulations, 2014	Governs World Heritage Sites. Although the study area does not currently host such sites, it does include part of the previously described 'Human Rights, Liberation Struggle and Reconciliation: Nelson Mandela Legacy Sites' serial nomination as well as the Succulent Karoo Protected Areas.
	National and provincial regulations and guideline documents	There is a Western Cape Government guideline document for involving heritage specialists in Environmental Impact Assessment (EIA) processes, while both SAHRA (2007) and HWC (2016) have issued guidelines and standards for conducting specialist assessments of archaeology and palaeontology.
Noise	Environmental Conservation Act of 1989, the Western Cape Noise Control Regulations (NCR) (2013) and national standards, NEMA: EIA	Both these regulations set the concepts of a "disturbing noise" and a "noise nuisance". A disturbing noise can be objectively measured, while a noise nuisance is a subjective "annoyance" that cannot be reliably measured, such as a dog barking or other discrete events. Two standards, SANS 10328 and SANS 10103 further expand on these regulations. SANS 10328 specifies the standard procedure for conducting a noise impact assessment. SANS 10103 specifies procedures for assessing the noise under investigation. The Western Cape NCR

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
	Regulations, 2014	supersede the national NCR.
Electromagnetic interference	Astronomy Geographic Advantage Act (AGAA) of 2007, NEMA: EIA Regulations, 2014	Empowers the Minister of Science and Technology to declare Astronomy Advantage Areas, and protect these areas through regulations. Required protection threshold levels for the radio astronomy service are described in International Telecommunications Union Recommendation ITU-R RA.769-2. The basic principles upon which this recommendation is developed has been used in the derivation of the South African Radio Astronomy Service (SARAS) protection level. This protection level has been promulgated in terms of the AGAA and adopted in South Africa to provide a clear and objective decision making process in the assessment of radiofrequency interference on the SKA and other radio astronomy facilities.
Spatial planning	Municipal Systems Act of 2000, NEMA: EIA Regulations, 2014	Enable coordinated service delivery and development between the three spheres of government and other role players within a municipal area, to 1) improve quality of life, 2) support sustainable development and transformation, and 3) facilitate democratic and multi-sector planning processes. The municipal Integrated Development Plan (IDP) addresses current and future societal needs within the context social and ecological systems in which they exist. All project and activities related to infrastructure, land development, service delivery, as well as land and environmental management within any area needs to form part of the relevant IDP and associated sector plans and infrastructure investment frameworks.
	The Spatial Planning and Land Use Management Act of 2013 (SPLUMA), NEMA: EIA Regulations, 2014, Western Cape Land Use Planning Act, 2014 (LUPA)	Makes provision for the establishment of a planning instrument to enable focused temporal and spatial coordination of governance and investment actions in and between different spheres of government, within areas with unique, but interrelated, attributes or development challenges that span more than one municipality and/or province. Since the advent of the SPLUMA in 2013, and in line with a series of pronouncements by the Constitutional Court since 2010, the locus of land use change approvals is the municipality. The decisions of other national or provincial departments may not overturn that of the municipality.
	Land Use Planning Ordinance, 15 of 1985	In the Northern Cape, the Northern Cape Planning and Development Act (NCPDA) of 1998 was promulgated. The three affected provinces are, however, each at different stages in evolving from a legal position based on LUPO to one that is in line with SPLUMA. The Western Cape already has new legislation in place (LUPA and an accompanying set of Land Use Planning Regulations (2015)), while the Northern and Eastern Cape provinces have draft legislation that is being considered in each of the respective provinces. In the absence of new provincial legislation and until such time as the municipalities have municipal planning bylaws in place, the former LUPO-based (or NCPDA-based in the case of the Northern Cape) system stays in effect until repealed by provincial governments as set out in the Guideline on Transitional Measures (DRDLR, 2015)
	Development Facilitation Act of	These legislation have allowed for a range of plans and investment instruments to be put in place to guide

Issue	National policy, plans and legislation	Relevance to shale gas exploration and production and comments on the existing regulatory framework
	1996 and Intergovernmental Relations Framework Act of 2005, NEMA: EIA Regulations, 2014	development and bring about more effective intergovernmental and spatial alignment within the planning system
	Spatial and integrated development planning and governance instruments, NEMA: EIA Regulations, 2014	Integrated and strategic national, local and regional plans are developed for every local and district municipality in the study area, and the Provincial Growth and Development Strategies and equivalent plans within the Western Cape, Eastern Cape and Northern Cape Provinces. Integrated Spatial Development Frameworks (SDFs) guide spatial development within national, provincial, regional, local and precinct scales. While plans are in place for all three provinces as well as relevant district and local municipalities, most of the local and district plans require an update to ensure that they can fulfil the functions and purposes as set out by recent legal developments and regulations. Integrated provincial and municipal sector plans include integrated housing plans, integrated transportation plans and integrated disaster management plans. Integrated investment frameworks i.e. Integrated Infrastructure Investment Framework (provincial and municipal), Capital Investment Framework (municipal) and spatially targeted budgeting instruments were introduced by National Treasury. Land use management schemes which are largely in place for towns, and in most cases require support to develop for the full extent of the municipal area, need support to ensure alignment with SDFs and EMFs and support with the preparation of relevant by-laws to guide development. In the Western Cape, the Laingsburg, Prince Albert and Beaufort West Local Municipalities (amongst others) have all adopted municipal by-laws enabling LUPA.

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3. ACTIVITIES ASSOCIATED WITH EXPLORATION AND PRODUCTION

3.1 Typical Shale Gas Project Life Cycle

Mining projects are typically divided into three distinct stages: Exploration, production and decommissioning. The typical shale gas project assumes five stages: Exploration, appraisal, development, production and decommissioning. The first two stages of a shale gas project (i.e. exploration and appraisal) lead to a decision on "possible exit" by the applicant based on the economic feasibility, where investment choices are made about whether or not to proceed to the next stage or not. These decisions are informed by technical and economic criteria, among other factors.

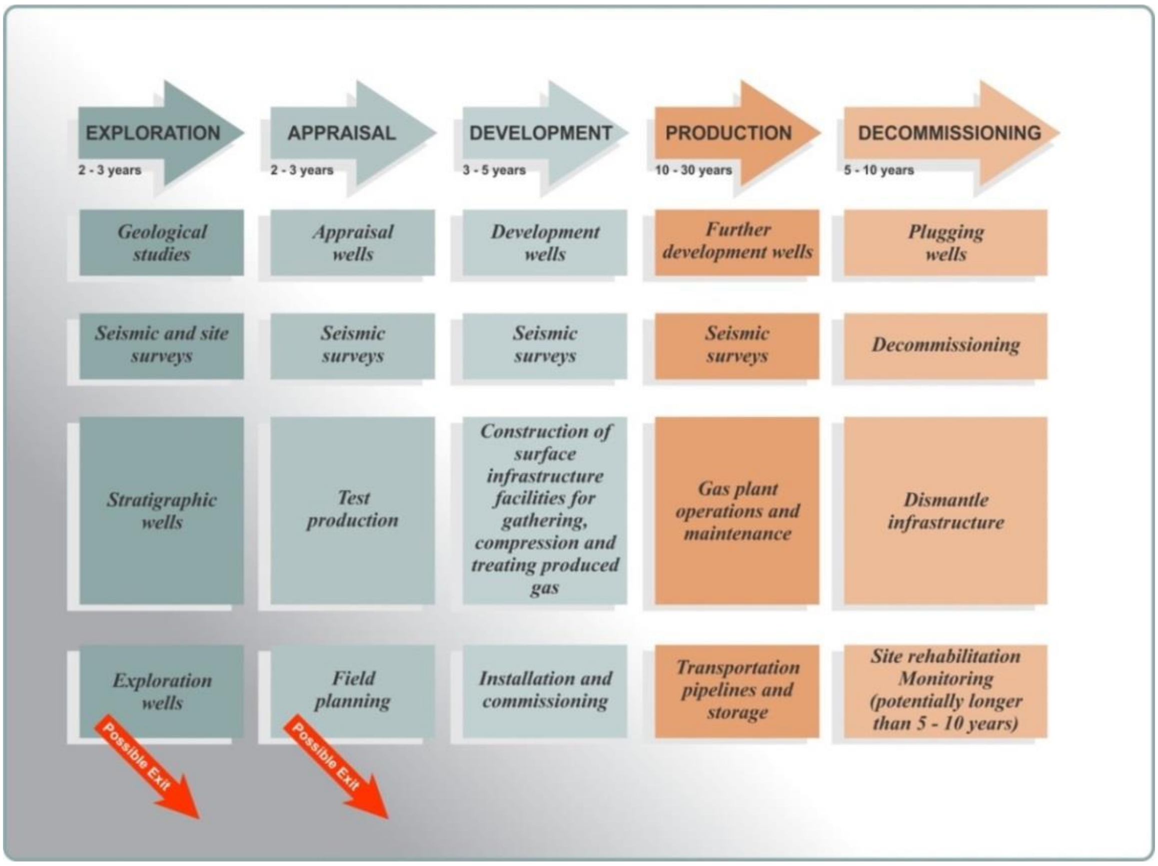

Figure 3–1: Typical life cycle of a shale gas project. The indicative timelines are associated with shale gas exploration and production activities characteristic of the USA and do not consider the geological complexity of the Karoo Basin nor the timing associated with the regulatory and baseline monitoring requirements that would be required in the South African context.

The foremost priority for South Africa is the accurate determination of the quantity of potentially recoverable shale gas and the protection of the resources which sustain the Central Karoo. The former can only be achieved through modern exploration. Based on the Scientific Assessment and in concurrence with ASSAf (2016), we recommend that the government assess the option of dividing exploration licencing into two distinct phases (Phase I "Exploration" and Phase II "Appraisal"), linked by continuous environmental monitoring and adaptive management. In this way, exploration is detached from production via continuous environmental impact assessments that can account for the environmental and operational baseline data obtained during Phase I. Considering this recommendation, the typical stages of traditional mining projects, relative to the typical shale gas development project lifecycle are provided in Table 3-1 which proposes two phases (Phase I "Exploration" and Phase II "Appraisal") prior to production, separated by different permitting procedures. Table 3-1 also provides the timing of the stages and the nature of activities associated with each of the stages.

Table 3–1: The typical stages of a mining project in comparison to a shale gas exploration and production project with suggested regulatory phasing, timing and the nature of activities. Note that the drilling of horizontal wells and hydraulic fracturing mark the beginning of "Appraisal".

Typical stages of a mining project	**Exploration**		**Production**		**Decommissioning**
Typical shale gas project	Exploration	Appraisal	Development	Production	Decommissioning
Suggested regulatory phasing	Phase I	Phase II	Small Gas 5 tcf	Big Gas 20 tcf	Decommissioning
Timeframe typical of projects in the U.S	3-5 years	3-5 years	10 Years	10 years	10 years (+ legacy monitoring)
Regulatory checks	EIA for Phase I and commencement of baseline monitoring for Phase II	Review of exploration data from Phase I, review and consolidation of baseline data for Phase II, EIA for Phase II, ongoing monitoring	EIA for limited production wellfield, baseline monitoring, ongoing monitoring	For > 50 wellpads, EIA for large-scale production wellfields (in the region of 400 wellpads), baseline monitoring, ongoing monitoring	EIA for decommissioning, continued monitoring according to closure EMPr requirements
Nature of activities	2-D seismics	3-D seismics	3-D seismics	3-D seismics	Gas flow suspension
	3-D seismics	Vertical wells	Vertical wells	Vertical wells	Well closure
	Vertical wells	Horizontal wells	Horizontal wells	Horizontal wells	Well plugging
	Roads	Hydraulic fracturing	Hydraulic fracturing	Hydraulic fracturing	Site clear up
	Trucks	Trucks	Roads	Roads	Production infrastructure removed
	Water management	Water management	Trucks	Trucks	Rehabilitation

<table>
<tr><th>Typical stages of a mining project</th><th colspan="2">Exploration</th><th colspan="2">Production</th><th>Decommissioning</th></tr>
<tr><td rowspan="8"></td><td rowspan="8">Waste management</td><td>Waste management</td><td>Water management</td><td>Water management</td><td rowspan="8"></td></tr>
<tr><td rowspan="7">Flaring</td><td>Waste management</td><td>Waste management</td></tr>
<tr><td>Flaring</td><td>Flaring</td></tr>
<tr><td rowspan="5">Gas compressors</td><td>Gas compressors</td></tr>
<tr><td>Gas2Power plants</td></tr>
<tr><td>Powerlines</td></tr>
<tr><td>Pipelines</td></tr>
<tr><td>Water treatment facilities</td></tr>
</table>

3.2 Exploration and Appraisal Activities

3.2.1 Phase I "Exploration"

During Phase I Exploration, the subsurface distribution of gas-shales and location of 'sweetspots' would be determined to establish with greater accuracy the total potential recoverable shale gas using seismic surveys and the drilling of stratigraphic wells. The sections which follow provide a summary of the key activities associated with Phase I Exploration.

3.2.1.1 <u>Seismic Surveys</u>

Seismic surveys involve mapping and imaging the sub-surface geological structures. They are typically conducted in a phased manner during exploration and also in stages during development of gas fields for production. Regional seismic surveys, usually comprising two-dimensional (2-D) seismic acquisitions, are normally conducted during initial exploration campaigns with the aim of furthering understanding of the sub-surface geological structure and identifying prospective zones for the next phases of exploration. More sophisticated three-dimensional (3-D) seismic surveys are typically commissioned during subsequent stages of exploration and/or production planning. The intensity of the surveys (e.g. density of seismic lines that are surveyed on a per km^2 basis) tends to increase for each subsequent stage of seismic exploration, especially as areas are prioritised for drilling.

A seismic survey is in effect an echo sounding technique. An acoustic pulse is initiated from a surface location, with reflection occurring at the boundaries of rock layers. This results in the seismic pulse traveling upwards as a reflected wave. The sub-surface response is recorded by an array of receivers placed on the land surface. Travel time to the reflectors and the velocity of propagation of the reflected pulse are analysed to develop a picture of the sub-surface geology.

The main approaches that would apply to gathering seismic data would include the shot-point method and the use of vibroseis trucks. The shot-point method of creating shock wave energy is used, amongst other reasons, in areas where the deployment of vibroseis trucks is not an option. The vehicles used for a shot-point seismic programme include a number of truck- or track-mounted drill rigs, a recording truck and several light pickups or stake-bed trucks for transporting crew and light equipment. The drilling rigs create small-diameter holes 3 to 8 m deep. Different shot hole depths are associated with different charge sizes that are used. Drilling water, when needed, is obtained from the nearest licenced source. To avoid contamination potentially attributable to the explosives that are used, water-bearing zones are sealed with gravel that is either poured directly down the hole or is placed down-hole in biodegradable cardboard tubes. A light helicopter is often used to move cabling, data boxes, geophones and other light equipment to workers on the ground.

An explosive charge is placed in the hole, which is back-filled with drill cuttings (the material excavated from the shot hole). Before the charge is detonated, the fill is tamped down to secure the charge. A ground crew is tasked to work through the area and set off the sources in sequence and retrieve equipment such as geophones, markers, etc. Detonations are often triggered (and/or effects measured) using a radio-controlled unit located in a nearby recording truck. Detonations are contained within the hole to force the generated energy downward through the rock strata. As a result, the only sound heard above ground is a dull thud.

Vibrator or 'vibroseis trucks' are mobile seismic sound sources (Figure 3-2) designed to do away with the need to drill shot holes and the complex process of detonating explosives, and to reduce safety and security risks relative to the shot-point method. These advantages are, however, offset by other impacts on the environment (e.g. vehicle passage width, which exceeds that of vehicles used for the shot-point method). The trucks can be equipped with special tyres or tracks for deployment in a range of environments; although terrain can impose limits to their operation.

During operations, the vehicle moves into position and lowers the baseplate to the ground. Seismic vibrators fitted to the trucks produce ground motion that propagates into the sub-surface. The vehicle operator can make the piston and baseplate assembly move up and down at specific frequencies thereby transmitting energy through the baseplate and into the ground. Vibroseis trucks can be employed individually or as a group, often with four or more trucks operating simultaneously. After the prescribed number of sweeps is completed, the baseplates are raised and the vehicles move to the next location, typically a distance of 10-50 m.

Figure 3–2: Seismic vibration (vibroseis) truck

The objective of an initial seismic acquisition programme in the study area would be to contribute to the understanding of the sub-surface geology of the Karoo Basin including its depositional environment, the tectonic activity that it has been subjected to and the presence of igneous intrusions including dykes, sills, breccia pipes and hydrothermal vents. The objective would also be to gauge the presence and distribution of potential shale gas plays. Subsequent seismic surveys would support, minimise or eliminate further exploration, including drilling programmes. Initial seismic operations would likely be completed in the first 3 years following the issuance of ERs. This could be followed by subsequent surveys conducted over a number of years, throughout the development and production cycle[7].

Only a fraction (< 0.0001) of the study area would be impinged upon directly through surveys conducted along quite widely spaced grids (e.g. 10 km spacing for a regional 2-D survey) of seismic lines (< 5 m wide, which is the width of the vehicles that traverse the lines). Exclusion areas would include municipal areas, conservation areas, wetlands and riparian zones, restricted activity zones and topographically complex landscapes, for example, where slopes exceed 10°[8]. There are likely to be other exclusion areas, discussed in Section 6.1.1.1. A closer grid spacing (e.g. 1 km or narrower) would be used for targeted areas, where 3-D surveys are commissioned.

[7] Companies generally complete the majority of spatially extensive seismic work relatively quickly so that drilling options can be determined early in the development process. They usually commission additional concentrated seismic work later when there is need to focus on a specific area/region.
[8] Slopes in excess of 10° would practically be extremely difficult to traverse in the course of seismic operations.

Various towns distributed across the study area would be used to support the seismic survey activities, including offices for project administration, accommodation of personnel, equipment storage and staging areas for equipment destined for deployment in the field and pre-processing and temporary archiving of seismic data. For a proportion of operations, in isolated areas, mobile camps in the immediate vicinity of operations might serve as operational bases for the seismic teams. The key sources of impacts associated with seismic surveys are:

1. Clearing of seismic lines (minimal if wireless technology is used optimally);
2. Vehicle and pedestrian traffic traversing the seismic grid; and
3. Noise emissions.

3.2.1.2 Stratigraphic Wells

Following seismic exploration, establishing the presence and potential yield of hydrocarbon reserves is achieved through drilling stratigraphic wells. The objectives of drilling a vertical stratigraphic well or set of wells ("X-wells" in Figure 3-3) are to:

- Correlate stratigraphic and structural records to seismic interpretations;
- Identify freshwater aquifers, drilling hazards and hydrocarbon-bearing zones;
- Confirm predicted organic-rich shale formation packages that might be anticipated, identify new potential target zones and identify existing fractures;
- If encountered, evaluate the thermal maturity, presence/absence of fractures, gas content, gas saturation (free and adsorbed), gas composition, mineralogy, porosity and permeability of the hydrocarbon-bearing shale unit/s (using cores, electric logs and other means).

Drilling is initiated by lowering a drill bit through a conductor pipe installed at the surface and by rotating the drill string to which the bit is attached. The rotating bit crushes the rock into small particles or 'cuttings'. Drilling fluid, often termed 'drilling mud', is used to perform a number of functions including providing hole stability, the entrainment and transport of drill cuttings to surface and circulating drill gas out of the hole. Drilling fluid is prepared through the addition of various compounds and chemicals to water that is supplied to site.

Cement is pumped down inside the casing and forced out of the bottom and up into the annular space between the casing and the borehole wall until there is a "show" at the surface. The cemented casing then undergoes a mechanical integrity pressure-test to ensure that there is adequate structural integrity at the bottom of the casing or casing shoe. The purpose of the casing is to provide structural support and integrity to the borehole, allow for deep drilling into high pore pressure formations and to isolate water- and hydrocarbon-bearing formations to prevent cross-contamination.

Petro-physical evaluation of the formations penetrated by the well is carried out during the course of drilling operations. Open hole wireline logging involves lowering diagnostic tools on an electric cable into the uncased hole. The ultimate goal is to determine the fluid/gas content in the rock along with the quality and quantity of a hydrocarbon reservoir. This data is key to determining if further well evaluation is necessary and to inform future exploration, development and production decisions and activities.

3.2.2 Phase II "Appraisal"

Hydraulic fracturing marks the start of Phase II, before and during which a new EIA should be conducted, inclusive of 3-D analyses based on continuous down the- hole data acquired during the drilling of vertical wells. No hydraulic fracturing should be permitted within 1 500 m of the surface until hydraulic fracturing and casing technologies improve to the point where it can be clearly demonstrated that such technologies are able to prevent groundwater pollution caused by rock and technology failure. Limited multi-directional hydraulic fracturing at selected wellpads will be needed during Phase II to evaluate the retrieval success of the shale gas and how efficiently the gas can be extracted to determine its economic return, and its status as gas reserve (ASSAf, 2016).

3.2.2.1 Appraisal Wells

If the results of tests from stratigraphic wells invite further investigation and following a new EIA permitting process for Phase II, additional appraisal wells will be drilled nearby. These wells are planned to yield increasingly detailed information on the properties of the target formation. An appraisal well ("Y-Well") is created in a similar way as a stratigraphic well with vertical ("X-well") and, typically, horizontal sections. In order to drill horizontally, directional drilling methods are used. In the region of 10 to 15 of horizontal laterals can be drilled from the same vertical wellbore.

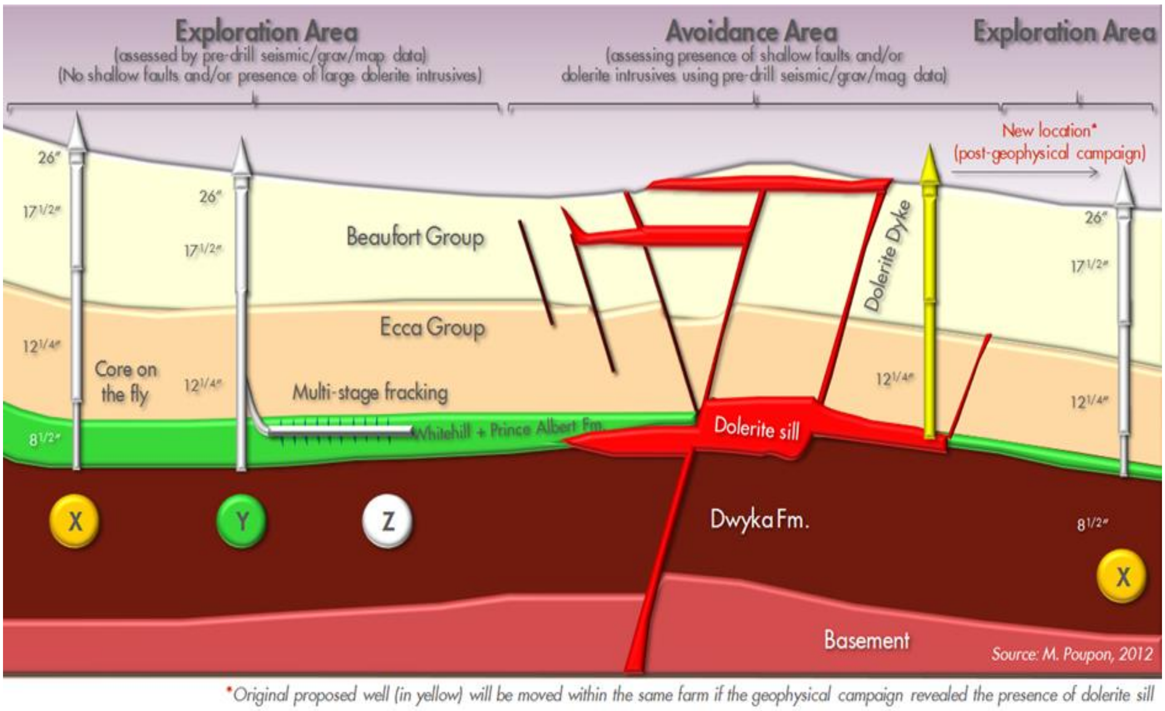

Figure 3–3: A stratigraphic well (indicated by "X-well") is a vertical well drilled to obtain geological core samples, ideally from the target formation. An appraisal well is a vertical well (indicated as "Y-well") that is drilled some distance away from the stratigraphic-well so that the characteristics of the formation can be further evaluated and delineated. If the evaluation is positive, a side track may be drilled through the wall of an appraisal well on a curved trajectory, ending with a horizontal section of well bore within the target formation. The horizontal well (indicated as "Z-well") is subjected to hydraulic fracturing.

3.2.2.1.1 Hydraulic Fracturing

On completion of drilling, the rig is removed and the site is prepared for hydraulic fracturing. Well perforating guns, employing directional explosive charges, are lowered into the cased wellbore by tubing or wireline. Once the guns reach the predetermined depths along the section(s) of the target formation they are discharged to perforate the casing (Figure 3-4).

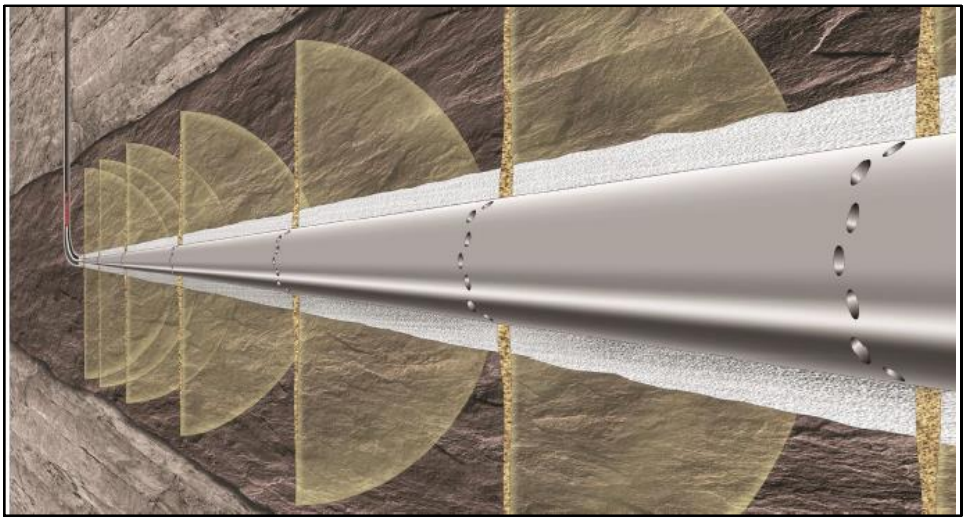

Figure 3–4: Schematic illustration of a horizontal wellbore with perforations through which fluid is transmitted into the surrounding shale (Burns et al., 2016).

Detonation of the charges punches holes through the well casing and surrounding cement layer into the reservoir rock in the sections of the well bore where gas is expected to be extracted. The perforating guns are then pulled out of the hole to surface where the pumping unit and other equipment are attached to the wellhead; pumping of hydraulic fracturing fluid to increase the hydraulic pressure then begins.

3.2.2.1.2 Hydraulic Fracturing Fluid

The hydraulic fracturing fluid is injected down the wellbore at a pressure of between 400 and 600 bar (40 – 60 MPa). The fluid migrates through the perforations in the well casing and cement into the reservoir rock to create fractures that are typically 2-7 mm in width, close to the wellbore. The fractures become narrower as they extend outwards for distances of up to about 300 m from the wellbore. The hydraulic fracturing fluid is made up of more than 90% water, with the balance comprising proppant (sized particles, either ceramic beads or high silica sand) and other additives. The proppant that is pumped into the fractures holds them open when the hydraulic pumping pressure is reduced. Gas that is released in the process flows out of the shale to the surface via the wellbore. In terms of the MPRDA technical regulations, an Exploration or Production Right holder required to disclose the fluids, chemicals and other additives used in hydraulic fracturing to the competent authority (MPRDA Regulations for Petroleum Exploration and Production, 2015: Chapter 9, Subsection 113). The use of Material Safety Data Sheets is a common means of communicating this information.

3.2.2.1.3 Proppant

Proppant is high specification aggregate, usually sand, which is treated and coated with a resin. It can also be produced as ceramic nodules. Sand in the southern Karoo is largely unsuitable for use as proppant because of the high clay content of the local soils, which are derived from shales and mudstones. For this reason, it unlikely that proppant would be sourced locally within the study area for shale gas extraction operations. For the scenario considered here, entailing exploration operations only, it can be assumed that proppant would be imported to South Africa and transported to the sites of hydraulic fracturing by road or rail. For the Small- and Big Gas scenarios outlined in, importation of proppant at the scales required would be uneconomical and it is likely that the product would be manufactured at a location where suitable aggregate can be sourced, for example where sandstones define the local geology, and transported to the study area.

3.2.2.1.4 Water Requirements

According to the industry, the volume of water used to effect hydraulic fracturing within the study area, for example, within a well comprising a 3 000 m vertical and 1 000 m horizontal section would amount to about 6 000 m^3. Water requirements for hydraulic fracturing can be much higher, with some reporting that the volumes used in wells drilled within the US Marcellus formation, with a 1 500 m vertical section and a 980 m horizontal section, ranging from 7 700 to 38 000 m^3. Vertical shale gas wells typically use approximately 2 000 m^3 of water, whereas horizontal wells typically use between 10 000 and 25 000 m^3 per well. Water requirements reported in the literature for hydraulic fracturing of individual wells range from 10 000 to 30 000 m^3. The volume of water used depends, amongst other factors, on well characteristics (depth, hole sizes and conditions, horizontal lateral length) and the number of fracturing stages within the well. Although oil and gas developers aim to reduce freshwater consumption through water re-use and use of waste water from other sources, in current practice freshwater still comprises 80-90% of the water used for hydraulic fracturing.

> Box 2: Water supply alternatives for shale gas exploration and production
>
> Supply options could include:
>
> - *Local non potable groundwater in the proximity of wellpads*
> - *Groundwater/surface water outside the shale gas licence areas.*
> - *Desalinated seawater from the coast, trucked, piped or transported via freight rail.*
> - *'Grey' water or waste water (e.g. treated Acid Mine Drainage) sourced either within or outside the shale gas licence areas.*

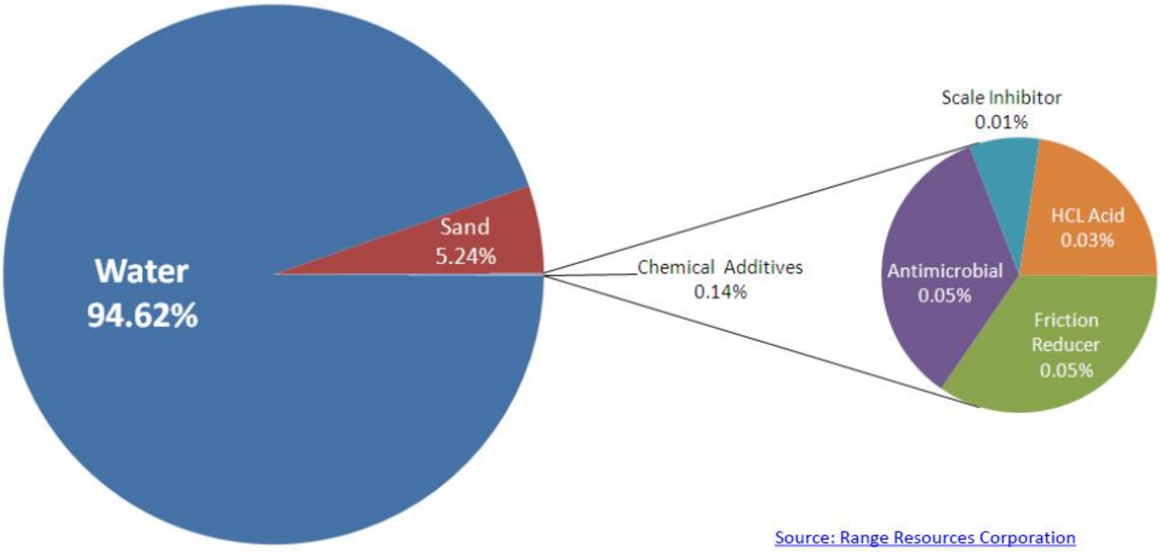

Figure 3–5: Example of the relative composition (% contribution to total volume) of compounds comprising a typical batch of hydraulic fracturing fluid (Burns et al., 2016)

Phase II includes planning, site preparation, drilling, hydraulic fracturing and flow-testing would proceed for each exploration and appraisal drilling campaign and involves the following key activities:

- Clearing of wellpad areas and the crew accommodation sites.
- Construction of new access roads to wellpads and temporary infrastructure.
- Road transport to the wellpad and ancillary equipment.
- Sourcing and supply of potable water for domestic use.
- Sourcing and supply of process water to prepare drilling mud and for hydraulic fracturing.
- Process water treatment for recovery (re-use as drilling and hydraulic fracturing fluid) and disposal of process waste (e.g. sludge recovered from flowback) and produced water.
- Drill cuttings disposal.
- Domestic and solid waste management.
- Hazardous waste management (additional to waste process water and solids).
- Flaring of gas during drilling and well-flow testing.
- Noise and light emissions.
- Decommissioning, including removal of equipment and infrastructure from site.
- Employment, personnel logistics, and labour negotiations.
- Management of safety, security and medical/health.

3.2.3 Development and Production

Following hydraulic fracturing, surface equipment is installed on the wellpad in order to allow it to be 'produced'. In the course of initial well-testing, the produced gas may be flared. Well testing is normally conducted for 30 to 60 days, with flaring undertaken for 30 days or less. Development and production would proceed based on the results of the most successful of appraisal campaigns that are undertaken. Activities associated with development and production would be contained within production blocks measuring in the region of 30 x 30 km.

It is likely that a significant proportion of activities undertaken to support production would be initiated immediately following exploration and appraisal to accelerate monetisation of the gas to offset these costs. The construction of production infrastructure (e.g. the initial suite of production wells, the associated gathering pipeline network, gas processing stations) would be concluded in a period of around 10 years. Ongoing drilling, completion and testing of production wells and related infrastructure would continue for much of the duration of production, extending over several decades. New wellpads would be developed on a regular basis, whilst existing wellpads would remain operational for several years as additional horizontal wells and/or horizontal laterals are drilled and hydraulic fracturing is undertaken to maintain a supply of gas at the required level.

Production from shale gas wells typically declines rapidly after start-up. Calculations are made of the estimated recovery per well, which then determine the number and average spacing of the wells (i.e. number of wells per unit area) and the rate at which they are established. New wells are drilled constantly in order to maintain a particular level of gas production.

Development would continue with the commissioning of supplementary seismic surveys across the production block. In parallel with or immediately following this, access roads and new wellpads would be established to enable drilling of a series of wells aimed at both resource delineation and production. Importantly, a supply of process water would be sourced and, most likely, a central treatment facility designed and constructed to treat the water evacuated from the wells (flowback water, including produced water). Water would be recovered for re-use and the waste separated from the flowback for disposal. The activities associated with appraisal are replicated for the production phase, but at different volume and intensity scales depending on the scenario of production, ranging from 5 tcf to 20 tcf of Economically Recoverable shale gas.

3.2.4 Decommissioning

On completion of production, gas-flow is suspended, surface equipment is disconnected and demobilisation proceeds. The decision to either suspend or permanently decommission (plug and abandon) is based largely on test results. Well suspension is affected by closing the valves on the wellhead to prevent product flow to surface; gauges are installed to detect possible changes in pressure that could be indicative of a leak. For final decommissioning, cementing of the well bore is undertaken from the furthest point to surface. This aims to ensure that all hydrocarbon- and water-bearing zones are isolated to prevent cross contamination or communication with shallow aquifers or the surface. The issue of well closure/decommissioning is critical and is implemented in accordance with industry best practice as described, for example, by American Petroleum Institute (2009) (see http://www.api.org/~/media/Files/Policy/Exploration/API_RP_51R.pdf).

If there is full decommissioning, in addition to well plugging, the wellhead and testing and production facilities are removed. Wellpad areas and access roads are rehabilitated to achieve pre-disturbance landform states, with vegetation re-established in accordance with EMPr specifications and relevant prescribed regulations. Baseline environmental studies undertaken in advance of exploration and production provide reference standards to be achieved through rehabilitation. The decommissioned well, along with one or more monitoring wells, are routinely inspected in accordance with prescriptive rules and EMPr commitments to ensure there is no sub-surface communication and subsequent groundwater contamination. In this regard, the period of operator liability extends as long as might be necessary (potentially several decades) in order to achieve compliance.

4. THE CENTRAL KAROO

4.1 The Sensitivity of the Receiving Environment

The Central Karoo is a special and even 'magical' place which has captured the hearts and minds of many people from around the world. The region includes relatively high levels of biodiversity (Holness et al., 2016), unique heritage features (Orton et al., 2016) and scenic hotspots (Oberholzer et al., 2016) which make it an attractive region to a growing niche tourism market (Toerien et al., 2016). The peace and tranquillity ('The Nothingness' or 'Die Niks') of the Central Karoo are especially important to tourists and their experience of the region (Toerien et al., 2016; Seeliger et al., 2016).

On the other hand, economic growth and adaptability to economic change varies across the Central Karoo. The region has high levels of poverty, inequality and limited opportunity for local inhabitants. Poverty rates in the Central Karoo are in the region of 30 – 60%, with high levels of inequality. Most of the Human Development Indices range between 0.5 and 0.6, which is fairly consistent with the national average for rural areas in South Africa. Dependency ratios (in other words, the non-working age population dependent on working age population) ranges from around 45 – 82% (Atkinson et al., 2016).

The Central Karoo is a semi-desert environment, with a mean annual precipitation that ranges from 100 mm in the west to 400 mm in the east. This assigns a premium value to freshwater resources that are critical, for example, for sustaining local communities and their livelihoods. Water availability in the Central Karoo is severely constrained. With surface water availability generally low, Central Karoo landowners are mainly reliant on groundwater resources for domestic, stock water supplies and the sustenance of local economic activity like agriculture (Hobbs et al., 2016).

The majority of the land in the Central Karoo is occupied by relatively large commercial farms used for domestic livestock grazing, with smaller areas used for game farming, communal farming or biodiversity protection. Agriculture in the western areas focuses on small livestock for meat and wool production, with a shift evident toward agri-processing and the use of crop types more resistant to lower rainfall (Burns et al., 2016).

The region is not a static system - its social, economic and biophysical characteristics are changing. For example, there are notable trends in human migration into and across the region (Atkinson et al., 2016), there are novel economic developments materialising, such renewable energy farms (van Zyl et al., 2016) and the SKA (Tiplady et al. 2016), there are increased tourism initiatives and land-use changes from traditional agriculture to game farming and eco-tourism enterprises (Toerien et al, 2016). Global trends, such as climate change, will also have impact on the Central Karoo as temperatures are expected to increase, in the region of 1-2° C, with a significantly higher number of very hot days likely to be experienced (temperatures are exceeding 35° Celsius) (Burns et al., 2016).

Based on a number of the special features of the Central Karoo, spatial sensitivity maps were developed for:

1.) Local community exposure to diminished air quality mapped around existing towns and populated areas which does not account for isolated populations, farms, homesteads etc. which may be encountered in the region (see Figure 4-1)
2.) Local community exposure to increased seismic activity (M>5) mapped around existing towns and populated areas which does not account for isolated populations, farms, homesteads etc. which may be encountered in the region (see Figure 4-2)
3.) Groundwater and surface water resources based on water supply wells and boreholes, distance to shallow groundwater, springs, watercourses, recharges zones, dykes and other geological features (see Figure 4-3)
4.) Biodiversity and ecology based on the outcomes of the Bioblitz, see Appendix 2, considering habitat for rare and endemic species, features that perform critical ecological functions such as wetlands, springs, Critical Biodiversity Areas, Protected Areas etc. (see Figure 4-4)
5.) Agriculture based on metrics calculated at a quaternary catchment scale for land capability, grazing land, surface water, rivers, dams, irrigated land and cultivated fields (see Figure 4-5)
6.) Tourism based on the number of enterprises in important town and scenic routes (see Figure 4-6)
7.) Visual, aesthetic and scenic resources based on topographic features, surface water, cultural landscapes, Protected Areas, human settlements, major roads, sites of optical and radio astronomy (see Figure 4-7)
8.) Heritage features based on archaeology (including graves) and palaeontological resources (see Figure 4-8)
9.) Electromagnetic and optical interference with the development of the SKA and existing Sutherland Large Telescope (SALT) (see Figure 4-9)

4.2 Spatial Sensitivity Analysis

Table 4–1: Rational and sensitivity class criteria for spatial sensitivity per topic

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
AIR QUALITY: LOCAL COMMUNITY EXPOSURE	
Proximity to towns / highly populated areas Protect against exposure to harmful air pollutants.	
Within 5 km	**Very high**
Within 10 km	**High**
Within 15 km	**Medium**
Beyond 15 km	**Low**
EARTHQUAKES: LOCAL COMMUNITY EXPOSURE	
Proximity to towns / highly populated areas Protect against loss of life and structural damage to buildings in towns densely populated and built-up environments.	
Within 10 km	**Very high**
Within 20 km	**High**
Within 30 km	**Medium**
Beyond 30 km	**Low**
GROUND- AND SURFACE WATER RESOURCES	
Water supply wells Protect current known water supply wells against contamination and/or over-abstraction, especially in areas dependent on groundwater and in view of climate variability and associated droughts.	**Very high**
Groundwater < 10 m Very susceptible to contamination due to shorter distance to saturated zone / water table.	**Very high**
Thermal springs Thermal springs usually closely associated with deeper geological structures: faults, folds, dykes.	**Very high**
Cold springs Possible vertical / horizontal connectivity between surface water and groundwater resources. Preferential pathways for contamination via associated	**Very high**

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
geological structures.	
Watercourses, wetlands, dry river beds and high flood risk areas High sensitivity in arid environments with high climatic variability, important / sole water supply in some areas.	**Very high**
Fold axis Possible preferential pathway via associated fracture zones.	**High**
Artesian boreholes Possible connection between deep and shallow aquifers and preferential pathways for contamination, apply precautionary principle.	**High**
Fault / shear zone Possible preferential pathway via associated fracture zones.	**High**
Undifferentiated geophysical anomaly Possible preferential pathway. Real extent of features unknown, therefore apply precautionary principle.	**High**
Artificial recharge zone Protect for possible future storage, groundwater storage areas will become more important in future in South Africa.	**High**
Kimberlite pipe Possible preferential pathway for contamination movement.	**Medium**
Dolerite dyke Possible preferential pathway for contamination movement.	**Medium**
Dolerite sills Possible preferential pathway for contamination movement.	**Medium**
Diatreme Represent possible preferential pathway for contamination movement.	**Medium**
BIODIVERSITY AND ECOLOGY	
Ecological and Biodiversity Importance and Sensitivity Class 1 Areas that contain extremely sensitive features, such as key habitat for rare, endemic or threatened species, or features that perform critical ecological functions. These sites are irreplaceable (i.e. no ecologically equivalent sites exist and there is no exchangeability between sites). • Wetlands, springs (including intact buffers) • Specific sites important for Threatened species and for range-restricted endemic or near-endemic species (fauna and flora) • High priority habitat for Threatened species or for range-restricted endemic or near-endemic species	**Very high**
Ecological and Biodiversity Importance and Sensitivity Class 2 Areas that contain highly sensitive features and/or features which are important for achieving targets for representing biodiversity and/or maintaining ecological processes. These areas represent the optimal configuration for securing the species, ecosystems and ecological processes of the Karoo.	**High**

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
• Rivers and associated habitats (including intact buffers) • Special habitats e.g. rocky outcrops, escarpment areas, riparian vegetation • Sites selected through a systematic biodiversity planning process to meet targets for terrestrial or aquatic ecosystems in an efficient configuration that aligns with other biodiversity features and priority areas Incorporates all FEPAs, both rivers and wetlands • Includes CBA 1 from relevant provincial biodiversity plans • Buffers around protected areas (intact areas) • United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve	
Ecological and Biodiversity Importance and Sensitivity Class 3 Other natural or semi-natural areas that do not contain currently known sensitive or important features, and are not required for meeting targets for representing biodiversity or maintaining ecological processes. • Severely modified areas that retain some importance for supporting ecological processes (e.g. agricultural fields within buffers around rivers and wetlands) • Natural habitat which is not irreplaceable and has not been selected as part of the optimal sites	**Medium**
Ecological and Biodiversity Importance and Sensitivity Class 4 Areas in which there is no remaining natural habitat, e.g. urban areas, larger scale highly degraded areas, large arable intensively farmed lands • Areas that have been severely or irreversibly modified and that are not important for supporting provision of ecological processes	**Low**
AGRICULTURE (Features equally weighted to determine sensitivity at quaternary catchment scale)	
Soil, Climate and Terrain Protect areas with high land capability for possible agricultural production.	
Land capability evaluation classes 8 - 10	**Very high**
Land capability evaluation classes 6 - 7	**High**
Land capability evaluation classes 3 - 5	**Medium**
Land capability evaluation classes 1 - 2	**Low**
Grazing Land Protect areas with good grazing potential	
2.5 – 10 Ha/LSU	**Very High**
11 – 30 Ha/LSU	**High**
31 – 60 Ha/LSU	**Medium**

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
61 – 140 Ha/LSU	Low
Surface water (Rivers and dams) Protect water resources for agricultural use	
Rivers	
>201 km per quaternary catchment	Very High
101 – 200 km per quaternary catchment	High
51 – 100 km per quaternary catchment	Medium
0 – 50 km per quaternary catchment	Low
Dams	
14 – 29% per quaternary catchment	Very High
2 – 4% per quaternary catchment	High
1 - 1.9% per quaternary catchment	Medium
<1% per quaternary catchment	Low
Irrigated land Protect irrigated land	
803 – 4077 ha per quaternary catchment	Very High
154 – 802 ha per quaternary catchment	High
25 – 153 ha per quaternary catchment	Medium
0 – 24 ha per quaternary catchment	Low
Cultivated Fields Protect cultivated fields	
1075 – 4077 ha per quaternary catchment	Very High
1074 – 272 ha per quaternary catchment	High
271 – 58 ha per quaternary catchment	Medium

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
0 – 57 ha per quaternary catchment	Low
TOURISM	
Mountain passes and 'poorts' Protect integrity of tourism infrastructure and experiences	Very high
Tourism routes Protect integrity of tourism infrastructure and experiences	
N9	Very high
N1 and N10	High
Tourism Towns Protect integrity of tourism infrastructure and experiences	
Graaff-Reinet Nieu-Bethesda, Prince Albert, Sutherland	Very high
Beaufort-West, Carnarvon, Colesberg, Cradock, Jansenville, Laingsburg, Loxton, Merweville, Middelburg, Murraysburg, Pearston, Queenstown, Richmond, Somerset East, Victoria West, Williston,	High
Aberdeen, Burgersdorp, Fort Beaufort, Fraserburg, Hofmeyr, Klipplaat, Lady Frere, Noupoort, Steynsburg	Medium
VISUAL, AESTHETIC AND SCENIC RESOURCES	
Topographic features Relates to significant landscape features of scenic or natural heritage value.	
Actual feature / receptor	Very high
Within 500 m	High
Within 1 km	Medium
Beyond 1 km	Low
Major rivers, water bodies (vleis, wetlands, dams, pans) Scenic and recreational value.	
Actual feature / receptor	Very high
Within 500 m	High
Within 1 km	Medium

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
Beyond 1 km	Low
Cultural landscapes (incl. cultivated lands) Rural scenic value and possible historical or heritage value.	
Actual feature / receptor	Very high
Within 500 m	High
Within 1 km	Medium
Beyond 1 km	Low
National Parks High wilderness and scenic value, including dark skies at night. Sensitive tourist receptors.	
Actual feature / receptor	Very high
Within 5 km	High
Within 7.5 km or viewshed	Medium
Beyond 7.5 km	Low
Nature Reserves (Provincial and Municipal reserves) Wilderness and scenic value, including dark skies at night. Sensitive visitor receptors.	
Actual feature / receptor	Very high
Within 5 km	High
Within 7.5 km or viewshed	Medium
Beyond 7.5 km	Low
Private reserves (incl. game farms, tourist accommodation) Wilderness and scenic value. Sensitive visitor receptors. Important for local tourism industry.	
Actual feature / receptor	Very high
Within 2.5 km	High
Within 5 km or viewshed	Medium
Beyond 5 km	Low

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
Human settlements (towns and villages, excl. farmsteads, rural kraals) Visually sensitive residents and visitors. Relates to property values. Subject to Integrated Development Plans, zoning schemes and bylaws.	
Actual feature / receptor	**Very high**
Within 5 km	**High**
Within 7.5 km or viewshed	**Medium**
Beyond 7.5 km	**Low**
National and Provincial roads (major arterial routes) Visually sensitive commuters, residents and visitors within the view corridor.	
Actual feature / receptor	**Very high**
Within 1 km	**High**
Within 2.5 km	**Medium**
Beyond 2.5 km	**Low**
Scenic routes, mountain passes and 'poorts' Visually sensitive visitors and tourists within the view corridor. Possible historical or heritage value.	
Actual feature / receptor	**Very high**
Within 2.5 km	**High**
Within 5 km or viewshed	**Medium**
Beyond 5 km	**Low**
Passenger rail lines (commuter and tourist routes) Visually sensitive commuters and tourists within the view corridor.	
Actual feature / receptor	**Very high**
Within 1 km	**High**
Within 2.5 km	**Medium**
Beyond 2.5 km	**Low**
SALT	

TOPIC, RATIONALE AND CRITERIA	SENSITIVITY
The Sutherland Core Astronomy Advantage Area. All land in the Northern Cape within an annulus of inner radius 3 km and outer radius 75 km centered on the dome of the SALT	Very high
HERITAGE	
Archaeology (including graves) Protect archaeological heritage resources.	
Uplands: Variable topography, rock outcrops, river valleys, cliffs and high lying interior plateaus with dolerite dykes and pans	High
Low foothills: Base of the escarpment where it is not mountainous yet and it's also not flat plains	Medium
Plains: Very flat land that stretches with little interruption and no topography	Low
Palaeontology Protect palaeontological heritage resources.	
High likelihood of fossiliferous geological units based on the South African Heritage Resources Information System (SAHRIS)	High
Medium likelihood of fossiliferous geological units SAHRIS	Medium
Low likelihood of fossiliferous geological units SAHRIS	Low
ELECTROMAGNETIC INTERFERENCE	
Separation distances from SKA antennae Protect radio astronomy from interference	
22 km	Very high
29 km	High
33 km	Medium
38 km	Low

4.2.1 Sensitivity of inhabitants to diminished air quality

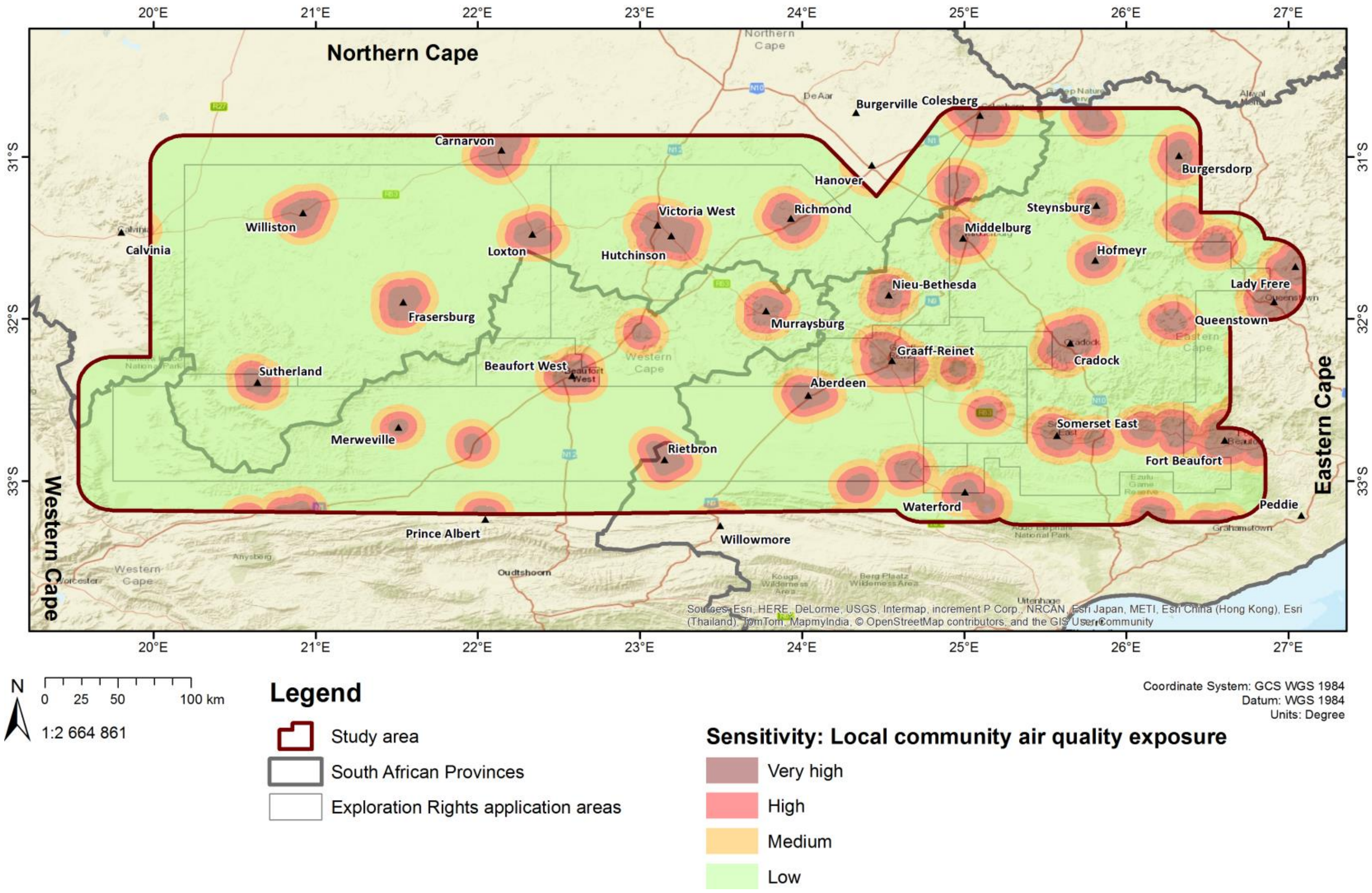

Figure 4–1: The sensitivity of local community exposure to diminished air quality mapped around existing towns and populated areas know at this GIS scale. The map does not account for isolated and rural populations on farms, homesteads which will be encountered in the Central Karoo and will have to be assessed on a case by case basis.

4.2.2 *Sensitivity of inhabitants to earthquakes*

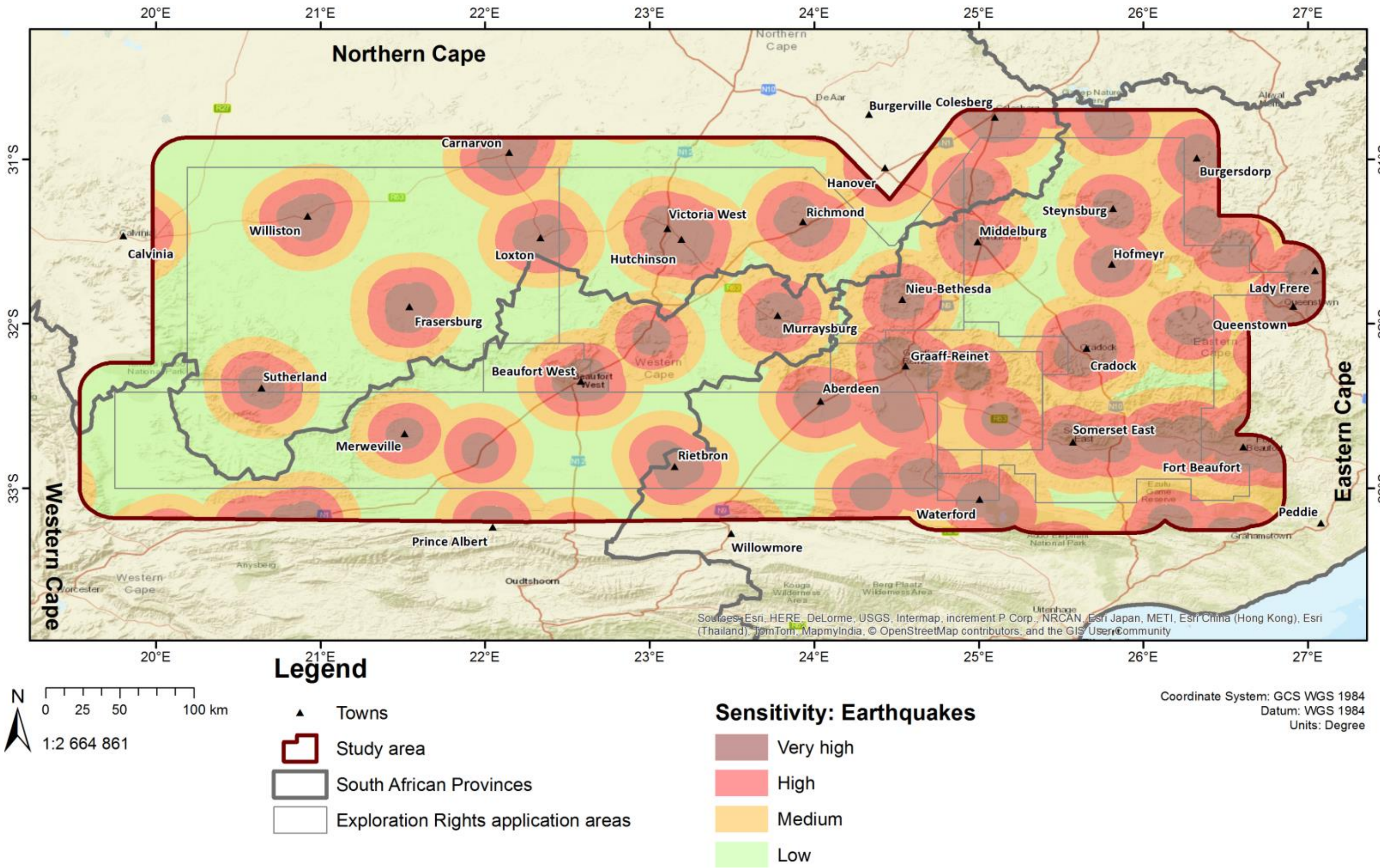

Figure 4–2: Local community exposure to increased seismic activity (M>5) mapped around existing towns and populated areas known at this scale. The map does not account for isolated and rural populations on farms, homesteads which will be encountered in the Central Karoo and will have to be assessed on a case by case basis.

4.2.3 Groundwater and Surface Water

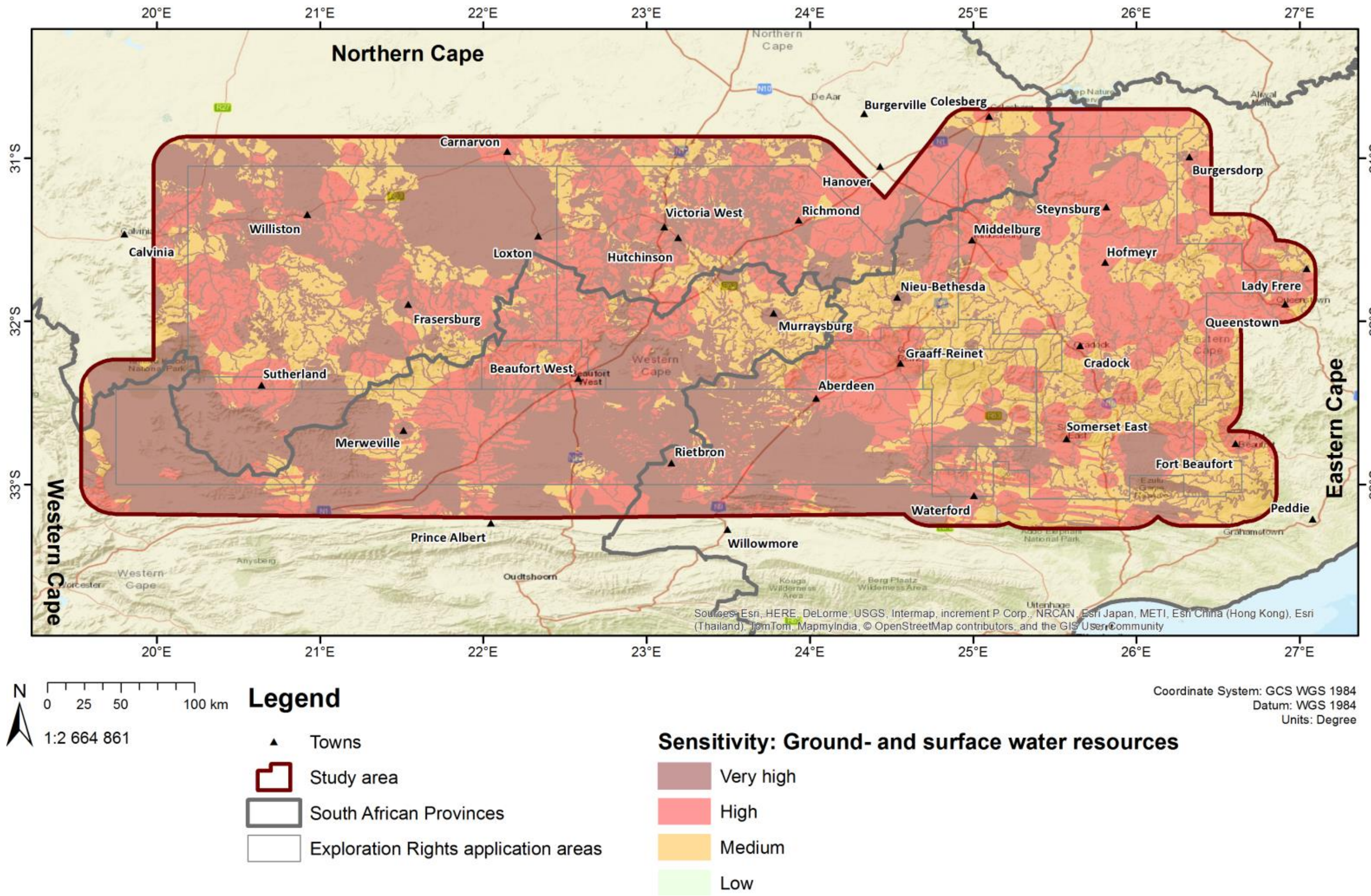

Figure 4–3: Groundwater and surface water resources based on water supply wells and boreholes, distance to shallow groundwater, springs, watercourses, recharges zones, dykes and other geological features.

4.2.4 Biodiversity and ecology

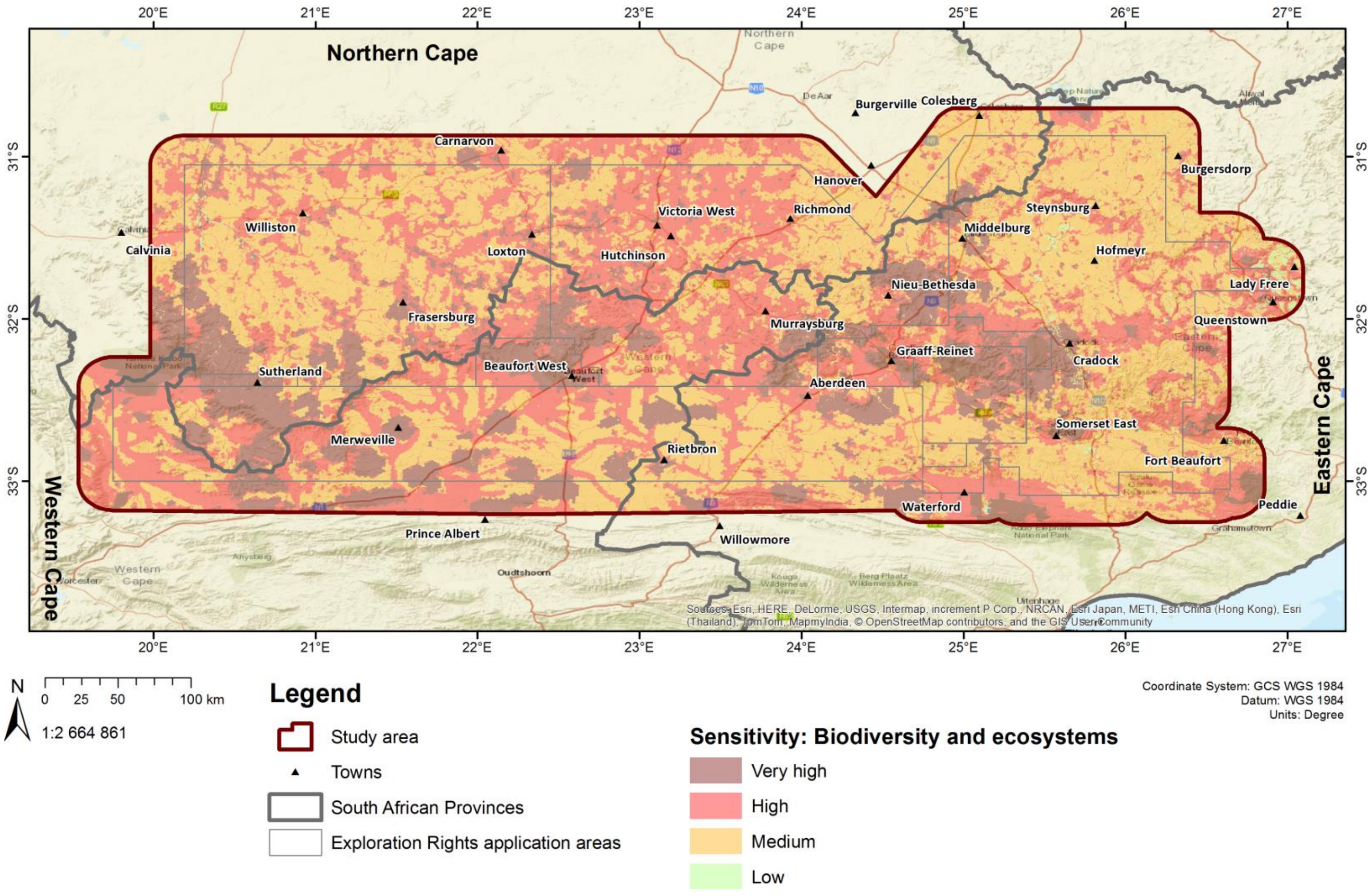

Figure 4–4: Biodiversity and ecology based on the outcomes of the Bioblitz, see Appendix 2, considering habitat for rare and endemic species, features that perform critical ecological functions such as wetlands, springs, Critical Biodiversity Areas and Protected Areas.

4.2.5 Agriculture

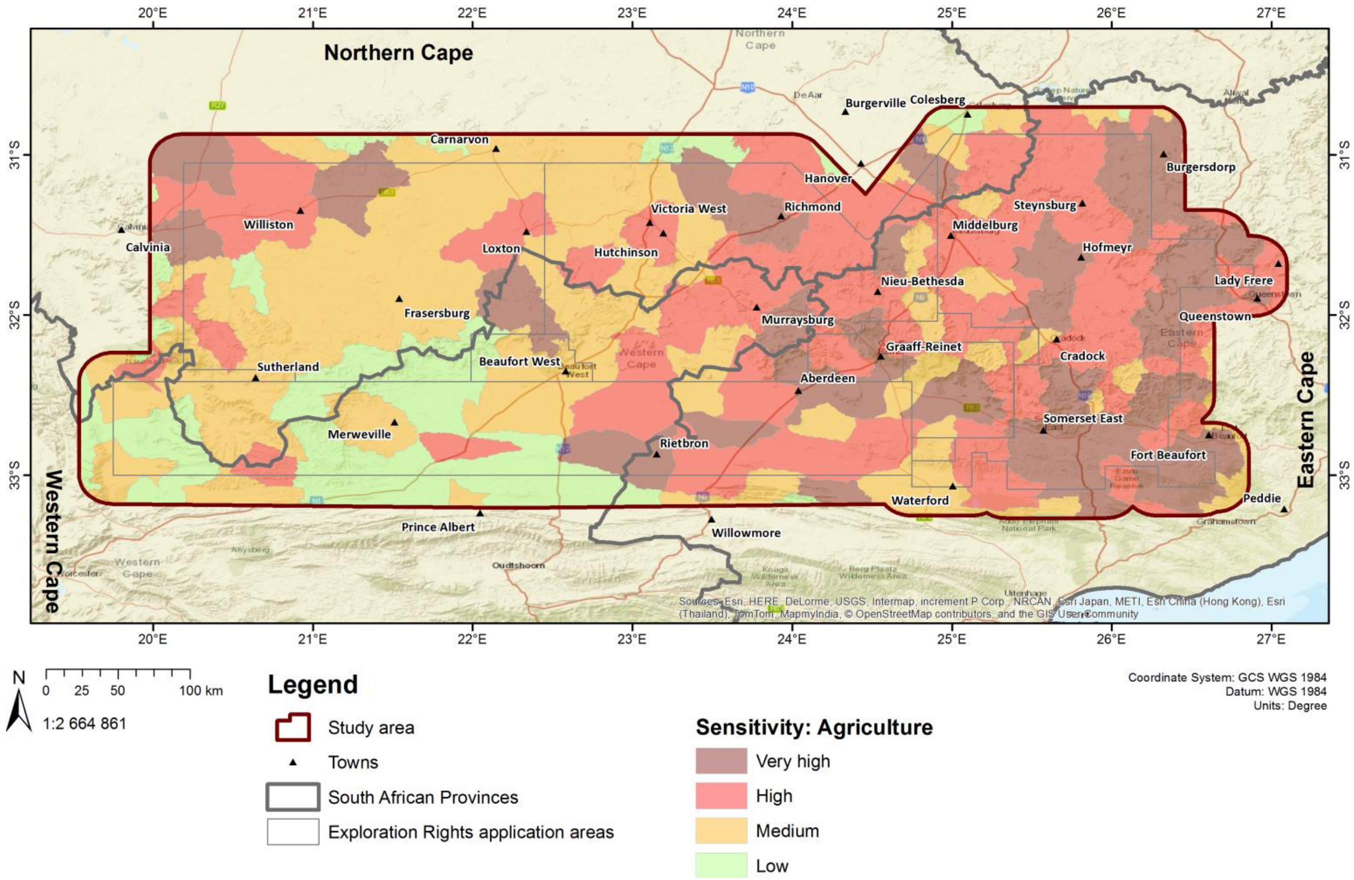

Figure 4–5: Agriculture based on metrics calculated at a quaternary catchment scale for land capability, grazing land, surface water, rivers, dams, irrigated land and cultivated fields.

4.2.6 Tourism

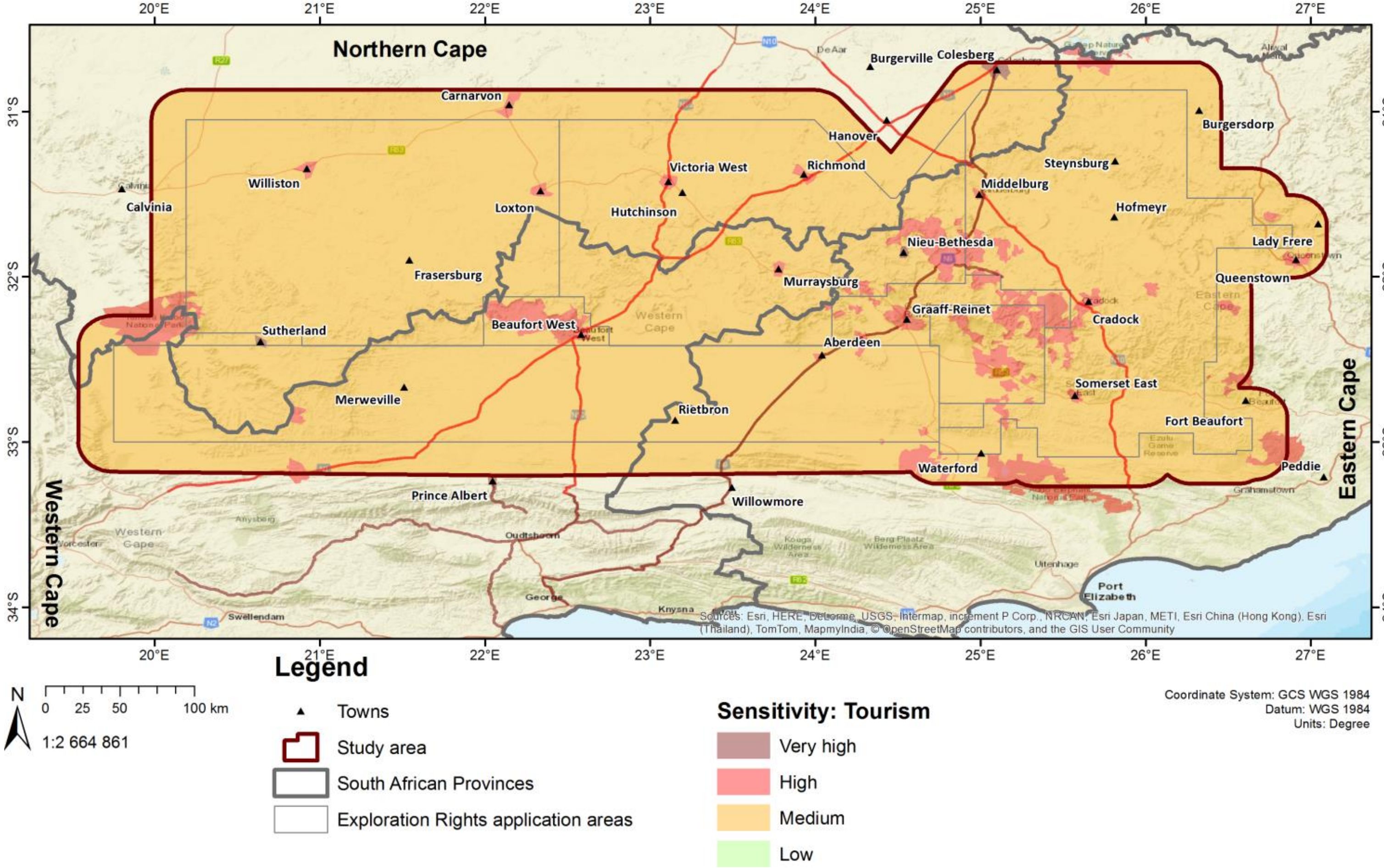

Figure 4–6: Tourism based on the number of enterprises in important town and scenic routes.

4.2.7 *Visual, aesthetic and scenic resources*

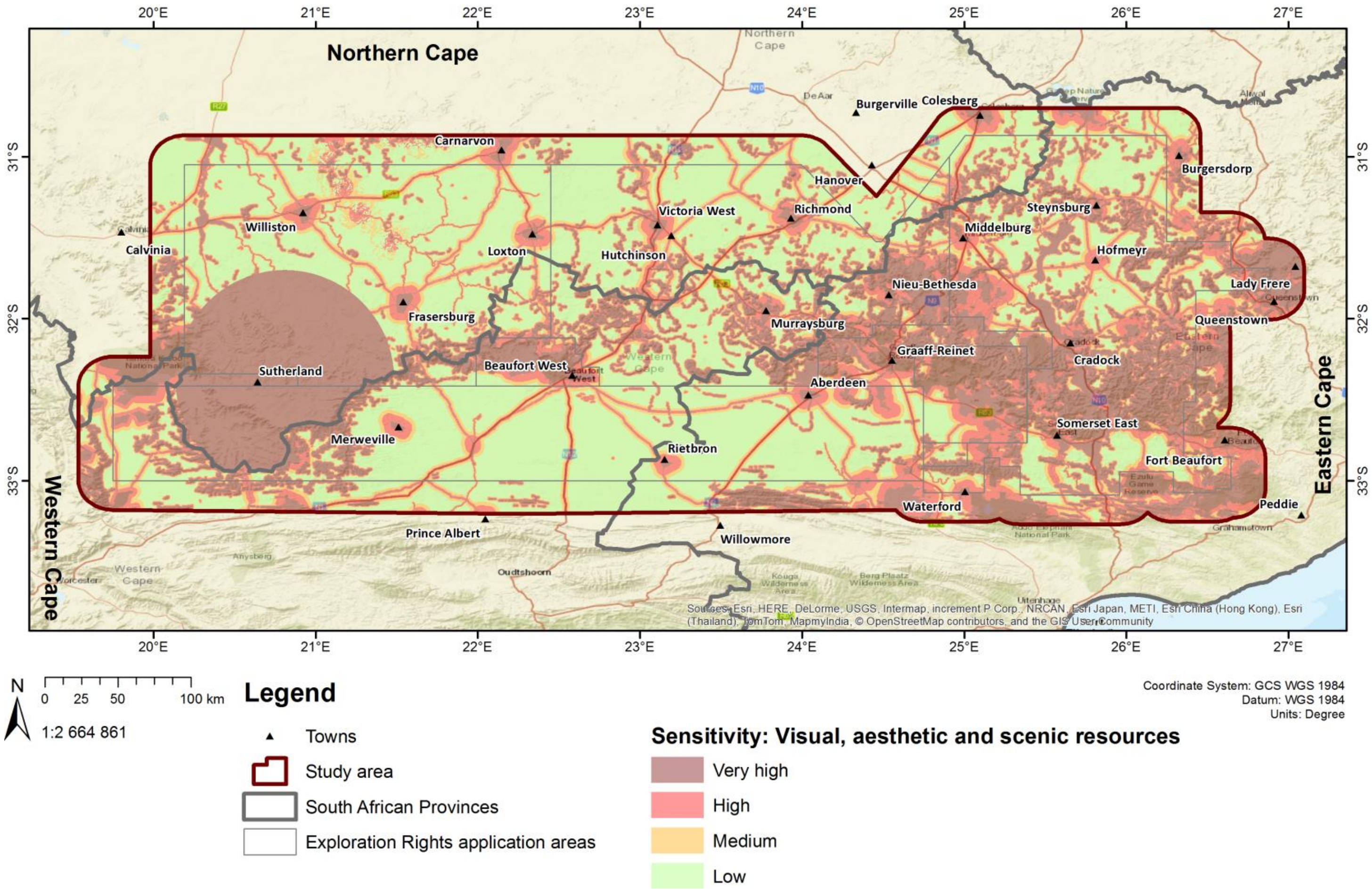

Figure 4–7: Visual, aesthetic and scenic resources based on topographic features, surface water, cultural landscapes, Protected Areas, human settlements, major roads, sites of optical astronomy – the Sutherland Large Telescope (SALT).

4.2.8 *Heritage (archaeology and palaeontology)*

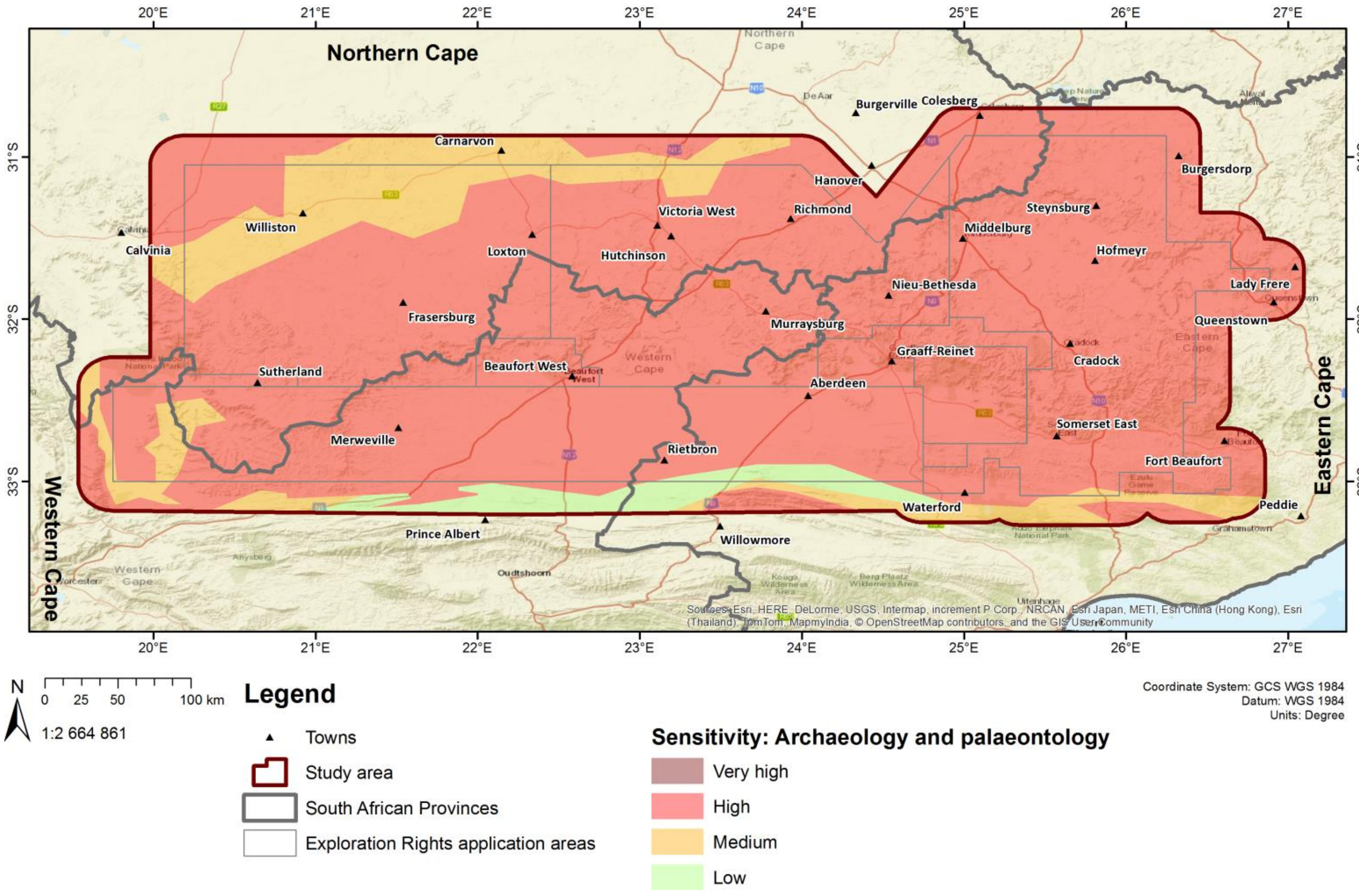

Figure 4–8: Heritage features based on archaeology (including graves) and palaeontological resources.

4.2.9 *Electromagnetic Interference with Astronomy*

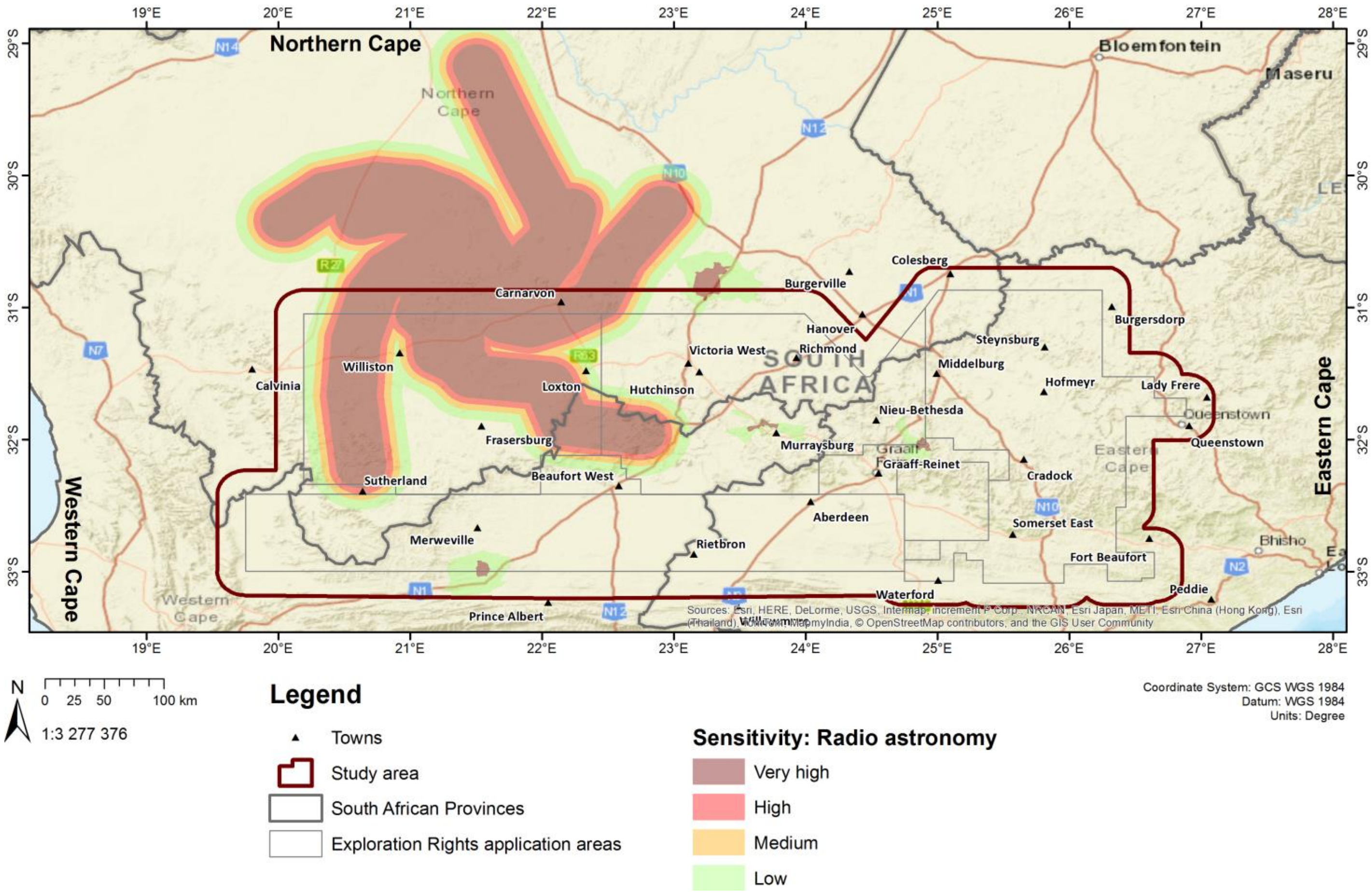

Figure 4–9: Electromagnetic interference based on full phase development of the SKA.

5. SUMMARY OF KEY IMPACTS AND RISKS

5.1 Risk Assessment Approach

The approach to the Scientific Assessment phase was based on the concept of 'risk', with specific spatial relevance to sensitive receiving environments in the Central Karoo as depicted in the previous section. The risk assessment approach was loosely based on the Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change which defines risk as "the probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur" (IPCC, 2014). Risk was determined by estimating the likelihood of events or trends occurring, in relation to their consequences (Risk= likelihood x consequence, ranging from Very Low to Very High risk) (see Figure 5-1).

Consequences were calibrated for each topic based on quantitative descriptions of the consequence terms ranging from slight to extreme, which ensured consistency in the manner in which risks were measured, enabled integration across different topics disciplines, and provided a common conceptual and spatial understanding of risks (Table 5-1). The allocation of consequence levels depended on three things:

- ***Exposure***: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected;
- ***Impact***: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources
- ***Sensitivity***: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Risks were assessed with- and without mitigation, across the four scenarios, with 'Without mitigation' assuming inadequate governance capacity, weak decision-making and non-compliance with regulatory requirements, while 'With mitigation' assumed effective implementation of best practice principles, adequate institutional governance capacity and responsible decision-making. The assessment of the four scenarios, both with- and without mitigation led to increased scenario variance and provides stakeholders and decision-makers with practical estimation of the importance of strong governance and institutional functionality.

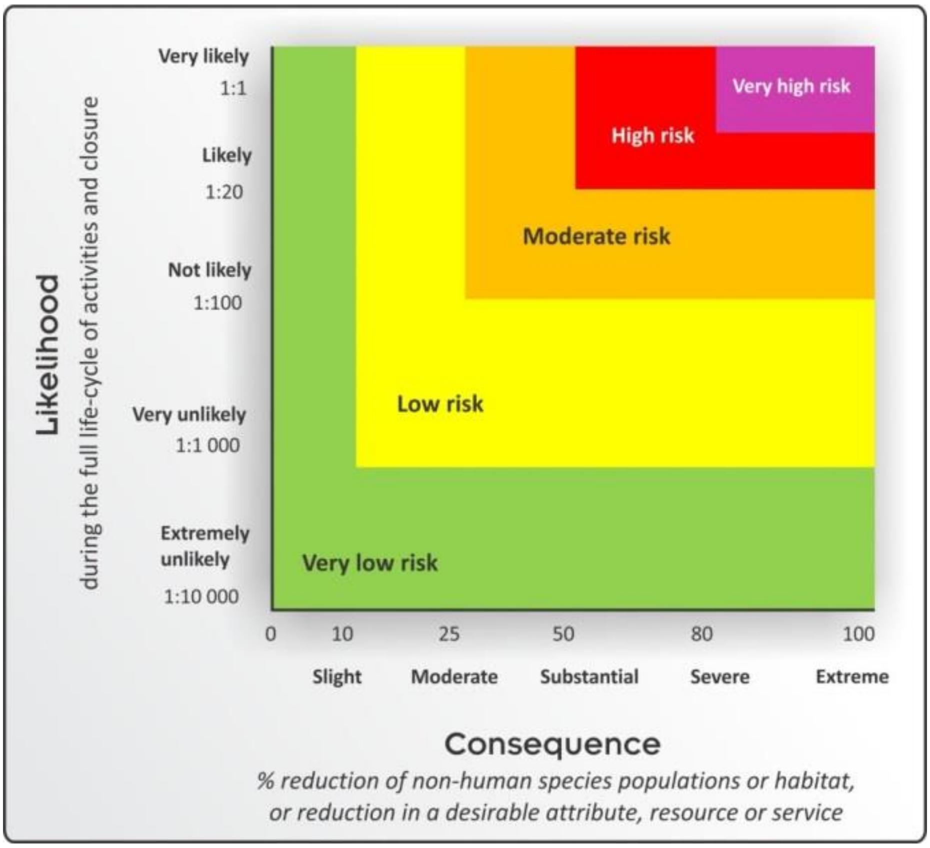

Figure 5–1: Risk is qualitatively measured by multiplying the likelihood of an impact by the severity of the consequences to provide risk rating ranging from very low, low, moderate, high and very high.

The risk assessment was based on an interpretation of existing spatial and non-spatial data in relation to the proposed activity, to generate an integrated picture of the risks related to a specified activity in a given location, with and without mitigation. Risk was assessed for each significant stressor (e.g. physical disturbance), on each different type of receiving entity (e.g. the rural poor, a sensitive wetland etc.), qualitatively (undiscernible, Very Low, Low, Moderate, High, Very High) against a predefined set of criteria (Table 5-1).

Table 5–1: Predefined set of criteria applied across the topics of the Scientific Assessment

Risk category	Definition
No discernible risk	Any changes that may occur as a result of the activity either reduce the risk or do not change it in a way that can be differentiated from the mean risk experienced in the absence of the activity.
Very low risk	Extremely unlikely (<1 chance in 10 000 of having a consequence of any discernible magnitude); or if more likely than this then the negative impact is noticeable but slight, i.e. although discernibly beyond the mean experienced in the absence of the hazard, it is well within the tolerance or adaptive capacity of the receiving environment (for instance, within the range experienced naturally, or less than 10%); or is transient (< 1 year for near-full recovery).
Low risk	Very unlikely (<1 chance in 100 of having a more than moderate impact); or if more likely than this, then the impact is of moderate consequence because of one or more of the following considerations: it is highly limited in extent (<1% of the area exposed to the hazard is affected); or short in duration (<3 years), or with low effect on resources or attributes (<25% reduction in species population, resource or attribute utility).
Moderate risk	Not unlikely (1:100 to 1:20 of having a moderate or greater impact); or if more likely than this, then the consequences are substantial but less than severe, because although an important resource or attribute is impacted, the effect is well below the limit of acceptable change, or lasts for a duration of less than 3 years, or the affected resource or attributes has an equally acceptable and un-impacted substitute.
High risk	Greater than 1 in 20 chance of having a severe impact (approaching the limit of acceptable change) that persists for >3 years, for a resource or attribute where there may be an affordable and accessible substitute, but which is less acceptable.
Very high risk	Greater than even (1:1) chance of having an extremely negative and very persistent impact (lasting more than 30 years); greater than the limit of acceptable change, for an important resource or attribute for which there is no acceptable alternative.

Chapters 2-17 of the Scientific Assessment phase undertook the risk assessment, based on the scenarios and activities (see Section 2). A number of impacts were identified associated with the seventeen topics and assessed in terms of the risk approach described. Following the results of the extensive risk assessment, 38 impacts are considered to have either a Very High or High risk before mitigation; or alternatively have a Moderate risk even after mitigation is applied. The 38 impacts identified by the assessment should provide the basis for any future site specific assessments which need to be undertaken for shale gas exploration and production activities in the near and long term future. These impacts are summarised as Table 5-2 below.

Table 5–2: A summary of the impacts, per scenario, according to location, where the risk without mitigation has been assessed as High or Very High and where Moderate risk persists after mitigation.

Topic	No	Impact	Scenario	Location	*Risk without mitigation*	*Risk with mitigation*
Energy planning	1	Energy infrastructure that does not match domestic shale gas supply	Big Gas	National	**High**	**Moderate**
Energy planning	2	Availability of sufficient network capacity to evacuate gas and gas fired power generation	Big Gas	National	**High**	**Very low**
Air quality	3	Exposure to air pollutants from flaring, dust and other activities that diminish air quality	Exploration Only, Small Gas and Big Gas	On wellpad	**High**	**Moderate**
GHG emissions	4	Fugitive GHG emissions from production well pads and supporting gas infrastructure	Big Gas	Local, regional and global	**High**	**Moderate**
Seismicity	5	Occurrence of a damaging earthquake M>5 causing damage to heritage resources and human well-being through building collapses	Big Gas	Within 20 km of towns	**Moderate**	**Moderate**
Groundwater	6	Reduced water availability of groundwater for people and other economic activities in the Central Karoo	Big Gas	In vicinity of production wellfield	**Very High**	**High**
			Small Gas		**High**	**High**
Groundwater	7	Contamination of groundwater resources caused by a loss of well integrity and via preferential pathways caused by hydraulic fracturing	Big Gas	In the vicinity of high sensitivity groundwater resources	**Moderate**	**Moderate**
Surface-water	8	Physical disturbance of watercourses during the construction of roads, well pads and other supporting infrastructure	Small and Big Gas	Much of the study area and regions of high flood risk	**High**	**Moderate**
Surface-water	9	Contamination of surface water resources as a result of spills and flowback discharge from the well pad	Small	In vicinity of watercourses and pans	**High**	**Low**
			Big Gas		**High**	**Moderate**
Surface-water	10	Contamination of surface resources as a result of contact with contaminated groundwater	Small and Big Gas	Springs, borehole-fed reservoirs, shallow aquifers	**High**	**Moderate**
Waste	11	Human exposure to hazardous and domestic waste and additional sewage loads caused by increased activities in the Central Karoo	Small and Big Gas	Near disposal or spillage site, landfills and wastewater treatment works	**High**	**Low**

Topic	No	Impact	Scenario	Location	*Risk without mitigation*	*Risk with mitigation*
Biodiversity	12	Impacts on ecological and biodiversity processes in the Central Karoo	Small Gas	Very High sensitivity areas	**High**	**Moderate**
			Big Gas	Very High sensitivity areas	**Very high**	**Moderate**
			Big Gas	High sensitivity areas	**High**	**Moderate**
Agriculture	13	Impacts of farming and agriculture as a result of shale gas exploration and production activities	Small Gas	Very High agricultural sensitivity	**High**	**Moderate**
			Big Gas		**Very High**	**High**
			Big Gas	High agricultural sensitivity	**High**	**Moderate**
			Big Gas	Medium agricultural sensitivity	**High**	**Moderate**
			Big Gas	Low agricultural sensitivity	**High**	**Moderate**
Tourism	14	Reduction in tourist numbers and enterprises in the Central Karoo and financial losses to the rural economy	Small Gas	Very High sensitivity	**High**	**Moderate**
			Big Gas		**Very high**	**High**
			Small Gas	High Sensitivity	**High**	**Moderate**
			Big Gas		**High**	**High**
			Small Gas	Medium Sensitivity	**High**	**Moderate**
			Big Gas		**High**	**High**
Economics	15	Impacts to public finances, including the budgets of Municipalities, associated with environmental externality costs	Big Gas	Local and regional	**High**	**Moderate**
Economics	16	Impacts to property values near wellpads in the Central Karoo	Big Gas	Wellpads where drilling occurs	**High**	**Moderate**
Social fabric	17	Human in-migration into the Central Karoo	Small Gas	In the region of wellfield development	**High**	**High**
			Big Gas		**Very High**	**High**
Social fabric	18	Altered physical security for residents and peoples working in the region	Exploration Only		**High**	**Moderate**
			Small Gas		**Very high**	**High**
			Big Gas		**High**	**High**
Social fabric	19	Altered social and new power dynamics	Exploration Only		**High**	**High**
			Small Gas		**High**	**High**
			Big Gas		**High**	**Moderate**
Human health	20	Exposure to pollution through water and air contamination	Small and Big Gas	Local community water sources	**High**	**Moderate**
Human health	21	Worker physical injury through contact with traffic or machinery	Small and Big Gas	On the wellpads or near roads	**High**	**Moderate**
Sense of place	22	Loss of sense of place to farmers, farm labourers, emerging farmers and land claimants	Big gas	The Central Karoo	**High**	**Moderate**

Topic	No	Impact	Scenario	Location	*Risk without mitigation*	*Risk with mitigation*
Sense of place	23	Loss of sense of place to Karretjie People	Big gas		**High**	**Moderate**
Sense of place	24	Loss of sense of place to lifestyle farmers, creatives, retirees, tourists and scientists	Small Gas		**High**	**Moderate**
Sense of place	25	Loss of sense of place to lifestyle farmers, creatives, retirees, tourists and scientists	Big Gas		**Very high**	**Moderate**
Sense of place	26	Loss of sense of place to shale gas development, low-skilled workers, unemployed youth	Reference Case		**Very high**	**Moderate**
Visual	27	Visual intrusion of shale gas development and associated activities into the landscape	Big Gas	Low visual sensitivity areas	**High**	**Moderate**
			Small Gas	Moderate visual sensitivity areas	**High**	**Moderate**
			Big Gas	Moderate visual sensitivity areas	**Very high**	**High**
			Exploration Only	Very High and High visual sensitivity areas	**High**	**Moderate**
			Small Gas	Very High and High visual sensitivity areas	**Very high**	**High**
			Big Gas	Very High and High visual sensitivity areas	**Very high**	**High**
Heritage	28	Impacts on built heritage, monuments and memorials - all impacts except earth tremors	Big Gas	High sensitivity areas - land less than 10 km from towns and settlements	**High**	**Moderate**
	29	Impacts on built heritage, monuments and memorials - earth tremors only	Big Gas	Central Karoo	**High**	**High**
	30	Impacts on archaeology and graves	Exploration Only	High sensitivity areas - uplands and areas with highly variable topography	**High**	**Low**
			Small Gas	High sensitivity areas - uplands and areas with highly variable topography	**High**	**Low**
			Big Gas	High sensitivity areas - uplands and areas with highly variable topography	**High**	**Low**
			Big Gas	Medium and low sensitivity areas - foothills and areas with undulating topography	**High**	**Low**
	31	Impacts on cultural landscapes	Small Gas	Central Karoo	**High**	**Moderate**
			Big Gas	Central Karoo	**Very high**	**High**
Noise	32	Disturbance to humans due to wellpad noise	Small Gas	Within 5 km of wellpads	**High**	**Moderate**
			Big Gas	Within 5 km of wellpads	**Very high**	**High**
	33	Disturbance to humans due to road traffic noise	Big Gas	Within 3 km of remote, quiet roads	**High**	**Moderate**
	34	Disturbance to sensitive species	Big Gas	Within 3 km of wellpads and remote, quiet roads	**High**	**Moderate**
SKA	35	Electromagnetic interference impact on radio	Exploration Only, Small	Very High sensitivity areas	**Very high**	**Moderate**

Topic	No	Impact	Scenario	Location	*Risk without mitigation*	*Risk with mitigation*
		astronomy	Gas, Big Gas			
			Exploration Only	High sensitivity areas	**High**	**Very low**
			Small Gas		**High**	**Low**
			Big Gas		**Very high**	**Moderate**
			Big Gas	Medium sensitivity areas	**High**	**Low**
Spatial planning	36	Local road construction and resource implications	Big Gas	Access road linkages	**High**	**Moderate**
	37	Pressure on regional road infrastructure	Big Gas	Along major regional transport corridors	**Very high**	**Moderate**
	38	Spatial and development planning, land use management and governance capacity	Reference Case	The Central Karoo	**High**	**Low**
			Exploration Only, Small Gas, Big Gas		**High**	**Moderate**

5.2 The Meaning of Mitigation

The ‘mitigation’ referred to in Table 5-2, is described at length in in each of the Scientific Assessment chapters which were developed as part of Phase 2 of the SEA, with various mitigation strategies proposed from the strategic level of assessment, down to site specific mitigation actions which will reduce the risk profile of the associated impact. The focus of this report, is on strategic mitigation actions which are provided via the proposed strategic exclusion areas (with an indication of which risks are being mitigated in Table 6-1), the proposed site specific exclusion areas (with an indication of which risks are being mitigated in Table 6-3), the levels of acceptable change (i.e. establishing a threshold reduces risk and hence is a mitigation action in Table 6-4) and the strategic management actions for government, which are a series of steps to reduce risk, hence are considered as mitigation actions (Table 6-5). At the strategic level of assessment, if these mitigation actions are complied with, the risk profile will substantially reduce and conform to the tents of the Precautionary Principle as envisaged in the NEMA.

5.3 The Precautionary Principle

The precautionary principle in the context of the protection of environmental rights is essentially about the assessment and management of risk. Section 2(4)(a)(vii) of NEMA applies to any organ of state that takes a decision in terms of a statutory provision connected to the protection of the environment. It requires a risk-averse and cautious approach that takes into account the limits of current knowledge about the consequences of decisions and actions. The precautionary principle provides for policy and political factors to be considered for decision making in the face of uncertainty (DEA&DP, 2012).

There is increasing support for placing the burden of proving the acceptability of a development on the applicant, and not the person arguing that it is environmentally undesirable, when there is a threat. If a proponent of a plan, programme or project fails to discharge this burden of proof, this does not necessarily mean that the plan, programme or project must be refused. It merely requires that the decision-maker in making his/her decision must, if no information has been presented to indicate otherwise, assume that there shall be serious or irreversible environmental damage (DEA&DP, 2012).

The precautionary principle is consistent with good science and good public policy, because it acknowledges the inherent uncertainty and limitations in our understanding of complex risks challenges. Therefore the precautionary principle enjoins policy-makers, scientists, members of the community etc. to develop new methods and tools to characterise these threats and focuses our attention on opportunities for prevention and innovation. The precautionary principle acknowledges that public environmental decisions in the face of great uncertainty should be informed by science, but in spite of that also acknowledges that environmental decisions are ultimately deeply political in essence. The precautionary principle implores those who are engaged in policy-making on the environment, given its complexity, to take ethical decisions based on values, accountability, democratic principles and probity. Given the arguments and facts in support of the precautionary principle, science and the precautionary principle are complementary to one another.

5.4 Spatial Extent of the Risk Assessed

Sensitivity maps were generated and are expressed in the Section 4.2. Building on this delineation of different receiving environments, an integrated risk model was developed, per scenario with- and without mitigation, based on the allocation of sensitivity ratings to geographically distinguishable receiving environments and the determination of risk profiles for these sensitive areas of the receiving environment.

Spatially explicit risk profiles were then overlayed and depicted using the 'maximum rule' to prioritise the highest risk areas over those of lower risk (Figure 5-2). The purpose of the risk modelling exercise is to demonstrate the evolution of the risk profile across the scenarios considered, which accounts for the full life-cycle of shale gas exploration and production activities, from cradle-to-grave, and to test the efficacy of mitigation actions in reducing risks. The purpose of the risk model is not to determine areas which should be excluded from shale gas exploration and production activities in the future, although status quo sensitivity mapping may reveal this with relatively high degrees of confidence (see Sections 4.2 and 6.1.1.1).

Table 5–3: Topics with spatially explicit risk profiles used to develop the integrated risk 'picture'.

<table>
<tr><th>Topic</th><th>No.</th><th>Impact</th><th>Spatial unit</th></tr>
<tr><td>Air quality</td><td>3</td><td>Local community exposure to air pollutants</td><td>Sensitive areas identified as being within 10 km of towns</td></tr>
<tr><td>Earthquakes</td><td>5</td><td>Damaging earthquakes induced by hydraulic fracturing</td><td>Sensitive areas identified as a being within 20 km of towns</td></tr>
<tr><td rowspan="2">Water*</td><td>7</td><td>Contamination of groundwater resources caused by a loss of well integrity and via preferential pathways caused by hydraulic fracturing</td><td rowspan="2">Water resource sensitivity maps developed based on legislated and proposed setbacks from surface and groundwater resources and associated geological structures</td></tr>
<tr><td>8</td><td>Physical disturbance of watercourses and contamination of surface water resources through flowback discharge and contact with contaminated groundwater</td></tr>
</table>

<table>
<tr><td></td><td>9</td><td>Contamination of groundwater resources through surface spills and discharge</td><td></td></tr>
<tr><td>Biodiversity and ecology**</td><td>12</td><td>Ecological and biodiversity impacts</td><td>Sensitivity classes defined at habitat to landscape scales generally utilised in spatial biodiversity planning</td></tr>
<tr><td>Agriculture</td><td>13</td><td>Alteration of agricultural landscape and impact on agricultural resources base</td><td>Agricultural sensitivity classes defined at the quaternary catchment scale</td></tr>
<tr><td>Tourism</td><td>14</td><td>Tourism impacts</td><td>Tourism sensitivity classes defined at town, protected area, and tourism route scale</td></tr>
<tr><td>Visual</td><td>27</td><td>Visual intrusion into the landscape, altering the rural character</td><td>Visual sensitivity classes defined at the regional scenic resource scale</td></tr>
<tr><td rowspan="3">Heritage</td><td>28</td><td>Impacts on built heritage, monuments and memorials</td><td>Sensitive areas identified as being within 10 km from towns</td></tr>
<tr><td>30</td><td>Impacts on archaeology and graves</td><td>Archaeology and graves sensitivity classes defined at the landscape scale.</td></tr>
<tr><td colspan="2">Impacts on palaeontology, meteorites and geological heritage – assessed as Low and Very Risk after mitigation</td><td>Palaeontology, meteorites & geological heritage sensitivity classes defined at a landscape scale</td></tr>
<tr><td>Electromagnetic Interference***</td><td>35</td><td>Electromagnetic interference (EMI) impacts on radio astronomy receptors (SKA)</td><td>EMI sensitivity classes defined at the scale of separation distances from the SKA development footprint</td></tr>
<tr><td colspan="4">* The primary mitigation measure assumed for the ‘with mitigation’ assessment for water resources is that shale gas exploration and production activities do not occur within the areas mapped as being of Very High and High sensitivity (see Figure 4-3).
** For biodiversity and ecosystems, ‘with mitigation’ assumes the following: 1.) That proclaimed protected areas are ‘no-go’ areas 2.); that Very High sensitivity areas are avoided 3.); and that High sensitivity areas are avoided, or at a minimum, utilised but only following securing suitable offset sites in Very High or High sensitivity areas (see Figure 4-4).
*** ‘With mitigation’ assumes that no shale gas exploration and production activities are permitted within Very High sensitivity areas and within the Karoo Central Astronomy Advantage Area (KCAAA) (see Figure 4-9).</td></tr>
</table>

Based on the evolution of the topic specific risk profiles, it is possible to trace the incremental increase of risk in relation to the increasing magnitude and shale gas volumes and development activities as described in the scenarios generated for the assessment. From this point of departure the specialist teams were able to develop proposals for what constitutes the ‘limits of acceptable change’ which are based on the results of the risk assessment and compared to the legislation, guidelines, rules, norms, institutions and expert judgement used as a proxy for societal values (all limits were subject to peer and stakeholder review process which acted as a calibration of the proposed limits).

The following were the key steps undertaken to produce the integrated risk model:

a) Define and map distinct receiving environments based on a sensitivity analysis for the following impacts:
    i. Local community exposure to air pollutants
    ii. Damaging earthquakes induced by hydraulic fracturing
    iii. Contamination of groundwater resources through surface spills and discharge
    iv. Contamination of groundwater resources caused by a loss of well integrity
    v. Physical disturbance of watercourses and contamination of surface water
    vi. Ecological and biodiversity impacts
    vii. Alteration of agricultural landscape and impact on agricultural resources base
    viii. Tourism impacts
    ix. Visual intrusion into the landscape, altering the rural character
    x. Impacts on built heritage, monuments and memorials
    xi. Impacts on archaeology and graves
    xii. Impacts on palaeontology, meteorites and geological heritage
    xiii. Electromagnetic interference impacts on radio astronomy receptors (i.e. SKA)
b) Define the mitigation cases from "without mitigation", to "with mitigation". Also define the legislation, rules and responsible institutions applicable.
c) Define the consequence levels for each specialist topic from (a) i-xiii
    i. What proxy indicators can be used? What established norms and standards exist?
d) For each impact:
    i. For each scenario/project specific development –
        1. Estimate likelihood
        2. Estimate consequence
        3. 1 x 2 = Risk. Test against expert judgement
    ii. Repeat with mitigation cases, legislation, rules and responsible institutions considered.
e) Use the tabulated outputs from d) with the sensitivity maps developed in a) to populate calibrated risk model for each impact. Overlay impacts to produce a composite risk model expressed across the mitigation cases.

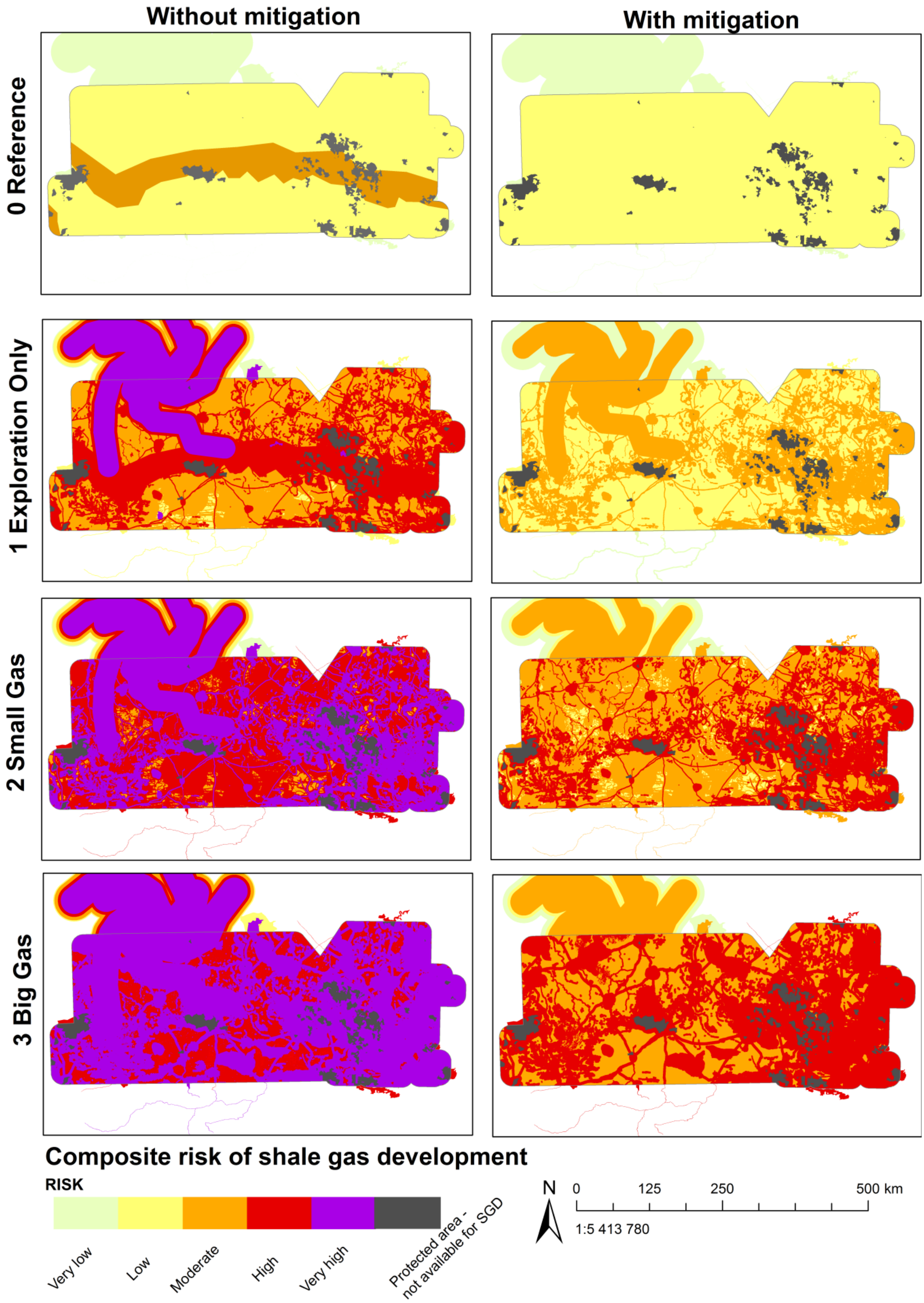

Figure 5–2: Composite map of spatially explicit risk profiles within the study area, depicting the risk of shale gas exploration and production activities (SGD) across four scenarios, without-and with mitigation.

6. STRATEGIC RISK MANAGEMENT

6.1 Defining Limits of Acceptable Change

Since only exploration for shale gas is on the 10 year horizon, it makes sense that exclusion zones would be generated for exploration and that only following field work, data acquisition, adaptive management and assumption testing, that exclusion zones could be generated for shale gas production when more information about the nature, distribution and extent of both the shale gas reserve, the sensitive features of the Central Karoo and the manner in which development activities interact with the social and ecological features are known. Thus this section is focused on the exclusion areas that are proposed for Phase I (“Exploration”) and Phase II (“Appraisal”).

The core principle in the determination of limits of acceptable change is the precautionary principle. The precautionary principle requires a risk-averse and cautious approach that takes into account the limits of current knowledge about the consequences of future decisions and actions. This can be primarily achieved through application of the mitigation hierarchy.

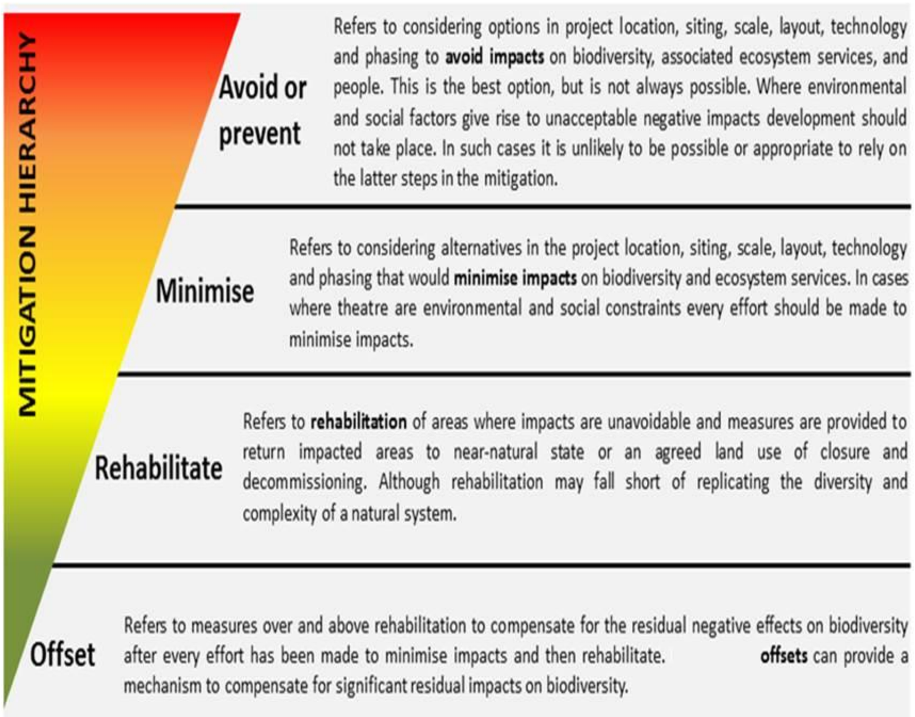

Figure 6–1: The mitigation hierarchy prescribes avoidance as the most efficient manner to minimise impact exposure and hence to reduce the risk profile. Avoidance is most commonly applied within a spatial context to delimited areas that are unacceptable for development for one reason or another (sometimes many). Avoidance can also mean the prohibition of certain development activities (e.g. types of technologies, hydraulic fracturing fluid composition) if more suitable, less consequential alternatives exist (DEA, 2013).

Even at the strategic level of assessment, many sensitive features of the Central Karoo are known to occur in this region and can easily be avoided during a shale gas exploration campaign. This includes regions which contain important groundwater and surface water resources, areas of high biodiversity sensitivity, scenic areas important to the cultural landscapes, vulnerable people living in populated communities, and the footprint of the SKA development phases.

During the Exploration Only scenario, which assumes extensive seismics plus vertical and horizontal drilling from 30 exploration wellpads (in excess of that which is actually proposed by Shell, Bundu and Falcon), only < 0.0001 % of the study area will be directly affected by shale gas activities. Even for the Small and Big Gas scenarios, at most, 0.0009 % of the surface area within the Central Karoo would be directly affected upon by exploration and production activities including the construction of new roads, wellpads, pipelines and gas combustion infrastructure[9].

This effectively means that > 99 % of the surface area of the Central Karoo will not be directly affected by shale gas exploration and production, even at the Big Gas scenario, meaning that it will be entirely possible to use avoidance as the primary mitigation mechanism in reducing the risks posed by shale gas exploration Phase I ("Exploration") and Phase II ("Appraisal"). There is more than sufficient evidence, that from a perspective of geographical footprint, that shale gas exploration can reach reasonably large proportions without impinging on other land-uses in Central Karoo provided that appropriate avoidance and site-specific mitigation is employed.

With this in mind, the prescription of exclusion areas for shale gas exploration is an effective approach to risk mitigation and the determination of limits of acceptable change. Exclusions areas can be delimited at two scales: at a course scale – where regional species, trends, features and populations which occur should be protected (the focus of a strategic-level study); and at fine scale – where sensitive features can be 'groundtruthed' and mapped onsite at fine-scale (the focus of an EIA-level investigation).

6.1.1.1 <u>Proposed Exclusion Areas at a Strategic Level of Assessment</u>

As discussed, under the Exploration Only scenario, < 0.0001 % of the surface area within the Central Karoo will be directly impacted by shale gas activities. Having said that, there are still significant concerns about the cumulative and interactive risk of activities related to shale gas exploration at the

[9] It is acknowledged that direct impact does not account for 'scale of impact, which may be spatially larger when one considers cumulative impacts such as those associated with increased traffic.

landscape scale, particularly through activities on the land surface that fragment the landscape, and the risk of the resulting impacts on spatially extensive ecological, economic and social processes. While > 99 % of the study area will not be directly affected by shale gas exploration, it is a near certainty that ancillary activities and infrastructure and activities will have a wider ranging spatial risk on the landscape if not adequately mitigated.

Figure 5-2 demonstrates the most effective way to mitigate cumulative and interactive risk is through application of the mitigation hierarchy conforming to avoidance first. What follows in Table 6-1, is a synthesis of the key spatial layers which are recommended for exclusion areas for exploration Phase I Exploration and Phase II Appraisal. Given that these layers are considered at the strategic level of assessment, the following two criteria had to be met in order for the layer to be included:

1. **Confidence**: There is a high degree of confidence in the data used to develop the layer, in other words, experts agree that the features represented in the layer almost certainly occur in the regions they are mapped. Note that the layers used to develop the exclusion areas represent proof of presence of sensitive features within the exclusion areas; but are not proof of absence of sensitive features in the areas located out of the proposed exclusion areas; and
2. **Significance**: Using the layer as a regional exclusion area would have a significant effect in reducing the risk profile associated with the some of 38 key impacts related to shale gas exploration at a regional scale which could not necessarily otherwise be mitigated at an EIA level of assessment. Significance also relates to the legislative framework and the existing provision as a region of exclusion for shale gas activities e.g. Protected Areas in terms of the NEMBA, the SKA in terms of the AGAA.

Section 49 of the MPRDA provides the DMR Minister with the power to "prohibit or restrict prospecting or mining. The Minister may prohibit or restrict the granting of any reconnaissance permission, prospecting right, mining right or mining permits in respect of land identified by the Minister for such period and on such terms and conditions as the Minister may determine". In addition, in terms of Section 24 of the NEMA, the DEA Minister is given the mandate to identify "geographical areas based on environmental attributes, and specified in spatial development tools adopted in the prescribed manner by the environmental authority, in which specified activities may be excluded from authorisation by the competent authority". At the strategic level of investigation, the declaration of exclusion areas for shale gas exploration with significantly help to mitigate the risks associated with a number of the 38 key impacts – these are captured in Table 6-1.

Table 6–1: Impact, feature of exclusion from shale gas Phase I Exploration and Phase II Appraisal and the supporting rational to apply the exclusion area at the strategic level of assessment.

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION *2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing*			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** *All development and ancillary activities up to and including hydraulic fracturing*		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
8, 9, 10, 12, 14, 27, 34	National Protected areas and regions of Very High and High ecological sensitivity as mapped in Figure 4-4	High confidence in spatial data. Rehabilitation efforts in the Central Karoo environment are very challenging, and disturbance can persist for decades or even centuries. This means that the preferred mitigation measures in this environment are to avoid or minimise impacts at the landscape level. This effectively makes regions of Medium and Low sensitivity available for shale gas exploration and production from an ecological perspective.	8, 9, 10, 12, 14, 27, 34	National Protected areas and regions of Very High and High ecological sensitivity as mapped in Figure 4-4	High confidence in spatial data. Rehabilitation efforts in the Central Karoo environment are very challenging, and disturbance can persist for decades or even centuries. This means that the preferred mitigation measures in this environment are to avoid or minimise impacts at the landscape level. This effectively makes regions of Medium and Low sensitivity available for shale gas exploration and production from an ecological perspective.
35	Shale gas exploration and production activities within both Very High sensitivity regions as mapped in Figure 4-9 and within the KCAAA	High confidence in spatial data. The acceptable threshold level of interference is determined by the SARAS protection level. Any received signal that is in excess of this protection level is deemed to be an interference source. Shale gas activities in Very High sensitivity regions and within the KCAAA are not permitted in terms of the AGAA. All shale gas development activities outside of the KCAAA, but within the sensitivity classes would be subject to	35	Shale gas exploration and production activities within both Very High sensitivity regions as mapped in Figure 4-9 and within the KCAAA	High confidence in spatial data. The acceptable threshold level of interference is determined by the SARAS protection level. Any received signal that is in excess of this protection level is deemed to be an interference source. Shale gas activities in Very High sensitivity regions and within the KCAAA are not permitted in terms of the AGAA. All shale gas development activities outside of the KCAAA, but within the sensitivity classes would be

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION ***2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing***			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** ***All development and ancillary activities up to and including hydraulic fracturing***		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
		specific mitigations per class.			subject to specific mitigations per class.
14, 24, 25, 26, 31	Regions of Very High visual sensitivity as mapped in Figure 4-7.	High confidence in spatial data. Visual, aesthetic and scenic resources based on known topographic features, cultural landscapes, human settlements, major roads, sites of both optical and radio astronomy.	14, 24, 25, 26, 31	Regions of Very High visual sensitivity as mapped in Figure 4-7.	High confidence in spatial data. Visual, aesthetic and scenic resources based on known topographic features, cultural landscapes, human settlements, major roads, sites of both optical and radio astronomy.
14, 24, 25, 27, 31, 36, 37	N9 between George and Colesberg and mountain passes such as the Swartberg, Outeniqua, Wapadsberg, Lootsberg, Huisrivier and Robinson mapped in Figure 4-6.	High confidence in spatial data. The idea of the exclusion of trucks from specific routes is will significantly reduce impact risk for tourism (Toerien et al., 2016), road infrastructure (van Huyssteen et al., 2016) and visual impact (Oberholzer et al., 2016). Exclusionary roads networks for high volume trucks are not new and have been applied successfully in the protection of scenic routes, for example, in the USA (Toerien et al., 2016).	14, 24, 25, 27, 31, 36, 37	N9 between George and Colesberg and mountain passes such as the Swartberg, Outeniqua, Wapadsberg, Lootsberg, Huisrivier and Robinson mapped in Figure 4-6.	High confidence in spatial data. The idea of the exclusion of trucks from specific routes is will significantly reduce impact risk for tourism (Toerien et al., 2016), road infrastructure (van Huyssteen et al., 2016) and visual impact (Oberholzer et al., 2016). Exclusionary roads networks for high volume trucks are not new and have been applied successfully in the protection of scenic routes, for example, in the USA (Toerien et al., 2016).
9	250 m buffer around pans	Pans are not expected to be in direct contact with groundwater nor do they form part of significant conveyance corridors for sediment and contaminants. A less stringent 250m buffer zone is suggested for non-intrusive ancillary activities (versus stimulation well activities) for all geological	9	300 m buffer around pans	Pans are not expected to be in direct contact with groundwater nor do they form part of significant conveyance corridors for sediment and contaminants. Thus a lower stimulation well setback of 300m is proposed vs the 500m stimulation well setback for wetlands. A high confidence

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION *2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing*			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** *All development and ancillary activities up to and including hydraulic fracturing*		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
		features, under which pans resort. A high confidence that the regionally mapped data does indeed occur at the specified localities in the field.			that the regionally mapped data does indeed occur at the specified localities in the field.
7	250 m buffer from kimberlites and diatremes	A less stringent 250m buffer zone is suggested for non-intrusive ancillary activities (versus stimulation well activities) for all geological features, under which kimberlites and diatremes resort. There is a high degree of confidence that the regionally mapped data does indeed occur at the specified localities in the field.	7	500 m buffer from kimberlites and diatremes	Kimberlites have complex associated emplacement models and the surface and underground morphology of these structures may be quite large and varied, with surface outcrop morphology varying from 1 ha to >15 ha. A 500 m buffer zone is recommended based on expert input. There is a high degree of confidence that the regionally mapped data does indeed occur at the specified localities in the field.
7	250 m buffer from faults, shear zones and fold axes	A less stringent 250m buffer zone is suggested for non-intrusive ancillary activities (versus stimulation well activities) for all geological features, under which shear zones and fold axes resort. There is a high degree of confidence that the regionally mapped data does indeed occur at the specified localities in the field.	7	1 000 m buffer from faults, shear zones and fold axes	Fold axes must be treated separately as their fold axis limb angles should be considered which may push the distance to several kilometres. A buffer of 1 000 m is thus recommended. There is a degree of confidence that the regionally mapped data does indeed occur at the specified localities in the field.
	1 000 m buffer from artesian boreholes and artesian Soekor wells	Artesian aquifer zones represent areas of possible deep/shallow groundwater connectivity. A less stringent 1000m buffer		5 000 m buffer from artesian boreholes and artesian SOEKOR	Artesian aquifer zones represent areas of possible deep/shallow groundwater connectivity. High confidence in current

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION ***2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing***			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** ***All development and ancillary activities up to and including hydraulic fracturing***		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
	(KL 1/65, SA 1/66, VR 1/66, CR 1/65)	zone is suggested for non-intrusive ancillary activities (versus stimulation well activities). High confidence in current mapped localities of specified Soekor wells and artesian wells identified by DWS.		wells (KL 1/65, SA 1/66, VR 1/66, CR 1/65)	mapped localities of specified Soekor wells and artesian wells identified by DWS.
7	1 000 m from town water supply wellfields	Shallow groundwater resources are at higher risk of contamination from exploration, appraisal and hydraulic fracturing activities. Ancillary activities including storage and transport of fracking fluids, chemicals or waste water are all considered potential contamination activities in terms of spills and leaks, representing a risk to water resources. A setback of 1 000 m is a conservative width (much larger than any current regulated setbacks) that takes cognisance of the possible high concentration of impacts/disturbance associated with the activity and risks associated with surface spills of contaminated flowback water or stored waste. High confidence in current mapped data.	7	5 000 m from town water supply wellfields	5 000 m between a stimulation well and municipal water wellfields are in line with GNR 466 setback distance for stimulation well activities. This setback distance is sufficient based on known hydraulic properties of shallow Karoo aquifers. These shallow groundwater areas are considered of high sensitivity and there is high confidence in current mapped data, however, more newly drilled town water supply wells may be identified during the EIA phase.
9, 10	500 m buffer upslope of cold springs	Ancillary activities are usually non-intrusive, hence the 500 m buffer upslope	9, 10	1 000 m buffer upslope of cold springs	All springs represent zones where there is probable vertical/horizontal connectivity

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION ***2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing***			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** ***All development and ancillary activities up to and including hydraulic fracturing***		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
9, 10	500 m buffer downslope of cold springs	downslope for cold springs. Due to the sensitive nature of thermal springs (associated closely with deeper geological structures), usually with faults and folds and dykes, definite indications of deep connections and source recharge areas possibly many kilometres from the spring discharge area, the setback distance remains the same as for stimulation well activities. Cold and thermal springs with associated seismic activity may be associated with active geological structures where drilling and well stimulation may trigger earthquakes, and would need a larger setback. Thermal springs within seismically active areas would need a 5000 m setback. Regions of seismic activity would however first need to be clearly delineated before identifying such springs. High confidence in currently mapped spring localities, however, more springs may be identified during EIA activities.	9, 10	500 m buffer downslope of cold springs	between surface and groundwater resources, hence the 1 000 m buffer upslope and 500 m downslope for cold springs. Thermal springs specifically are associated closely with deeper geological structures, usually with faults and folds as well as dykes. High water temperatures as well as thermogenic methane associated with some thermal springs indicate definite deep connections. Thermal springs are also likely to have source recharge areas many kilometres from the spring discharge area and these must be delineated during the EIA prior to setting site-specific setback distances. Cold and thermal springs with associated seismic activity may be associated with active geological structures where drilling and well stimulation may trigger earthquakes, and would need a larger setback. Thermal springs within seismically active areas would need a 5 000 m setback. Regions of seismic activity would however first need to be clearly delineated before identifying such springs. High confidence in currently
9, 10	1 000 m buffer around thermal springs		9, 10	1 000 m buffer around thermal springs	

PROPOSED EXCLUSION AREAS FOR PHASE I EXPLORATION ***2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing***			**PROPOSED EXCLUSION AREAS FOR PHASE II APPRAISAL** ***All development and ancillary activities up to and including hydraulic fracturing***		
Mitigation of impacts	**Feature / exclusion buffer**	**Rationale**	**Mitigation of impacts**	**Feature / exclusion buffer**	**Rationale**
					mapped spring localities.
				10 km buffer from towns and highly populated areas within the Central Karoo	High confidence in spatial data. Significantly reduce risks posed to ambient air quality (Winkler et al., 2016), building collapse due to induced seismicity (Durrheim et al., 2016; Orton et al., 2016), human health (Genthe et al., 2016), noise impacts (Wade et al., 2016) and towns dependent on groundwater and surface water (Hobbs et al., 2016). Towns are known to occur at this mapping scale, there is no requirement for groundtruthing their presence.

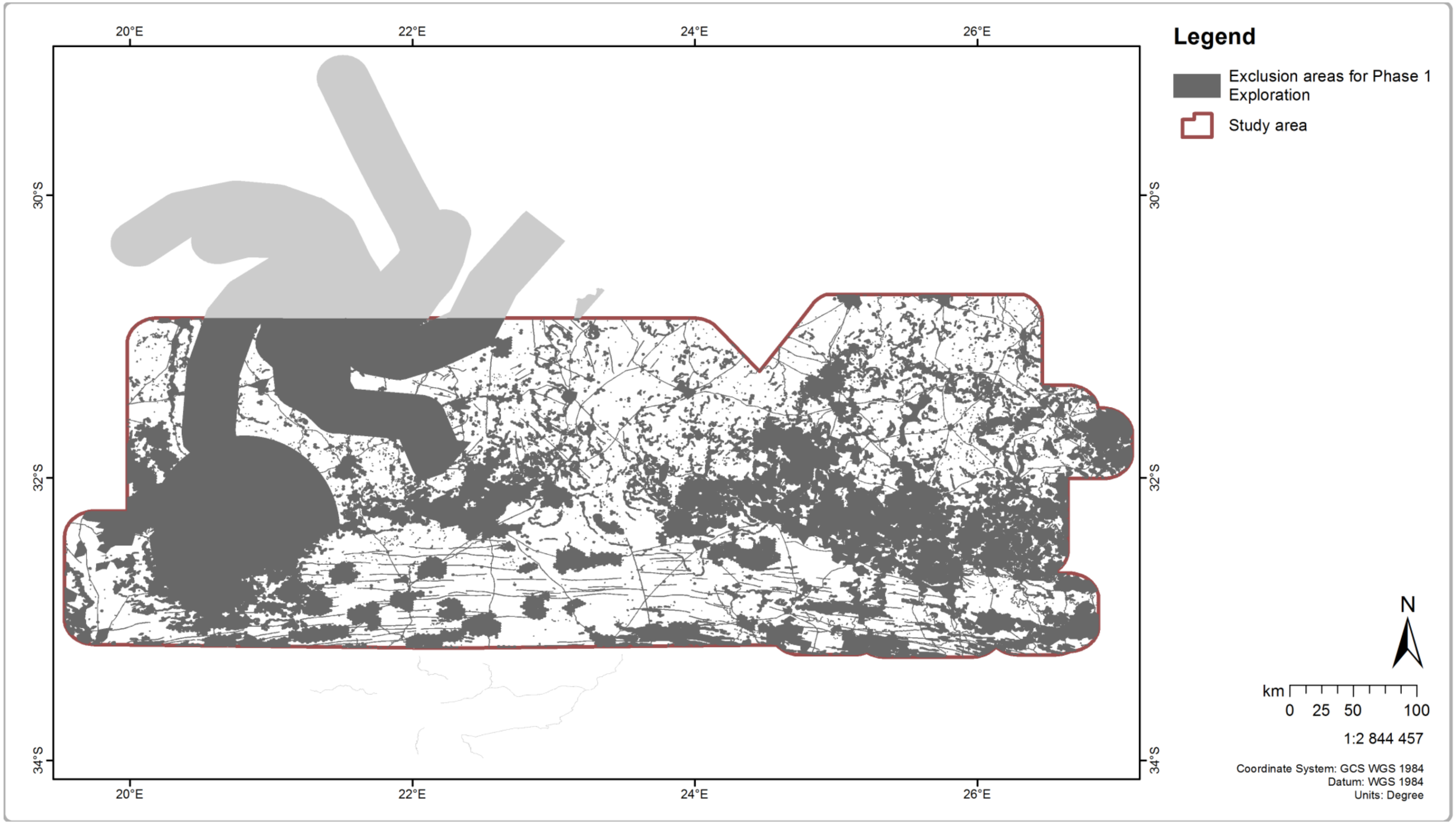

Figure 6–2: Proposed exclusion areas for Phase I Exploration – all activities associated with shale gas exploration excluding hydraulic fracturing

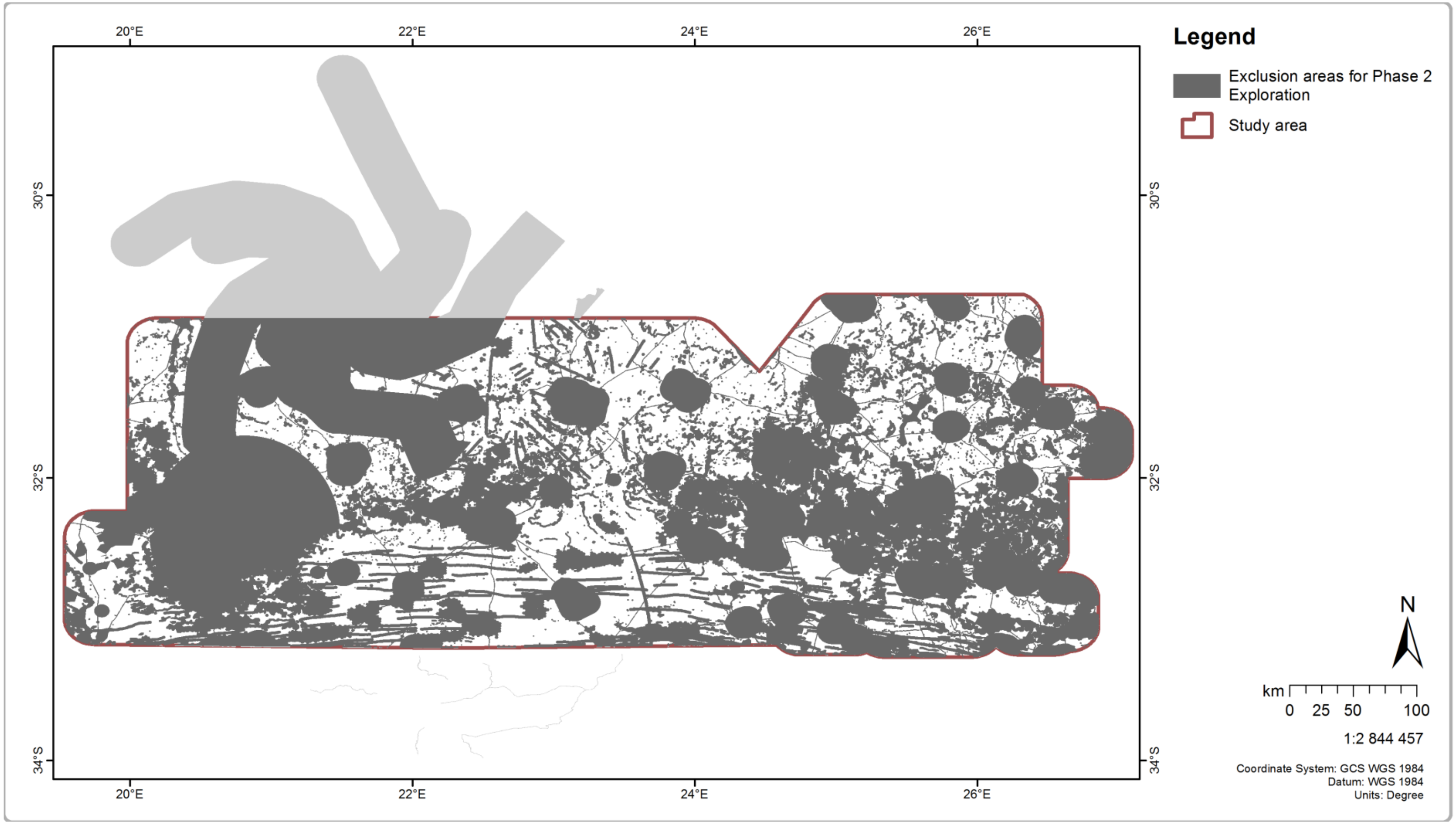

Figure 6–3: Proposed exclusion areas for Phase II Appraisal – all activities up to and including hydraulic fracturing

Table 6–2: Percentage coverage of each exclusion layer within the study area for Exploration Phase I and Appraisal Phase II

EXCLUSION AREAS FOR PHASE I EXPLORATION ***2-D seismics, 3-D seismics, vertical X-wells, horizontal Y-wells, roads, trucks, water management, waste management – all ancillary activities associated with shale gas exploration other than hydraulic fracturing***			**EXCLUSION AREAS FOR PHASE II APPRAISAL** ***All development and ancillary activities up to and including hydraulic fracturing***		
Feature / exclusion buffer	**Area (km^2)**	**% study area**	**Feature / exclusion buffer**	**Area (km^2)**	**% study area**
National Protected areas and regions of Very High and High ecological sensitivity	30815.95	17.94%	National Protected areas and regions of Very High and High ecological	30816.0	17.94%
Shale gas exploration and production activities within both Very High sensitivity regions and within the KCAAA	16104.65	9.37%	Shale gas exploration and production activities within both Very High sensitivity regions and within the KCAAA	16104.7	9.37%
Regions of Very High visual sensitivity, including optical astronomy	49790.52	30.98%	Regions of Very High visual sensitivity, including optical astronomy	49785.2	30.98%
N9 between George and Colesberg and mountain passes such as the Swartberg, Outeniqua, Wapadsberg, Lootsberg, Huisrivier and Robinson.	0.995	0.001%	N9 between George and Colesberg and mountain passes such as the Swartberg, Outeniqua, Wapadsberg, Lootsberg, Huisrivier and Robinson.	1.0	0.001%
250 m buffer around pans	2913.08	1.70%	300 m buffer around pans	3558.8	2.07%
250 m buffer from kimberlites and diatremes	12.56	0.01%	500 m buffer from kimberlites and diatremes	50.3	0.03%
250 m buffer from faults, shear zones and fold axes	2571.3	1.50%	1 000 m buffer from faults, shear zones and fold axes	10819.9	6.30%
1 000 m buffer from artesian boreholes and artesian SOEKOR wells (KL 1/65, SA 1/66, VR 1/66, CR 1/65)	34.55	0.02%	5 000 m buffer from artesian boreholes and artesian SOEKOR wells (KL 1/65, SA 1/66, VR 1/66, CR 1/65)	863.7	0.50%
1 000 m from town water supply wellfields	74.42	0.04%	5 000 m from town water supply wellfields	624.7	0.36%
500 m buffer upslope and downslope of cold springs	11.74	0.01%	1 000 m buffer upslope of cold springs and 500 m buffer downslope of cold springs	44.4	0.03%
1 000 m buffer around thermal springs	15.69	0.01%	1 000 m buffer around thermal springs	15.7	0.01%
			10 km buffer from towns and highly populated areas within the Central Karoo	27438.3	15.97%
Total	**81067.8**	**49.18%**		**99050.46**	**59.65%**

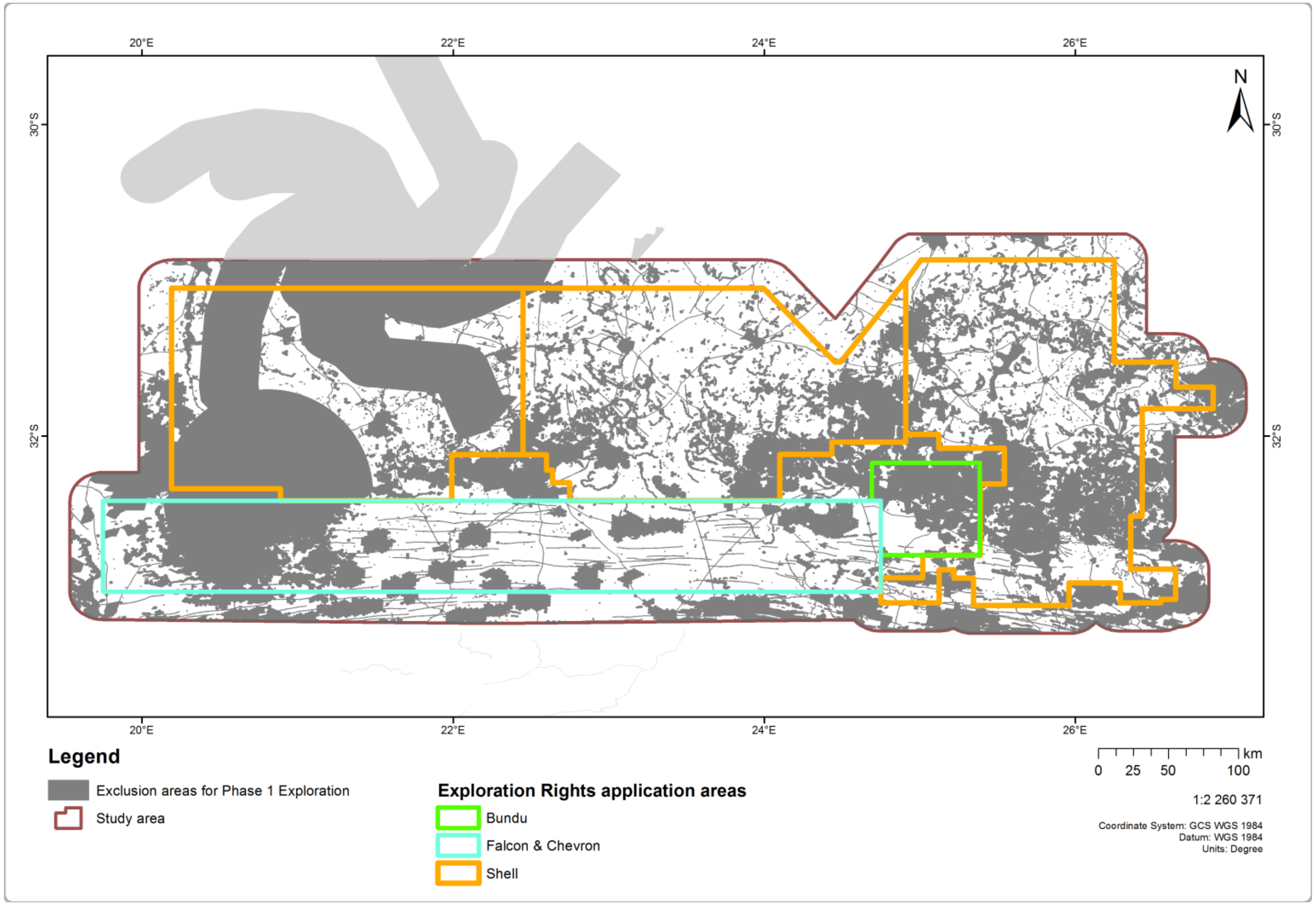

Figure 6–4: Proposed exclusion areas for Phase I Exploration in relation to the current EMPr licence applications

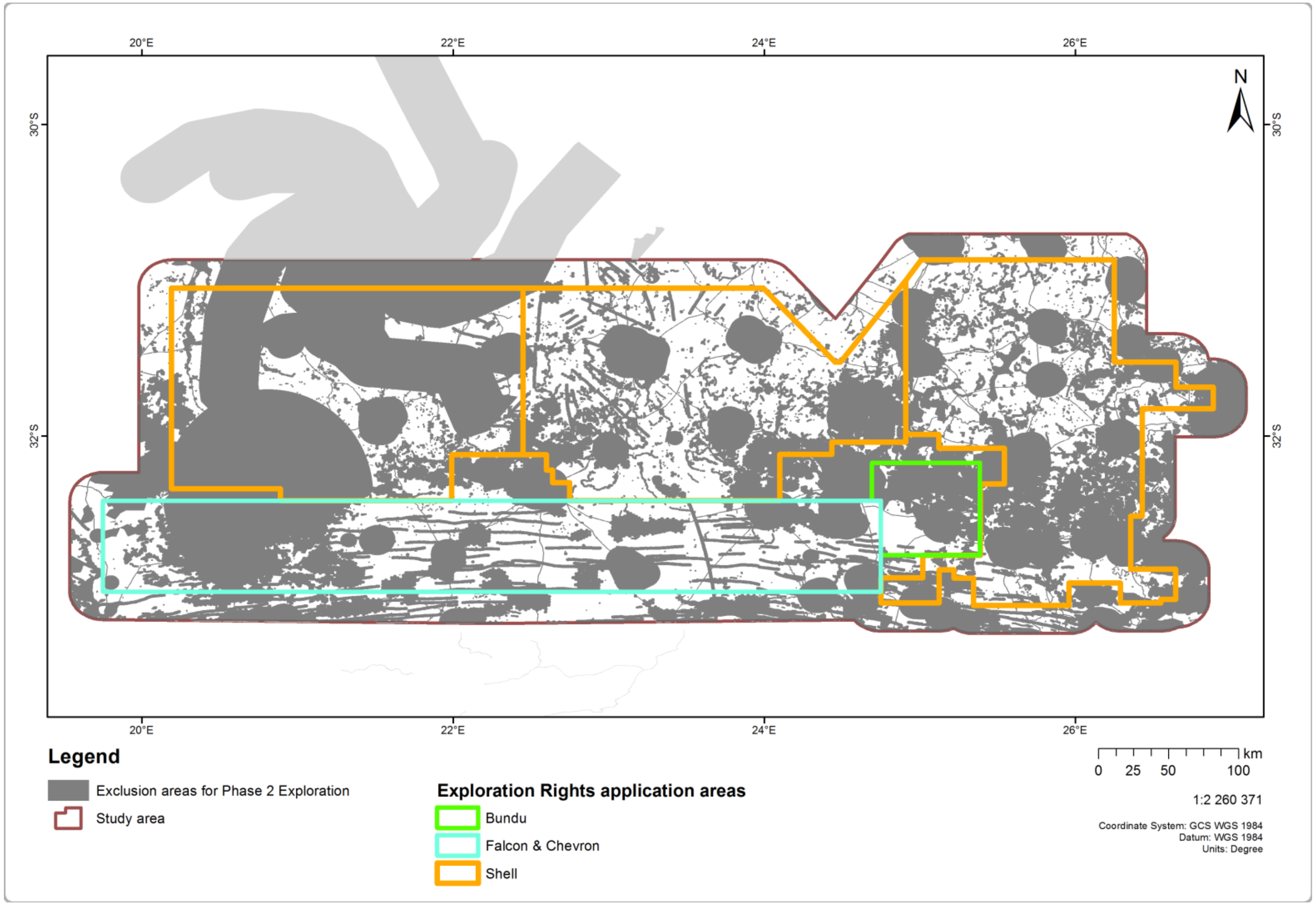

Figure 6–5: Proposed exclusion areas for Phase II Appraisal in relation to the current EMPr licence applications

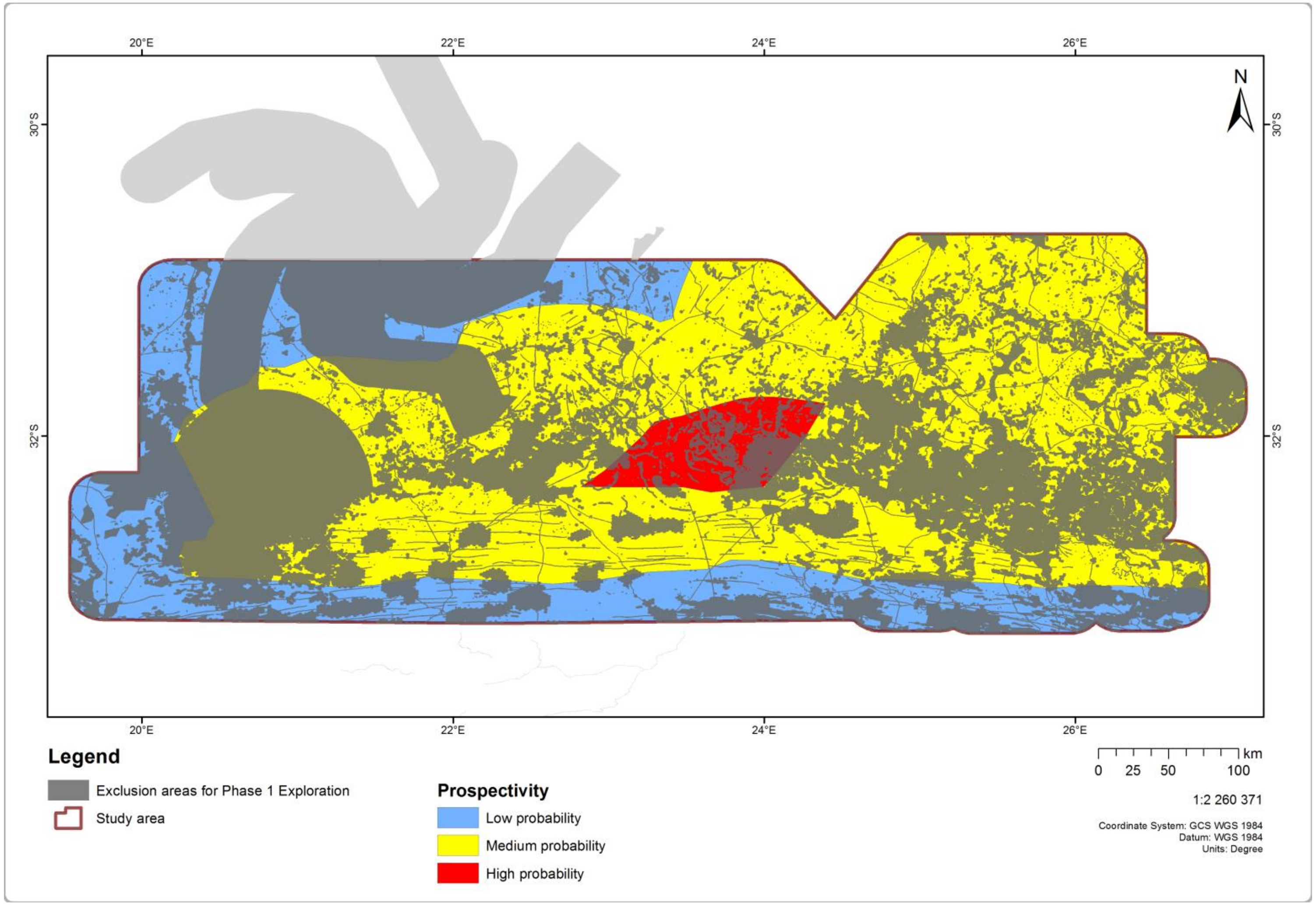

Figure 6–6: Proposed exclusion areas for Phase I Exploration in relation to current understanding of shale gas prospectivity

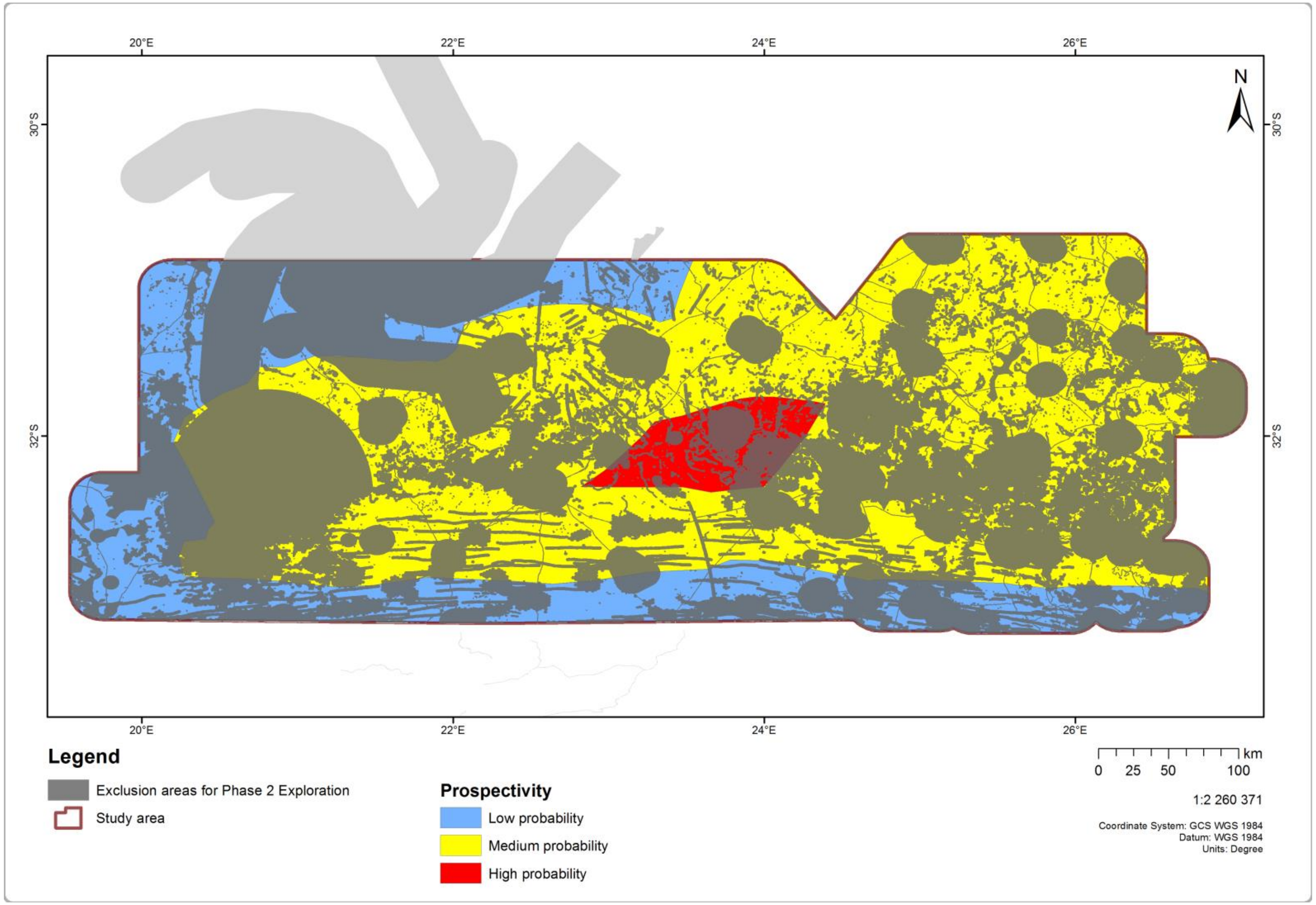

Figure 6–7: Proposed exclusion areas for Phase II Appraisal in relation to current understanding of shale gas prospectivity

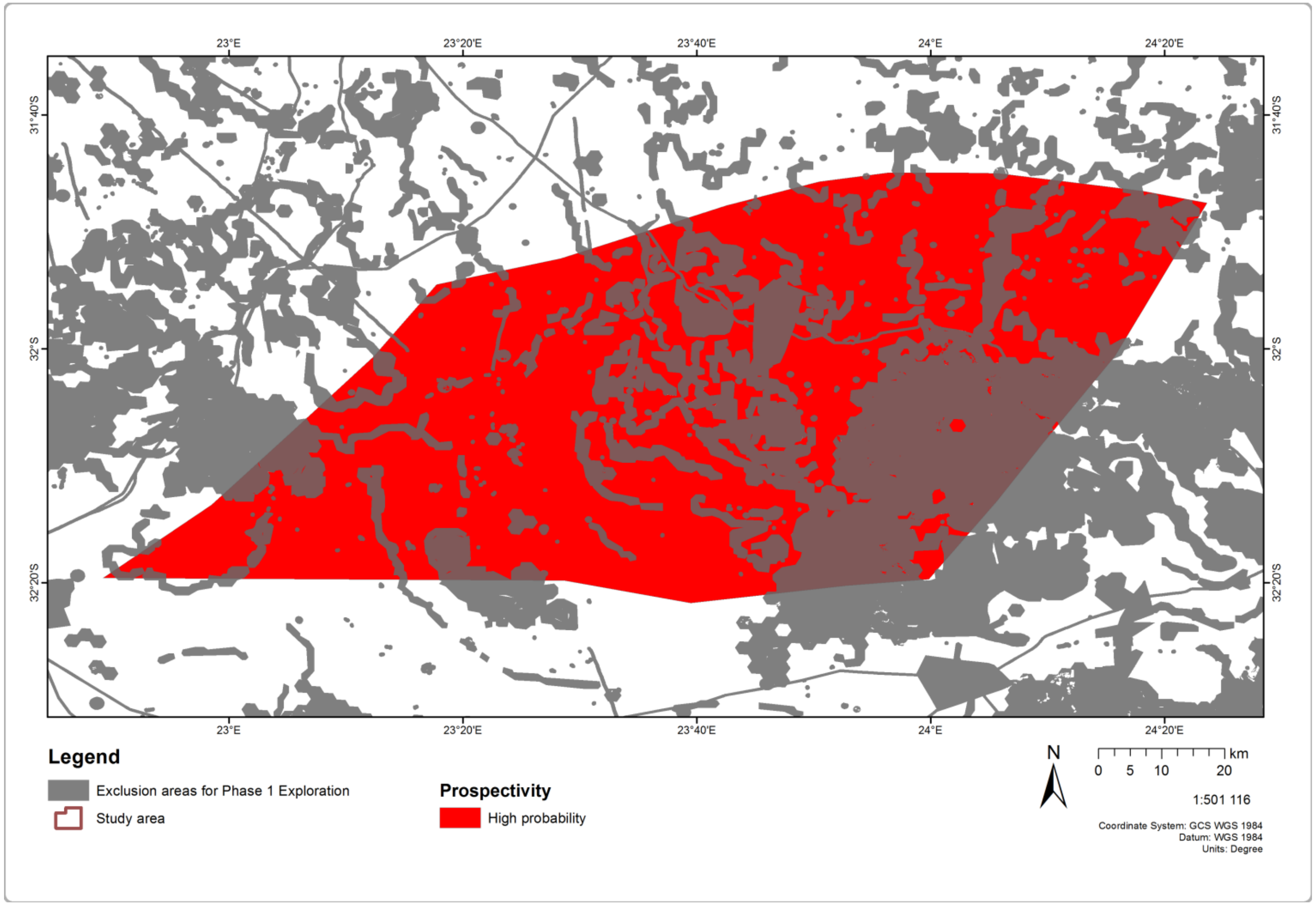

Figure 6–8: Proposed exclusion areas for Phase I Exploration in relation to shale gas prospectivity – "zoomed" into area of highest prospectivity

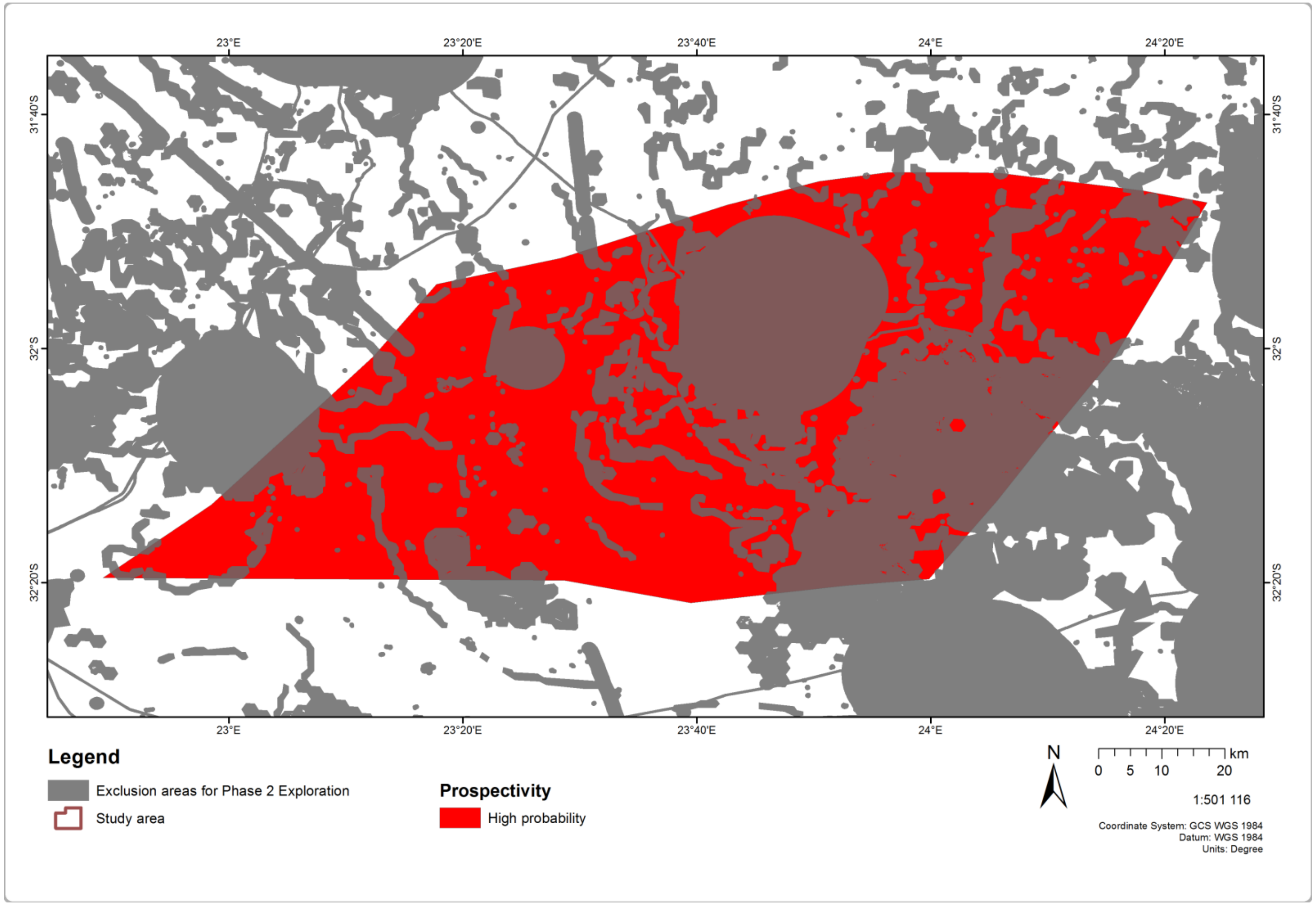

Figure 6–9: Proposed exclusion areas for Phase II Appraisal in relation to shale gas prospectivity – "zoomed" into area of highest prospectivity

6.1.1.2 Proposed Exclusion Areas at a Site-Specific Level of Assessment

Because of the uncertainty in aspects of the spatial data at the strategic level of assessment, the following features must be delimited during a site-specific EIA process with buffer areas applied which are appropriate to the site-specific spatial context. Table 6-3 outlines these buffer areas and provides guidelines for the buffer distances, which will have to be determined at a site-specific level, on a case by case basis.

Table 6–3: Site-specific buffer guidelines to be determined during the EIA level of investigation

Feature/s	Mitigation of impacts	Buffer distance recommendations
Exploration Phase I ("Exploration")		
Deep recharge zones	6, 7	Investigate these zones in detail during the EIA to delineate any flowpaths to shallow aquifers and then buffer accordingly on a case-by-case basis.
Artificial recharge areas (current and future)	6, 7	Exclude areas 5 km around artificial recharge areas, based on the setback distance in regulations GN R466 for water supply wellfields. Should such areas be managed in terms of inducing maximum drawdowns, then site-specific studies must be carried out to determine the required setback.
Groundwater source zones	6, 7	Not within 5 km of groundwater source zones, based on setback distance for wellfields in GN R466.
Water resources (water courses including mapped dry river courses, wetlands, pans, shallow aquifers, cold and thermal springs) and water supply infrastructure (water supply boreholes, wellfields, water storage dams)	6, 7, 8, 9, 10	Exclude areas where the wet season groundwater lies at 10 m or closer to the surface. No closer than 1 km from water supply sources infrastructure (domestic, stock watering or irrigation supply borehole or downslope storage dam or water supply wellfields). Where town wellfield is not known, identify town water source, if groundwater or a combination of groundwater and surface water, then use built-up area of town and buffer by 1 km, in accordance with precautionary principle. No closer than 500 m from any thermal spring or cold spring. No closer than 500 m from any identified watercourse or other wetland type without a detailed ecological, hydrological and geohydrological investigation. Setback distance = 5 km from cold or hot springs within region of known seismic activity. Example: Middelburg cold springs area. Leeu-Gamka hot spring area. Springs with associated seismic activity may be associated with active geological structures where drilling may trigger earthquakes, and would need a larger setback than normal. As a general guideline, structures and infrastructure should be located at least 100 m from the delineated edge of any watercourse or other wetland and such that they do not impact on their condition, characteristics or function.
Faults, shear zones, fold axis, dolerite	6, 7, 8, 9, 10,	No hydraulic fracturing chemicals storage, waste or waste water management infrastructure, fuel depots or

Feature/s	Mitigation of impacts	Buffer distance recommendations
dykes and sills, kimberlites and diatremes	11	sanitation infrastructure within 250 m of geological features without a detailed geohydrological investigation.
Regions of ecological sensitivity	8, 9, 10, 12, 14, 27, 34	National Protected areas and regions of Very High and High ecological sensitivity mapped at a fine scale during the EIA process would be considered exclusion areas.
Regions of EMI sensitivity	35	The SKA will undertake a high level assessment for a specific site - a quick desktop analysis which takes into account the local conditions at that site. If SKA identify any potential risks, they would do a more detailed assessment and propose mitigation strategies. It is highly likely that SKA would do this for the first few - and as they build up a level of confidence in the risks associated with shale gas development (types of equipment being used, profile of EMI emissions), SKA could provide significantly quicker turnaround times and perhaps provide a template for mitigation (as they are starting to do with renewable energy facilities). The mitigation required per sensitivity class, is 5 dB for Low sensitivity regions, 10 dB for Medium sensitivity regions, 15 dB for High sensitivity regions, and > 20 dB for Very High sensitivity regions.
Regions of visual sensitivity including popular tourist routes	14, 24, 25, 27, 31	Regions of Very High and High Visual sensitivity, confirmed at an EIA level of assessment would be considered exclusion areas. At the local project scale this would be determined through viewshed mapping and public participation, and by means of the regulatory framework, usually as part of the EIA process. Sensitive landscape features should normally be identified during SDF and EMF planning processes. Setbacks and exclusion zones would to some degree define levels of acceptable change and may relate to: • Topographic features • Restricting development on steep slopes (>10^{o}), elevated landforms • Away from major rivers, water bodies (see previous impacts on water) • Cultural landscapes • Graded heritage sites and cultural landscapes • National Parks • Nature Reserves • Provisions included in local authority planning documents • Scenic routes and passes • SALT exclusion zone
All sites formally protected under the NHRA including National and Provincial Heritage Sites, Grade I, Grade II and Grade III Sites and all heritage register	28, 29, 30	> 1 km buffer

Feature/s	Mitigation of impacts	Buffer distance recommendations
sites in the Northern and Eastern Cape		
Other archaeological sites, graves and graveyards and palaeontologically sensitive areas	28, 30, 31	> 50 m from all shale gas exploration activities
Exploration Phase II ("Appraisal")		
Identifying relevant geological structures	5, 14, 16, 18, 22-25, 28-31, 35	The sub-surface should be mapped prior to hydraulic fracturing operations for the presence of faults, shear zones, fold axis, dolerite dykes and sills, kimberlites and diatremes and the measurement of their properties as well as other relevant structures of concern. Artesian features and hot springs must also be mapped, noting that geological structures plotted on the 1:1 000 000 scale data from the Council for Geoscience (CGS) does not show all possible geological features that are present, and need to be identified on a more localised scale. During the EIA, 1:50 000 geological structure data should be used to determine setback distances for these features. Seismic data may also be used to determine sensitive geological structures, and the CGS has deployed six new seismic stations in the proposed Shell exploration areas, of which three, near Graaff- Reinet, are already operational. The setback distance should be based on a reasonable risk analysis of hydraulic fracturing increasing the pressures within the fault/fracture. The properties of the target shale gas formation and upper bounding formations should be verified, post-hydraulic fracturing, to assess how the hydrogeology will change.
Municipal water well fields, artificial recharge areas, areas of shallow groundwater (<10m) or groundwater source zones.	6, 13,15, 20,	Not within 5 km, measured horizontally, from the surface location of an existing municipal water wellfield and identified future wellfields and sources and directional drilling may not be within 2.5 km of municipal wellfields. Apply this setback distance for artificial recharge areas and groundwater source zones as well. Where town wellfield is not known, identify town water source, if groundwater or a combination of groundwater and surface water, then use built-up area of town and buffer by 5 km, in accordance with precautionary principle. Exclude areas where the wet season water table lies at or closer to 10 m from the surface.
Water supply boreholes or water storage dams	6, 13,15, 20	Not within 500 m, measured horizontally, from the surface location of existing water borehole and directional drilling may not be within 500 m of the borehole. No closer than 1 000 m from any domestic, stock watering or irrigation supply borehole or downslope storage dam, and directional drilling may not be within 500 m of the borehole.
Watercourses	8, 9, 12, 13	No closer than 500 m from the 1:100 year floodline or outer edge of the riparian zone (whichever is the

Feature/s	Mitigation of impacts	Buffer distance recommendations
		greater) of any watercourse or from the temporary or other outer edges of any other wetland type
Pans (isolated wetlands)	8, 9, 12, 13	No closer than 300 m from the delineated temporary edge of any perched, isolated seasonal pan (i.e. not on a drainage line)
Cold springs	8, 9, 12, 13	1 000 m buffer upslope of cold springs. 500 m buffer downslope of cold springs.
Thermal springs (water temperature >25º C), artesian boreholes, artesian aquifer zones and artesian SOEKOR wells.	8, 9, 12, 13	Calculate buffer zone after Hobbs et al., 2016. Guideline is setback distance of 1 000 m from centre point where no temperatures available and setback distance of 5 000 m from thermal springs within region with known seismic activity.
Dykes	4, 6, 7, 8, 9, 10	Dyke width can be measured in the field, estimated from high-resolution aerial photography or aeromagnetic imagery, or by using of the equations in Hobbs et al., 2016. If the estimated width of the calculated dyke buffer is <250 m, set buffer to 250 m.
Kimberlites and diatremes	4, 6, 7, 8, 9, 10	500 m radius from centre point of structure
Faults, shear zones and fold axis	4, 6, 7, 8, 9, 10	1 000 m from centre line of structure
Dolerite sills	4, 6, 7, 8, 9, 10	250 m from rim of surface outcrops
Undifferentiated geophysical anomalies	4, 6, 7, 8, 9, 10	1 000 m from centre line of feature
Regions of ecological sensitivity	8, 9, 10, 12, 14, 27, 34	National Protected areas and regions of Very High and High ecological sensitivity mapped at a fine scale during the EIA process would be considered exclusion areas.
Regions of EMI sensitivity	35	The SKA will undertake a high level assessment for a specific site - a quick desktop analysis which takes into account the local conditions at that site. If SKA identify any potential risks, they would do a more detailed assessment and propose mitigation strategies. It is highly likely that SKA would do this for the first few - and as they build up a level of confidence in the risks associated with shale gas development (types of equipment being used, profile of EMI emissions), SKA could provide significantly quicker turnaround times and perhaps provide a template for mitigation (as they are starting to do with renewable energy facilities). The mitigation required per sensitivity class, is 5 dB for Low sensitivity regions, 10 dB for Medium sensitivity regions, 15 dB for High sensitivity regions, and > 20 dB for Very High sensitivity regions.
Regions of visual sensitivity including popular tourist routes	14, 24, 25, 27, 31	Regions of Very High and High Visual sensitivity, confirmed at an EIA level of assessment would be considered exclusion areas. At the local project scale this would be determined through viewshed mapping and public participation, and by means of the regulatory framework, usually as part of the EIA process. Sensitive landscape features should normally be identified during SDF and EMF planning processes. Setbacks and exclusion zones would to some degree define levels of acceptable change and may relate to: • Topographic features

Feature/s	Mitigation of impacts	Buffer distance recommendations
		• Restricting development on steep slopes (>10°), elevated landforms • Away from major rivers, water bodies (see previous impacts on water) • Cultural landscapes • Graded heritage sites and cultural landscapes • National Parks • Nature Reserves • Provisions included in local authority planning documents • Scenic routes and passes • SALT exclusion zone
All sites formally protected under the NHRA including National and Provincial Heritage Sites, Grade I, Grade II and Grade III Sites and all heritage register sites in the Northern and Eastern Cape	28, 29, 30	> 10 km buffer
Other archaeological sites, graves and graveyards and palaeontologically sensitive areas	28, 29, 30	> 50 m from all shale gas exploration activities

6.1.2 Spatial Risk Modelling to Determine Production Level Thresholds

The risk model presented in Section 5.2 shows a mosaic of cumulative risk, evolving across the scenarios. Risks range from Low to Very High in the study area, with higher risk areas prevalent towards the eastern portion of the study area. This may be attributed to more variable landscape features in the east which are characterised by a denser distribution of towns (Burns et al., 2016), more diverse habitats and a greater concentration of protected and sensitive areas (Holness et al., 2016), higher agricultural production potential (Oettlé et al., 2016) and an increased concentration of scenic resources and landscapes (Oberholzer et al., 2016).

Without mitigation, the risks associated with shale gas development from the Exploration Only to Big Gas scenarios increase incrementally from Moderate - Very High; to High - Very High. Effective implementation of mitigation and best practice principles may reduce the risk profile to low-moderate for Exploration Only, and overall Moderate - High for the Small- and Big Gas scenarios.

At the strategic-level of assessment, the risks associated with Exploration Only could be mitigated to between Low and Moderate (considering both spatial and non-spatial risks). Good practice mitigation is reliant on the veracity of the future decision-making processes. These should be guided by evidence-based policies, robust regulatory frameworks and capacitated institutions in a manner that is ethical, responsible and transparent.

In the Exploration Only scenario, there are some Moderate risks even after mitigation is applied. These include impacts to physical security and altered local social dynamics; occupational exposure to air pollutants on drilling sites; EMI within Very High sensitivity areas; local road construction and regional pressure on road infrastructure; spatial and development planning and governance capacity. The impact of altered power dynamics is the sole impact assessed as High after mitigation within the Exploration Only scenario.

With mitigation, the Small Gas scenario shows mosaics of Low and Moderate risk scattered through the study area, with the eastern highlands dominated by High risk landscapes. There are reasonably sizeable regions of Moderate risk located in or around the location of the highest shale gas prospectivity (between Beaufort West and Graaff-Reinet). Moderate risk is defined as: Unlikely (1:100 to 1:20 of having a moderate or greater impact); or if more likely than this, then the consequences are substantial but less than severe, because although an important resource or attribute is impacted, the effect is well below the limit of acceptable change, or lasts for a duration of less than 3 years, or the affected resource or attributes has an equally acceptable and un-impacted substitute.

With mitigation, the Big Gas scenario demonstrates increased proportions of High risk regions and fewer regions of Moderate and Low risk. As defined at the outset of the risk assessment and modelling process, High risk is considered to mean: Greater than 1 in 20 chance of having a severe impact (approaching the limit of acceptable change) that persists for >3 years, for a resource or attribute where there may be an affordable and accessible substitute, but which is less acceptable.

The risk modelling indicates that based on the twelve spatial impacts modelled spatially, it would seem that as gas resources increased upwards of 5 tcf (decades into the future), decision-makers will need to pause and reassess the scale and extent of shale gas production activities and the degree to which they conform with international, national and local development agendas for energy resources. This is the basis upon which it is proposed in Table 3-1, that an additional EIA process is undertaken should shale gas production exceed 5 tcf.

The limits of acceptable change associated with shale gas exploration and production can be conceptually developed through predicative landscape modelling exercises as has been undertaken above; they can also be developed in specific response to the 38 key impacts posed by shale gas exploration and production developed per chapter topic in the independent Scientific Assessment phase of the SEA. These topic specific limits of acceptable change are based on national policy, plans, legislation, regulations and guidelines plus key learning from international best practice and are detailed in Table 6-4 below.

Should exploration activities ever advance to production, even the risk associated with production can be largely offset by using avoidance as the primary mechanism of mitigation. Within a resource and infrastructure scarce environment like the Central Karoo means that if shale gas is ever produced in the volumes contemplated in the Small and Big Gas scenarios, it would be concentrated within gas “sweet-spots” which would be determined based on a proved petroleum reserve in the Central Karoo following intensive seismics programmes and exploratory drilling, which may last up to and exceeding 10 years. The sweet-spots areas of hypothetical production would in turn need to be supported by, within near-immediate spatial proximity, industrial processing facilities to generate inputs to the shale gas development cycle e.g. water, proppant, hydraulic fracturing fluids, traffic volumes etc. and to manage the outputs of the shale gas development cycle e.g. product gas and associated infrastructure, wastes streams, traffic volumes etc.

The significance of this is that shale gas production in the Central Karoo will, in all technical likelihood, be concentrated within contained development wellfields, about 30 x 30 km in size. The need for any extensive production of shale gas reserves to be undertaken within confined well-fields is further accentuated by the depth at which Economically Recoverable shale gas might exist in the Karoo Basin. Current estimates are that hydraulic fracturing and recover of gas would only occur at depths, probably in excess of 2.5 km beneath the surface of the earth. This is significantly deeper (and hence more expensive) than the vertical wells drilled in the USA. Thus, in order to make shale gas in the Central Karoo a technical possibility, a significant number of horizontal wells (> 10) will need to be drilled from the vertical borehole in order to make it a financially viable option. This means that only 55 wellpads would be required for Small Gas and 410 wellpads for Big Gas assuming 10 production wells were drilled per well pad (this could reduce, if say, 15-20 well are drilled which is entirely plausible).

Should exploration move into production, the concentration of production wellfields and very low surface area that they would cover, would allow for suitable and strategic management of risks based on the avoidance of sensitive features in the receiving environment. This would follow a significantly different development path compared to that of, for example the USA, which was undertaken under substantially different geological conditions; with the free availability of skills, infrastructure and services; under markedly different regulatory conditions (i.e. where land owners owned the petroleum reserve); and at a time when the international market was ‘gas hungry’. The potential for rapid, unchecked and sprawling growth of shale gas production in the Central Karoo is thus very low given the geological, technological and regulatory environments of South Africa and the Central Karoo.

6.1.3 Limits of Acceptable Change as Non-Spatial Guidelines

Table 6–4: Guidelines on non-spatial limits of acceptable change

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
1	Energy infrastructure that does not match domestic shale gas supply	IEP 2015, IRP 2010, IRP 2013, GUMP 2015 (draft).	**Stranded or unutilised infrastructure is not acceptable.** In addition, a lack of sufficient infrastructure to process gas and evacuate electricity is equally unacceptable. The IEP 2015, IRP 2010, IRP 2013, GUMP 2015 (draft) will ensure that unnecessary energy infrastructure is not constructed without proving the viability of a long-term commercially extractible resource. In addition, the documents provide the framework to ensure that, if shale gas is found in sufficiently large volumes and at flow rates that promote a commercial viability, there will be sufficient energy infrastructure to allow for generation and evacuation of gas or electricity.
2	Availability of sufficient network capacity to evacuate gas and gas fired power generation		
3	Exposure to air pollutants	NEM:AQA 2004, NAAQS 2009, Hazardous Chemical Substances regulations of the Occupational Health and Safety Act of 1993, the MPRDA technical regulations 2015.	**Any legal person undertaking shale gas exploration or production will require an AEL which must be based on the community exposure standards from NAAQS (2009)**. The Hazardous Chemical Substances regulations of the Occupational Health and Safety Act of 1993 specify the allowed exposure limit over eight hour shifts, and are generally based on the guidelines produced at regular intervals by the American Conference of Governmental Industrial Hygienists. Best practice regarding worker risk to silica inhalation is found in the Controls and Recommendations to Limit Worker Exposures to Respirable Crystalline Silica at Hydraulic Fracturing Work Sites (2013) see http://www.tandfonline.com/doi/suppl/10.1080/15459624.2013.788352/suppl_file/uoeh_a_788352_sm4302.pdf
4	Fugitive emissions	The Paris Agreement of 2016,	**The most complete set of emission standards for unconventional gas exploration and recovery has been**

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
		National Climate Change Response White Paper of 2011, Nationally Determined Contribution of 2015, Priority Air Pollutants of 2016 (draft), Pollution Prevention Plans of 2016, GHG reporting guideline of 2015.	**developed by the United States Environmental Protection Agency.** These rules are currently undergoing further review and refinement see https://www.gpo.gov/fdsys/pkg/FR-2012-08-16/pdf/2012-16806.pdf. National climate policy requires reporting of GHG emissions that is mandatory for entities that emit more than 0.1 Mt of GHGs annually. DEA has published for comment draft regulations declaring GHGs as priority air pollutants, regulations requiring the submission of Pollution Prevention Plans and GHG reporting guidelines. With shale gas exploration and production likely to exceed 0.1 Mt CO_2-eq per year, it is expected that developers will be subject to these and any further regulations, including possible company-level carbon budgets. Such reporting will contribute to South Africa's implementation and achievements of its Nationally Determined Contribution, as required under the Paris Agreement. South African standards do not exist for levels of air pollution related to impacts on crops and vegetation. Internationally, there are guidelines for critical levels for air pollution related to impacts on crops and vegetation (Convention on Long-range Transboundary Air Pollution). Ozone impacts agriculture and ecosystems at concentrations lower than ambient air quality standards for health, partially due to the importance of cumulative exposure of crops and vegetation. The United Kingdom critical level using AOT40 for ozone (i.e. cumulative exposure above 40 ppb during daylight hours over a three month growing season) for crops and semi-natural vegetation is 3000 ppb hours (Air Pollution Information System). However, it is not known what the critical level may be for the vegetation in the study area see https://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf
5	Occurrence of a damaging earthquake M>5	The MPRDA technical regulations.	**Damaging earthquakes (M>5) in populated regions or areas which contain high concentrations of heritage resources are not acceptable.** Many thousands of hydraulic fracture wells have been drilled worldwide. Most only caused micro-seismic events (M<3) imperceptible to humans, while none of the few felt events have caused any damage. The occurrence of a damaging earthquake (M>5) anywhere in the study area is considered to be very unlikely. To date, all damaging events associated with fluid injection are associated with the disposal of large volumes of waste water, not hydraulic fracturing. The disposal of waste water by injection into underground aquifers is forbidden by current South African legislation. Identification of Very

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			High and High sensitivity regions from a seismicity perspective are indicated as a 20 km buffer around towns in Figure 4-2. While a 20 km buffer area around towns would reduce the risk of hydraulic fracturing from Moderate to Low, it would not at this this stage make sense to delimit areas 20 km around towns as 'exclusion areas' for the reason of seismicity alone.
6	Reduced water availability for people and other economic activities	The NWA, the Water Services Act of 1997 and the and SANS for Drinking Water and Waste Streams of 2015	**Water for utilised for shale gas development from existing local sources is unacceptable**. Water availability in the study area is severely constrained. Surface water availability is generally low, and in many areas over-allocated. Landowners rely mainly on groundwater resources for domestic and stock water. Groundwater recharge is typically low and sporadic. The use of groundwater is increasing, particularly during drought years. In many areas, groundwater already supplies 100% of the use. The availability of groundwater to meet the demand of even the Reference Case (where there is no development), is already seriously constrained. The additional demand under the Small and Big Gas scenarios could not be met from known local potable resources and would be considered a Very High risk if local resources were utilised. The Water Services Act governs the provision of water services and promotes effective water resource management and conservation. Municipalities must ensure that water of a specific quality is provided, must ensure assurance of supply and must ensure sanitation.
8	Physical disturbance of watercourses	The NWA and the NEMA	• Regulation 4 (NWA, GN 704): No person in control of a mine or activity may locate or place any residue deposit, dam, reservoir together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 m from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked. • Regulation 5 4 (NWA, GN 704): No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource. Other relevant regulations are GN 1199, which specifies conditions for impeding or diverting flow or altering the bed, banks, course or characteristics of a watercourse to persons using water under Sections 21 (c) and (i)

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			of the NWA. In these regulations, no water use is allowed within a 500 m radius from the boundary of a wetland. Also, **altering the bed, banks, course or characteristics of a watercourse is not allowed within the 1:100 floodline or within the riparian habitat,** whichever is the greatest. The most effective management action is to avoid Very High and High sensitivity water resources. These have been mapped, at a high-level in Figure 4-4. The sensitive areas are deliberately conservative, considering the low confidence in scale and available data. Additional investigations will be required at EIA level to determine 'no-go' areas. It can be stated with reasonably high confidence that shale gas activities located in areas of Medium-Low sensitivity will reduce the risk profile to Low and Very Low for all direct water impacts. **Any impact that results in deterioration in resource quality of high negative significance if assessed at an EIA level of investigation – even if associated with only one attribute or one water quality variable, would be considered unacceptable.** The water quality guidelines for aquatic ecosystems and agriculture should be used as a guide to what constitutes a significant change in a water quality variable, bearing in mind that pre-shale gas development conditions might already exceed some of these thresholds. This emphasises the importance of undertaking extensive pre-development monitoring.
9	Contamination of surface water resources as a result of spills and flowback discharge into surface systems	The NWA and the South African Water Quality Guidelines of 1996.	**Any impact that would result in degradation of any aspect of water resource to a level less than the desired Management Class (MC) for that resource component is unacceptable.** The MC represents the desired characteristics of the resource and outlines those attributes that the custodian (DWS) and society require of different water resources. The outcome of the Classification Process will be the setting of the MC, Reserve and Resource Quality Objectives (RQO's) for every significant water resource. The aim of this process is therefore to help facilitate a balance between protection and use of the nation's water resources. Note that the MC has not yet been set for the study area, and would need to be set before any shale gas development-associated resource use is considered in the Central Karoo. Target water quality ranges for surface water use are provided for in the South African Water Quality Guidelines (1996) – for (1) Agricultural Water Use for Irrigation, (2) Agricultural Water Use for Livestock Watering and for (3) Aquatic Ecosystems.
10, 7	Contamination of surface resources as a result of		

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
	contact with contaminated groundwater		
11	Exposure to hazardous and domestic waste and additional sewage load	The MPRDA technical regulations; NEMA, NEM:WA, NWA, National Nuclear Regulator Act of 1999, National Road Traffic Act of 1996, Disaster Management Act for 2002	**Discharge of hydraulic fracturing fluids, flowback, and produced water into a water source is unacceptable and is prohibited by the technical regulations.** In terms of the regulations, treated surplus water not recycled back into the operations may be discharged into surface water resources provided that it meets quantity and quality limits stated in the applicable water use licence (see previous section on water); however this does not conform to the principles of the waste management hierarchy. Facilities for the disposal of domestic solid waste, generated by workers deployed to the study area and migrants are limited to small and communal disposal sites. As at 2007, only twelve sites were estimated to have 15 years or more airspace remaining, the other sites are likely to be filled up by now. Additional waste generated for all development scenarios will put pressure on these already constrained waste disposal facilities. All landfills in the study area require upgrades to meet the requirements of the National Norms and Standards for Disposal of Waste to Landfill. Recycling initiatives in the Karoo are limited due to relative low volumes and large transport distances to markets for recyclables. Many of the waste water infrastructure facilities in the Central Karoo have been placed under regulatory surveillance or require immediate interventions. The risk associated with treatment of fluid waste at municipal waste water treatment facilities relates to design capacity, operational flow, and number of non-compliance trends in terms of effluent quality and compliance or non-compliance in terms of technical skills. **As such, disposal of liquid waste at domestic waste water treatment facilities is not acceptable.** Liquid waste from Exploration Only to Small Gas could be dealt with by modular, on-site treatment facilities which are commercially available for liquid waste volumes in the region of 101 400 m^3 – 6 000 000 m^3 respectively. For waste volumes exceeding 6 000 000 m^3 and up to 40 000 000 m^3 (in the case of Big Gas), construction of a new on-site or centralised disposal facility could be triggered. The cost of establishing or upgrading of treatment facilities for treatment of liquid waste from shale gas development should be for the account of the developer and not that of the municipality. All Type 1 hazardous waste generated will have to be transported to a suitably designed and authorised hazardous waste disposal site in

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			Gauteng, Port Elizabeth or Cape Town. The shale gas development industry, and not local municipalities, should be responsible for the treatment of waste streams onsite and safe disposal thereof emanating from exploration and production operations. Transportation and disposal of waste must be undertaken in accordance with the National Road Traffic Act of 1996, Disaster Management Act for 2002. Naturally occurring Radioactive Materials must be managed in line with the National Nuclear Regulator Act of 1999.
12	Impacts on ecological and biodiversity processes	The NEMBA, The National Environmental Management: Protected Areas Act of 2003, National Biodiversity Strategy and Action Plan (NBSAP), the NBA, the NPAES, Atlas of FEPAs, and provincial spatial biodiversity plans	**No loss or degradation of Very High sensitivity areas is acceptable**. These areas are irreplaceable and no ecologically equivalent areas exist for securing the features they contain. **In High sensitivity areas, loss or degradation is acceptable only if ecologically equivalent sites are identified and secured through biodiversity offsets or equivalent mechanisms.** An ecologically equivalent site means a site that contains equivalent ecological processes, ecosystems and species, and that compensates for the full ecological impact of the activity as identified through a detailed study. In addition, loss or degradation of High sensitivity areas will result in the need to identify additional sites from within Medium sensitivity areas for inclusion into High sensitivity areas, in order to meet targets for ecological processes, ecosystem and/or species. The limits of acceptable change in High sensitivity areas are determined by the ability to find ecologically equivalent sites in the remaining intact Medium sensitivity areas. **Loss or degradation of Medium sensitivity areas is acceptable, as long as there is no impact on Very High and High sensitivity areas**. Activities that are authorised in Medium sensitivity areas need to be assessed for potential impacts on Very High and High sensitivity areas. In Low Sensitivity areas, site-level impacts are not significant from a biodiversity or ecological point of view. Change is acceptable as long as it does not impact on Very High or High Sensitivity areas. Refer to Figure 4-4 which indicates corresponding sensitivity classes Very High, High, Medium and Low for biodiversity and ecosystem services.
13	Impacts of farming and agriculture	The Conservation of Agricultural Resources of 1983.	**Shale gas development activities cannot compete with water currently used for local agricultural purposes. Any contamination of existing water resources will be an unacceptable level of change.**
14	Reduction in tourist numbers and	NDP (2012), Medium Term Strategic Framework for 2014	**>20% of tourism enterprises, tourism job losses of >2 660, and a losses >R 500 million Gross Value Add are unacceptable.** Additionally, limits of acceptable change can be determined through identifying activities

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
	enterprises	– 2019, National tourism plans and Provincial and regional tourism plans	that should be prohibited entirely or within certain regions. In this regard, it is suggested that risk can be significantly reduced by lessening the impacts of traffic densification by 1.) creating "no-go" roads for heavy load haulage and 2.) promoting the use of railway rather than tourist roads which are mapped as Very High sensitivity (see Figure 4-6). Routes that should be considered "no-go" areas are the N9 between George and Colesberg and mountain passes such as the Swartberg, Outeniqua, Wapadsberg, Lootsberg, Huisrivier and Robinson. The idea of the exclusion of trucks from specific routes is not new. For instance, in California commercial vehicles with three or more axles, or a gross vehicle weight of >4 000 kg, are prohibited on Route 2 between the City of La Canada Flintridge and County Route N4 see special route restrictions at http://www.dot.ca.gov/trafficops/trucks/restrict-list.html.
15	Impacts to public finances associated with externality costs	The Constitution, the MPRDA, the NEMA – polluter pays principle, financial provisioning	Establishing that a given action is economically desirable generally requires that one can show that it is still likely to result in a net benefit to society even when all externalities are taken into account or 'internalised'. The most effective way to achieve this is through mitigation or compensation to the point when externalities are effectively dealt with. **The limit of acceptable change is then up to the point at which externalities cannot be mitigated or compensated for.** Going beyond this point generally results in significant and pervasive risks to other sectors thereby risking the emergence of an unsustainable, under-diversified and far less robust economy. It is anticipated that while, in the short term, the Central Karoo will benefit from increased job opportunities and economic activity associated with well establishment, the benefits will decline in the long term. The benefits associated with the production of shale gas will be remote from the Central Karoo (e.g. gas processing facilities and power generation). It will therefore be important to ensure that the gas industry contributes to investing in a legacy of sustainable alternative livelihoods for local communities.
16	Impacts to property values near wellpads		Compensation payments to landowners for the use of their land during shale gas development would need to be guided by the principle of comfortably compensating landowners for all impacts and losses. They would need to be based on best practice and include elements for loss of land value, future income, assets or infrastructure and have a solatium element. There is a need to establish the appropriateness and legitimacy of compensation through dialog with stakeholders. This dialogue should include agreeing on the compensation principles to be applied and, to the degree possible, fair minimum amounts or conventions/formulas for

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			establishing compensation (see Measham, T.G., Fleming, D.A. and Schandl, H. 2016. A Conceptual Model of the Socioeconomic Impacts of Unconventional Fossil Fuel Extraction. Global Environmental Change, 36, 101-110 available at: https://mpra.ub.uni-muenchen.de/68523/). Establishing acceptable compensation payments to landowners for shale gas development that are guided by processes such as the Independent Power Producers Programme is thus recommended. Aside from ensuring the fair treatment of landowners, compensation which goes beyond what is strictly required by law should also play an important role in facilitating the development of shale gas development. Interactions with land owners would be less likely to be acrimonious, reaching agreement would take less time and turning to the law to force landowners to grant access to their land is less likely to be necessary (under the MPRDA, companies with mineral exploration or extraction rights can force land owners (i.e. surface rights holders) to grant them access to their land).
17	Human in-migration	The Constitution, the NEMA, the Social Assistance Act of 2004.	**Some degree of in-migration is acceptable, as long as it does not place the local housing market under severe strain.** If there is some strain, it may kick-start private investors to expand their housing stock, which may benefit these towns in the long run (see Equitable Origin Standards for Onshore Conventional Oil and Gas Operations at: https://www.equitableorigin.org/eo100-for-responsible-energy/eo100tm-for-conventional-onshore-oil-gas/)
18	Physical security		**Decreasing municipal capacity in policing, disaster management, traffic management and significantly increased social pathologies are unacceptable.** Recruitment of labour exclusively from outside of the Central Karoo with a disregard for local employment and non-transparent procurement process is unacceptable. A fair and transparent hiring system will reduce social tensions. Racial marginalisation of groups in the Central Karoo leading to physical violence is the beyond the limits of acceptable change. A significant increase in family violence, alcohol and drug abuse and sexual crimes showing correlation and causality to shale gas development is an unacceptable limit.
19	Altered local power and social dynamics		**The widespread erosion of farmers associations, churches and other social fabric institutions is unacceptable.** Any decrease in local governance performance in planning and administering municipal services is a limit of acceptable change. Any significant increase in corruption and nepotism behaviours beyond the current levels is not acceptable.

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
20	Exposure to pollution through water contamination	The NWA, the South African Water Quality Guidelines of 1996, the MPRDA technical regulations, the Health Act of 2003.	**Standards for drinking water and purification of waste waters are legislated.** The SANS specifies the minimal quality of drinking water, defined in terms of microbiological, physical, chemical, and taste-and odour parameters at the point of delivery to the consumer. The Water Services Act of 1997, updated as SANS (2015a: 2015b), requires that water provided by water services authorities meets the specified standards. It should be noted that these standards apply only to water to be delivered to the consumer, and not to water in rivers or aquifers, where only the relevant guidelines apply. Standards are drawn from: • SANS. 2015a. SANS 241-1. Drinking water. Part 1: Microbiological, physical, aesthetic and chemical determinants. Edition 2. Standards South Africa. • SANS. 2015b. SANS 241-2. Drinking water. Part 2: Application of SANS 241-1. Edition 2. Standards South Africa. Standards were also set in the 1956 Water Act for some 23 constituents in effluents and waste waters entering a stream. While the updated version modifies the legal limits of some constituents, no additional constituents are considered. The values set for most or all of the constituents listed in the current list are derived from the South African Guidelines for Aquatic Ecosystems. One definition of acceptable risk that has been widely accepted in environmental regulation, although is not relevant to microbiological parameters, is if lifetime exposure to a substance increases a person's chance of developing cancer by one chance in a million or less. This level, which has come to be taken as 'essentially zero', was apparently derived in the US in the 1960s during the development of guidelines for safety testing in animal studies. A figure, for the purposes of discussion, of 1 chance in 100 million of developing cancer was put forward as safe. This figure was adopted by the Food and Drug Administration in 1973, but amended to one in a million in 1977. This level of 10^{-6} has been seen as something of a gold standard ever since. The US Environmental Protection Agency (EPA) typically uses a target reference risk range of 10^{-4} to 10^{-6} for carcinogens in drinking water, which is in line with WHO guidelines for drinking water quality which, where practical, base guideline values for genotoxic carcinogens on the upper bound estimate of an excess lifetime cancer risk of 10^{-5} (see http://apps.who.int/iris/bitstream/10665/42442/1/924154533X.pdf).
21	Worker physical	Health Act of 2003	An overall fatality rate of 27.5 deaths per 100 000 workers was recorded by National Institute for

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
	contact - traffic or machine injury		Occupational Safety and Health in 2012 in the USA oil and gas industry, a total that is more than seven times the death rate for all other industries (3.9 for all US workers). In South Africa, the fatality rates are considerably higher than developed countries with five times the fatality rate of developed countries. Assuming these data, 5 x 27.5 = 137.5 deaths per 100 000 workers working on shale gas development projects in South Africa. This is 7 times higher than the fatality rate of 19.2 per 100 000 for all industries currently operating in South Africa according to Department of Labour data. **137.5 deaths per 100 000 workers is thus not an acceptable fatality rate which should be less than 20 deaths per 100 000 workers, as delimited by the USA experience and Department of Labour data.**
22	Loss of sense of place to farmers, farm labourers, emerging farmers and land claimants	The NEMA and NHRA	At an EIA level of investigation, sense of place indicators should be developed through existing development processes like Environmental Management Frameworks (EMFs) and SDFs and used as limits of acceptable change. It is important to distinguish sense of place indicators as different from biophysical, cultural and natural indicators. This is because sense of place indicators are essentially relational indicators that are about the significance a particular community places on a natural or cultural artefact or space at a point in time. Sense of place values are not static but influenced by new technologies, alternative forms of energy generation, political opportunism, social movements and changes in small and multi-national business interests. The constructed nature of sense of place values means they are dynamic and open to change. They shift as individuals and communities needs and interests change. **Exactly what is understood as acceptable change is in theory open to negotiation with the stakeholders involved.** For example, some farmers may be willing to sell their farms to shale gas developers for the right price and relocate to other parts of the country. Other farmers on the other hand, might regard this as an irrevocable loss of cultural heritage and identity. Because of its intangible nature, most senses of place should survive in the face of development. However, with large-scale population influx, new cultural traditions could arrive and possibly influence the degree to which local traditions continue to be practised. Marginalised communities like the Karretjie People are already struggling and with the addition of a new economic driver these communities would be particularly vulnerable. **Unacceptable change would occur should local traditions, practices and customs be abandoned or forced out in favour of non-local ones.** The addition of a new living heritage layer would not
23	Loss of sense of place to Karretjie People		
24	Loss of sense of place to lifestyle farmers, creatives, retirees, tourists and scientists		
25	Loss of sense of place to lifestyle farmers, creatives, retirees, tourists and scientists		

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
26	Loss of sense of place to shale gas development, low-skilled workers, unemployed youth		be unacceptable though. The irreparable damage to a place that has strong associations with living heritage, such as a water hole, would also be regarded as unacceptable change.
27	Visual intrusion into the landscape	NEMA, MPRDA technical regulations, NHRA, National Parks Act, Provincial Ordinances and Municipal Bylaws, SDFs, EMFs, Municipal Zoning Schemes and Overlay Zoning Schemes, Regulations in terms of the AGAA, 2007	**Shale gas development in regions of Very High sensitivity is not acceptable** (see Figure 4-7). At the local project scale limits would be determined through viewshed mapping and public participation, and by means of the regulatory framework, usually as part of the EIA process. Sensitive landscape features should normally be identified during SDF and EMF planning processes. Setbacks and exclusion zones would to some degree define levels of acceptable change and may relate to: • Topographic features • Restricting development on steep slopes (>10^{o}), elevated landforms • Away from major rivers, water bodies (see previous impacts on water) • Cultural landscapes • Graded heritage sites and cultural landscapes • National Parks • Nature Reserves • Provisions included in local authority planning documents • Scenic routes and passes • SALT exclusion zone • SKA exclusion zone
28	Impacts on built heritage, monuments and memorials - all impacts except	The NHRA and the NEMA	**For direct impacts to built heritage, very little change can be deemed acceptable because this aspect is one of the most tangible and accessible aspects of heritage and adequate mitigation of high significance resources is generally impossible.** During field assessment at an EIA level, decisions would need to be taken based on condition, rarity, representivity and setting as to which resources and their constituent attributes could be altered or destroyed if necessary, and the degree of prior investigation and recording that might be

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
	earth tremors		required. Change would only be allowed in exceptional circumstances if it is impossible to avoid the resource.
29	Impacts on built heritage, monuments and memorials - earth tremors only		At a broader level, any long-term infrastructural development that disrupts the setting, character and sense of unity of a built heritage resource or precinct would be unacceptable. Particularly important in this regard is the potential for insensitive industrial development that could occur in or on the peripheries of intact historic towns with a strong sense of place. **Any widespread damage to built heritage resources that might occur through induced seismic activity or any other shale gas development related activity would be considered entirely unacceptable in heritage terms** and, should the possibility of such widespread damage be expected then this may be considered a fatal flaw.
30	Impacts on archaeology, graves and palaeontology		Greater than 90% of recorded archaeological and palaeontological heritage resources are of low heritage significance and can be destroyed without undue negative impact to the National Estate. A small proportion of these would require mitigation, while the remainder could be suitably recorded during the EIA Phase. Archaeological resources are unique and degrees of change are not an appropriate measure – they should either be conserved or else destroyed, either with or without mitigation depending on their significance. The nature of palaeontological resources – the majority essentially hosted by large-scale geological units that can vary spatially in palaeontological sensitivity – means that degrees of change cannot be meaningfully suggested. **Unacceptable change to archaeological and palaeontological heritage resources would therefore be if those sites set aside for in situ preservation (the other <10%) are disturbed or if sites requiring mitigation are disturbed prior to that mitigation being effected.** By necessity, archaeological and palaeontological heritage resources that do not have formal protections (declaration or grading) in place or have not been identified during earlier assessments can only be identified at the EIA phase. Only then could the number of sites requiring further attention be delineated for any particular area. While meteorites can be recorded, collected and housed in a museum, geological sites and palaeontological type localities derive their meaning from their location and can therefore not be adequately mitigated; their destruction would be unacceptable unless equally good equivalents can be designated.
31	Impacts on cultural landscapes		Cultural landscapes cannot be destroyed but their integrity is eroded and their character changed through inappropriate development. The degree of erosion is impossible to quantify and universal limits cannot be set.

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			This is partly due to the very personal nature of one's perception of the landscape and the amount of inter-observer variability that would result. Given the degree of variation in topography, vegetation cover, land use, settlement patterns and other cultural factors involved in the creation of cultural landscapes, it is likely that, given a consistent observer, the limits of acceptable change would also be strongly variable across space. In general, however, the wellpads and access roads should be sited in such a way as to not become the focus of attention when viewed from the middle to long distance. Because impacts to the cultural landscape are largely visual in nature and very variable across space, the limits of acceptable change would need to be set through the application of viewshed analysis with appropriate visual buffers established on a case-by-case basis during EIA studies. It is also necessary to consider that the merino sheep and the wind pump massively changed the cultural and economic landscape of the Karoo at the time of their introductions and are now revered as heritage. The landscape has also been changed by the ongoing addition of an astronomical layer which also has cultural significance. The introduction of shale gas development would introduce yet another new layer to the cultural landscape. However, this new layer would need to be carefully managed in order to maintain the complexity of the historical layering.
32	Disturbance to humans due to wellpad noise	the Western Cape Noise Control Regulations (2013) and national standards, the NEMA, the NEMBA	**Noise impacts which have the potential to result in significant losses to human wellbeing are unacceptable.** The NCRs state that a disturbing noise is created if the activity noise raises the ambient noise level by 3 or 7 dBA or more above the residual noise level depending on the NCR applicable to the province. A noise nuisance is created if a noise impairs the peace of a person. This is a subjective assessment, and is often closely related to audibility of the noise source, and whether the person approved of the activity related to the noise. Shale gas development must avoid obviously noise sensitive areas, such as residential properties, resorts, areas where the quiet and calm nature of the place is material to its appeal. A noise impact assessment for the planned site must be done at the EIA phase according to the methods of SANS 10328. Follow the best practice guidelines in British Standard (BS) 5228-1 for controlling noise on open sites (see BSI British Standards. 2009. BS 5228-1 Code of practice for noise and vibration control on construction and open sites - Part 1: Noise, BSI.). The predicted noise excess over residual noise from shale gas development activities at 4 km are provided in the table below. The extent to which these will be acceptable or unacceptable will have to
33	Disturbance to humans due to road traffic noise		

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			be determined on a case by case basis, especially within 5 km of point or source noise to sensitive receptors.
34	Noise disturbance to sensitive species		Animal species differ in their sensitivities to noise exposure. Some animals will be negatively impacted, for example if they require a quiet environment to hunt or to hear predators. Consequentially, prey could thrive if their natural predators can no longer find them using hearing. The extent to which noise impacts faunal species will have to be investigated on a case by case basis as part of an EIA process.
35	Electromagnetic interference impact on radio astronomy	the SARAS protection level of the AGAA, 2007	**The acceptable threshold level of interference is determined by the SARAS protection level.** Any received signal that is in excess of this protection level is deemed to be an interference source. No increase in the background EMI environment is acceptable at each of the SKA stations if it is to increase the level of EMI (as detected by an SKA station) above the SARAS protection level. Shale gas development activities in Very High sensitivity regions and within the KCAAA are not permitted in terms of the AGA. All shale gas development activities outside of the KCAAA, but within the sensitivity classes would be subject to specific mitigations per class. At a site specific level the SKA would need to be informed of the exact location of the development activities. The SKA will undertake a high level assessment for a specific site (quick desktop analysis which takes into account the local conditions at that site). If SKA identify any potential risks, they would do a more detailed assessment and propose mitigation strategies. It is highly likely that SKA would do this for the first few - and as they build up a level of confidence in the risks associated with shale gas development (types of equipment being used, profile of EMI emissions), SKA could provide significantly quicker turnaround times and perhaps provide a template for mitigation (as they are starting to do with

Activity	Noise level L_p, dBA at 4 km from the activity	
	Daytime	Night time
None	0	0
Access road construction	4	12
Wellpad construction	-1	7
Rotary air well drilling	-4	4
Horizontal drilling	-5	3
Fracking	23	31

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			renewable energy facilities). The mitigation required per sensitivity class (see Figure 4-9), is 5 dB for Low sensitivity regions, 10 dB for Medium sensitivity regions, 15 dB for High sensitivity regions, and > 20 dB for Very High sensitivity regions.
36	Local road construction and resource implications	Municipal Systems Act of 2000, the SPLUMA, Land Use Planning Ordinance, 15 of 1985, Development Facilitation Act of 1996 and Intergovernmental Relations Framework Act of 2005 Spatial and integrated development planning and governance instruments	• **Any further increase in maintenance requirement would be unacceptable** unless fully financed by the developers - the latter could be difficult to apportion fairly and must be negotiated prior to development. • **Any increase in normal maintenance cycles for roads or the requirement of new roads to be constructed at the expense of the municipality is beyond the limit of acceptable change.** • **More finance than what is available in provincial and local budgets is beyond the limit of acceptable change.**
37	Pressure on regional road infrastructure		• **Any increase in current maintenance budget requirement and cycle is unacceptable.** • **Any increase in the maintenance costs beyond the existing cycle is unacceptable.** • **Any increase in normal maintenance cycles for roads or the requirement of new roads to be constructed at the expense of the municipality is beyond the limit of acceptable change.** • **Any additional budget requirements as budgets are already constrained are unacceptable.** • **Any increase in accidents and road deaths above current levels is unacceptable is unacceptable.**
38	Spatial and development planning, land use management and governance capacity		• **Any increase in housing and service delivery backlog is unacceptable.** • **Any above average growth in informal – green fields or 'backyard' settlements is unacceptable.** • **Any increase in operation and service cost with increase in budget deficits is unacceptable.** • **Any increase in the demand for water and other bulk services beyond the planned delivery targets, or when the demand exceeds the projected resource availability and bulk infrastructure capacity is unacceptable.** • **Any exceedance of capacity and accessibility to social services and municipal services such as education, health social services and sport facilities, land fill sites, etc. is unacceptable.** • **Any increase in inequality as measured by the average for the Gini-coefficient in the relevant regional and provincial context is unacceptable.**

No.	Impact	Relevant national policy, plans, legislation, regulations and guidelines which will guide the implementation of mitigation measures specific to the impact in question	The limits of acceptable change based on national policy, plans, legislation, regulations and guidelines, the risk assessment and spatial modelling plus key learning from international best practice
			• **The absence of forward planning (IDP/SDFs) and of credible SDFs (based on existing growth rates) is unacceptable.** • **Absence of regulatory framework and administration. Legal certainty must be regarded as the acceptable norm.** The minimum municipal planning bylaws needed for most municipalities should be expected to be promulgated • **The absence of consideration of projected and cumulative impacts of separate but inter-related land use changes and developments is unacceptable.** • **The absence of municipal skills development programmes to fulfil their mandates is unacceptable.**

6.2 Strategic Management Actions

Table 6–5: Strategic management actions with key action items and responsible parties for implementation.

Impact No	Key action items	Responsible Parties
1	**Communicate to Government that production of shale gas is not a *fait accompli*, it could only occur following promising results during a detailed and comprehensive 10 year exploration programme.** Obsolete infrastructure to connect potential shale gas to demand areas could be a risk. In order to mitigate this, there should only be investment decisions made on pipeline infrastructure once reasonable expectation and evidence of commercial scale shale gas resources are found. Localised and limited power generation in the study area should be pursued initially with imported LNG and/or regional piped gas being sought while initial production is being undertaken. Only once significant shale gas volumes at proven low prices is feasible, should pipeline infrastructure be considered for transport of gas to demand areas. Obsolete LNG import infrastructure, which is a natural outcome of a Big Gas scenario (a consequence of success), could materialise, but the associated storage facilities could potentially be converted to support liquefaction for LNG export and thus would not be stranded. Gas reticulation infrastructure for residential/industrial/commercial end-use may become stranded if developed too quickly. Similar to large pipeline infrastructure from the study area to demand areas around the country, developments in this regard should be moderated initially until significant shale gas volumes at feasible prices are established. There is a risk of gas end-users converting processes to gas and then having sub-optimal outcomes as a result of higher gas prices and needing to convert to other energy sources if gas prices increase. The switch to gas as a primary energy source should only be sought once domestic gas volumes and prices are better defined (early adoption will prove risky). As for power generation, the risk of stranded assets is relatively low, as a gas fleet built on the assumption of large and cheap shale gas supply can be utilised in a Big Gas scenario and in a solar PV/wind/LNG or solar PV/wind/piped gas scenario alike (with lower load factors – which does not affect the unit cost much for relatively cheap-to-build gas-fired power stations). The clear requirement for pipeline infrastructure to get shale gas to demand centres not located in the study area is a risk. However, planning for and implementation of significant pipeline infrastructure from the study area to demand centres will only take place once considerable	Key actors to mitigate against obsolete infrastructure investment would include DoE at a national level as well as Transnet, iGas PetroSA, DMR, DoE, Nersa and downstream industry stakeholders.

Impact No	Key action items	Responsible Parties
	verification of the shale gas resource has taken place and risk of stranded infrastructure is minimised.	
2	**Promote strategic energy planning for shale gas development, should it prove to be a commercially viable resource.** The development of sufficient network infrastructure to evacuate gas-fired power generation as well as transport natural gas to demand centres from relevant geographical locations (not only in the study area) becomes more essential at high shale gas volumes. It will become increasingly critical to ensure that sufficient electrical and natural gas network planning is periodically performed and updated in order to ensure sufficient network capacity at appropriate timescales in the study area.	Key actors to mitigate against insufficient transmission network infrastructure would include current state-owned enterprises like Eskom and Transnet while private industry midstream operators and developers would also play a key role. Key actors in ensuring sufficient gas distribution and reticulation infrastructure would likely include DoE, Nersa and downstream industry stakeholders.
3, 4, 20, 21	**(1) Implement good practice guidelines for air quality management.** Good practice guidelines are needed to minimise adverse impacts on air quality and human health. This could include application of NEM:AQA, possible amendments of its regulations and / or a SEMA. See examples of controls from: - The International Energy Agency Golden rules for a golden age of gas (2012) - The Global Gas Flaring and Venting Reduction Voluntary Standard (2004) - The IFC Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development (2007) - The United Kingdom Department of Energy and Climate Change. Fracking UK shale: local air quality (2014) Implementation of these would require strengthening of capacity within district municipalities to ensure licensing and implementation; especially given that district municipalities in the affected areas have had limited experience in the practice of air quality management and shale gas is a unique combination of emissions hitherto unknown in South Africa. **(2) Develop standards for GHG emissions**. It is recommended that national departments develop and legislate domestic "best practice" emissions standards for shale gas development.	(1) Led by the DEA in collaboration with the Shale Gas Monitoring Committee (SGMC) and Department of Health, the Eastern Cape, Northern Cape and Western Cape provincial governments; including Local and District Municipalities. (2) DEA, as the focal point for climate change should work with the DoE, DMR, Science & Technology and Water & Sanitation in developing an effective regulatory framework for GHG emissions associated with shale gas exploration and production.

Impact No	Key action items	Responsible Parties
	(3) **Develop, implement and maintain an air quality and GHG monitoring station in the Central Karoo.** There is an urgent need for at least one monitoring station for local air quality and GHG within the study area, well before shale gas exploration and development begins with the capacity to measure for NOx, SO_2, Particulate Matter, Volatile Organic Compounds, CO_2 and N_2O. A baseline air quality monitoring study should be at least 12 months long in order to capture seasonal differences, however studies longer than a year are needed to understand differences between years. There are currently no ambient air quality monitoring stations in the study area. As more information on the location of drilling and exploration activities is made available, sites should be identified for intensive air quality monitoring. This baseline information should be made publicly available to inform stakeholders on the current status of the area. It may be possible to use high precision measurement combined with inverse modelling, and information about local wind patterns, to improve attribution, if shale gas exploration and development takes place. The immediate priority, as for air quality, should be to establish baseline values for any methane emissions in the Karoo	(3) Led by the DEA in collaboration with the SGMC and Department of Health, the Eastern Cape, Northern Cape and Western Cape provincial governments; including Local and District Municipalities. Further monitoring requirements for air quality and GHGs must be identified in the Minimum Information Requirements currently being led by DEA.
5	**Install additional seismicity monitoring stations in the study area.** Current monitoring stations operated by the CGS, should be densified in the study area, for baseline monitoing. The CGS currently operates two seismograph stations within the study area, and another four stations close to its perimeter. It is desirable that sufficient stations are installed so that all events exceeding M1 are recorded in any part of the area where shale gas exploration and production is likely to take place. These areas will only become apparent when the exploration and appraisal phase nears completion. At the present time (August 2016) a further six stations were being installed by the CGS in the study area. This should improve the threshold of completeness to M1.	CGS should lead this in collaboration with DMR, DST (especially considering their SKA interest), DEA and DWS.
6, 20, 21	**Develop a policy statement regarding the use of water in the Central Karoo.** Each well requires in the region of 10 500 m^3 of water to be fractured. The exact amount of water required depends on hole depth, geological conditions and the number of fracturing stages required. Assuming water re-use at 50% of drill fluid and 30% of fracking fluid, in the region of 6 000 000 – 45 000 000 m^3 would be required for the Small Gas and Big Gas scenarios respectively. The quality of the water does not have to be of a potable standard and can be	The SGMC and shale gas SEA PEC consisting of DEA, DST, DMR, DWS, DoE and DAFF

Impact No	Key action items	Responsible Parties
	salty or 'brackish'. There is not capacity to supply water for shale gas exploration and production from existing local sources. Water availability for existing users in the study area is severely constrained. Surface water availability is generally low, and in many areas over-allocated. Landowners rely mainly on groundwater resources for domestic and stock water. Groundwater recharge is typically low and sporadic. The use of groundwater is increasing, particularly during drought years. In many areas, groundwater already supplies 100% of the use. The availability of groundwater to meet the demand of even the Reference Case, is already seriously constrained. The additional demand under the Small and Big Gas scenarios could not be met from known local potable resources and would be considered a very high risk if local resources were utilised. This should be captured as a clear policy statement and the following text should be inserted into the current technical regulations: *"Evidence has demonstrated an insufficient availability of water resources in the Central Karoo to supply the needs of shale gas exploration and production, as such existing water resources are prohibited from use. All water required for shale gas exploration and production operations should be sourced from deep saline groundwater and treated to industry standards or sourced from outside the Central Karoo region, as demarcated by the study area of the strategic environmental assessment for shale gas development (2017)".*	
7, 9, 10, 20, 21	**Ensure baseline and ongoing water monitoring data is adequately collected.** Monitoring of water resources is important for minimising, controlling and mitigating against the effects of shale gas exploration and production. For Phase 1 Exploration where vertical drilling will be undertaken without hydraulic fracturing, there is little baseline monitoring that can be usefully undertaken. This process in itself, as the first step of exploration acts as a monitoring opportunity to test groundwater as holes are drilled and sampled. Prior to Phase 2 ("Appraisal"), where hydraulic fracturing is undertaken, a comprehensive understanding of groundwater conditions is required prior to the commencement to ensure proper interpretation of changes in groundwater over time. Monitoring data would also be used for calibration and verification of prediction and assessment models, for evaluating and auditing the success of management plans, and for assessing the extent of compliance with prescribed standards and regulations. Furthermore, it would be difficult, if not impossible, to identify the effects of shale gas development on surface and groundwater systems without baseline monitoring. Long-term data would therefore need to be collected, preferably over at least five years, to	MIRs must provide the structure for the submission of monitoring plans which will be included in applications for EA. DEA is leading the process to development the MIRs along with the shale gas SEA PEC and the SGMC. More broadly, oil and gas companies, government or its appointees, and perhaps independent monitoring institutions, should be involved in monitoring. Strict reporting requirements, to government and/or other independent institutions, should be in place and results should be

Impact No	Key action items	Responsible Parties
	identify trends in the biophysical conditions and functioning of these systems in the absence of development activities. The proposed action is that MIRs are developed and include the need and requirements for baseline and ongoing water monitoring, especially for Phase 2 ("Appraisal"), where hydraulic stimulation is planned.	independently verified. Government should play an oversight role, which might include verification sampling. It may be necessary to establish an independent laboratory for monitoring aspects such as natural isotopes, constituents of fracking fluids, and uncommon organic substances emanating from fracked wells and local groundwater.
11, 20, 21	**Develop a policy statement regarding the disposal of waste in the Central Karoo.** Municipal landfills in the study are not designed or equipped to receive waste generated by shale gas development activities, and municipal staff do not currently have the skills or experience to manage it responsibly. As such, waste effluent should be treated on site by the industry for reuse in fracking operations. The waste streams from shale gas exploration and production are new to South Africa and therefore capacity needs to be created to evaluate licence applications efficiently and responsibly. There is insufficient laboratory capacity in South Africa able to perform the volume of analyses necessary for operational waste classification under the Big or Small Gas scenarios. The analyses must be undertaken at South African National Accreditation System accredited laboratories, very few of which have accreditation for the prescribed tests. Additional laboratory capacity will be needed to deal with the volume of analyses that would be required for shale gas operations. Currently, no sites are licensed for Type 1, 2 or 3 hazardous waste disposal in the study area. This should be captured as a clear policy statement and the following text should be inserted into the current technical regulations: *All waste streams emanating from shale gas exploration and production must be treated on-site by the industry and at their expense for reuse in continued hydraulic fracturing operations. Municipal landfills and treatment works cannot accept waste from shale gas exploration and production. Hazardous wastes must be transported out of the Central Karoo as there are no sites currently permitted to receive these wastes.*	The SGMC and shale gas SEA PEC consisting of DEA, DST, DMR, DWS, DoE and DAFF. Local Institutional Governance Programmes for Shale Gas must be initiated by each Province in collaboration with Local Municipalities so that a baseline inventory of municipal waste services and capacity is clary established and so that regional staffs are aware of what is planned over the next 10 years as regards shale gas exploration and appraisal activities.
12	**Develop a landscape biodiversity baseline monitoring programme.** Institutional arrangements and responsibilities are fundamental to the success of baseline monitoring	Implementation of these recommendations require proactive

Impact No	Key action items	Responsible Parties
	efforts. There is a need for independent monitoring by third parties, not just monitoring by the shale gas companies themselves. This will generally be led by government. Shale gas companies could be required to contribute to the cost of such government-led monitoring in proportion to the scale of their activities. The implementation of the strategic approach to mitigation, assumes the existence of appropriate capacity in a range of organs of state including regulatory authorities. Capacity is currently weak with regard to some of the mitigation measures, and would need to be strengthened in order to support their successful implementation. It is important for monitoring efforts to be co-ordinated. In addition, a system or process should be in place for integrating monitoring data from the site level, the ecosystem level and the landscape level into a coherent set of information for the study area as a whole, which can be used to inform planning and decision-making. Information from monitoring should feed into SANBI's programme of monitoring and reporting on the state of biodiversity nationally. A strategic analysis for identifying and filling capacity gaps within the current institutional framework should be initiated, using the recently approved Business Case for Biodiversity Stewardship (SANBI, 2015) as the first point of reference.	support from the DEA and National Treasury to unlock resources for strengthening biodiversity stewardship programmes.The development of a landscape level monitoring plan for the Central Karoo should be shared across several organisations, led by the South African Environmental Observation Network, which has an important role in landscape-level monitoring and maintaining benchmark sites for the evaluation of shale gas extraction impacts. Partner organisation would include SANBI, provincial conservation authorities and DWS.
14, 15	**Develop an adequate financing and fund review model for abandoned or decommissioned wells.** The South African experience in mining shows that funds are too often insufficient and/or not properly secured for mine closure. Similar experience can be found in other countries such as the USA for mining and hydraulic fracturing. In the future this should be investigated and an adequate financing and fund review model for abandoned or decommissioned wells should be put in place using the amended regulations for financial provisions in mining as a departure point. It will be particularly important that sound mechanisms are put in place to deal with all potential long-term legacy (i.e. latent and residual) risks including those which may remain beyond the ten year period post-closure for which financial provisions must be made in mining. This could, for example, include considering the potential role for industry-wide financial mechanisms that allow for the pooling of risks among producers in order to protect water resources drawing on lessons from the mining industry. A future shale gas industry would have the rare opportunity to learn from mining and put such mechanisms in place from the start thereby enhancing the chances of achieving sustainability goals. The benefits of shale gas production to the national Gross Domestic Product will only be realised if externality costs are not borne by local	Plan of action to be developed jointly by the DEA, the DMR, the DoE, National Treasury and DEA&DP. DEA&DP have initiated an internal process for this and have a working draft covering the adequacy of the financial provisioning regulations to cover latent or legacy shale gas impacts. This document should be used as the point of departure in further analyses of the financial provisioning regulations.

Impact No	Key action items	Responsible Parties
	municipalities and residents. This will require shareholding, purchasing agreements, local hiring and training programmes as envisaged in Social and Labour Plans and developer requirements as established by the Renewable Energy Independent Power Producers Procurement Programme with unambiguous compensation mechanisms for landowners in the event of an externality cost occurring.	
16, 17, 18, 19, 22-26, 27, 32-34, 35, 36-38	**Ensure institutional capacity development and integrated governance.** A large number of national, provincial and local government departments will be responsible for authorisation processes for shale gas exploration and production activities – these need to be undertaken in a participatory, integrated and streamlined manner as envisaged in the Constitution and the OES. Institutional capacity and governance programmes should focus on educating local municipalities about shale gas exploration and good governance. National and provincial departments must work together with local government to identify gaps in knowledge, key questions, skill interventions, training programmes and infrastructure requirements. This information must be fed into broader regional planning processes such as SDF, IDP, EMF, Integrated Tourism Plans and Regional SDFs so that planning for shale gas exploration and production is strategic and integrated. The Western Cape DEA&DP are piloting such a programme. This programme must investigate the potential for pro-actively releasing land for housing, and installing infrastructure, so that in-migrants can build informal housing if required (in the short-term), or provide public housing (in the longer-term). Upgrades to water, electricity and sewerage infrastructure, as well as local streets and stormwater drainage, to cope with the additional demand should be assessed. This will be the responsibility of Local Municipalities, as part of their spatial planning responsibility; however, it may also require financial and technical support by provincial authorities. Assistance should be provided to the local business sector, particularly through Business Chambers, to understand and respond to new opportunities created by shale gas exploration and production. Where such chambers do not exist, they need to be established by municipalities and the business community working together.	Led by the provincial Departments in the Western, Eastern and Northern Cape and Local Municipalities, with the participation of the Department of Co-operative Governance and Traditional Affairs, the Department of Transport, the EDD and others.
28-31	**(1) Develop guidelines for heritage assessments and monitoring.** The South African Heritage Resources Authority (SAHRA), under Section 38 and with input from provincial and local authorities, should draft a set of guidelines for the implementation of shale gas exploration and production which will serve to guide the assessment and monitoring of all	The SAHRA and PHRAs

Impact No	Key action items	Responsible Parties
	activities. For the same reason, where necessary, SAHRA, with input from provincial and local authorities, should be responsible for comments and decisions related to shale gas. **(2) Develop a Memorandum of Understanding between SAHRA and each Provincial Authority.** Heritage monitoring is generally only requested during excavations that may reveal buried heritage resources. It is recommended, however, that more extensive monitoring (similar to that carried out by an Environmental Control Officer in the EIA context) be encouraged by heritage resource authorities in order to monitor Development Phase impacts, especially those associated with built heritage. **(3) Update provincial heritage registers.** In terms of Section 30 of the NHRA, all Provincial Heritage Resource Authorities (PHRAs) should have an updated heritage register. Local planning authorities are required, under certain circumstances, to submit to the PHRA a list of heritage resources under their jurisdiction. The PHRA is then responsible for adding to the Provincial heritage register those sites that it considers to be conservation-worthy and that meet the requirements for listing on the register. This is an existing legal requirement that has not yet been complied with throughout the study area but is considered important to action. Such heritage registers should include urban and rural areas and should be updated so as to adhere to the 60 year provision of Section 34 of the NHRA. Heritage resources authorities are also required to have an up-to-date register of communities who have expressed interest in heritage. Such registers should be in place before exploration commences. To date, of the three provinces included in the study area, only Western Cape is reasonably functional in this regard.	
36-38	**Investigate the feasibility of using rail to mitigate road risks.** Transnet should assess the following questions: • Is it possible to move the volumes of materials as contemplated in the Small and Big Gas scenarios? • What are the costs to move these materials, considered per scenario and also considered for the three different railway links proposed? i.e. Cape Town-Beaufort West, Port Elizabeth- Beaufort West and Beaufort West –Johannesburg. • What are the costs relative to the cost saving derived from not requiring the same extent of road maintenance? • What are the costs for each scenario, for each railway link compared against	Department of Transport, Department of Public Works, Transnet, DEA

Impact No	Key action items	Responsible Parties
	conventional trucking costs? i.e. Is the freight rail option cost competitive? • Considering the tonnes per annum assumed for the Small Gas scenario versus the tonnes per annum required for the Big Gas scenario, at what gas production volume i.e. ranging from 5 – 20 tcf (and corresponding material metrics) does the use of freight rail become really cost competitive?	

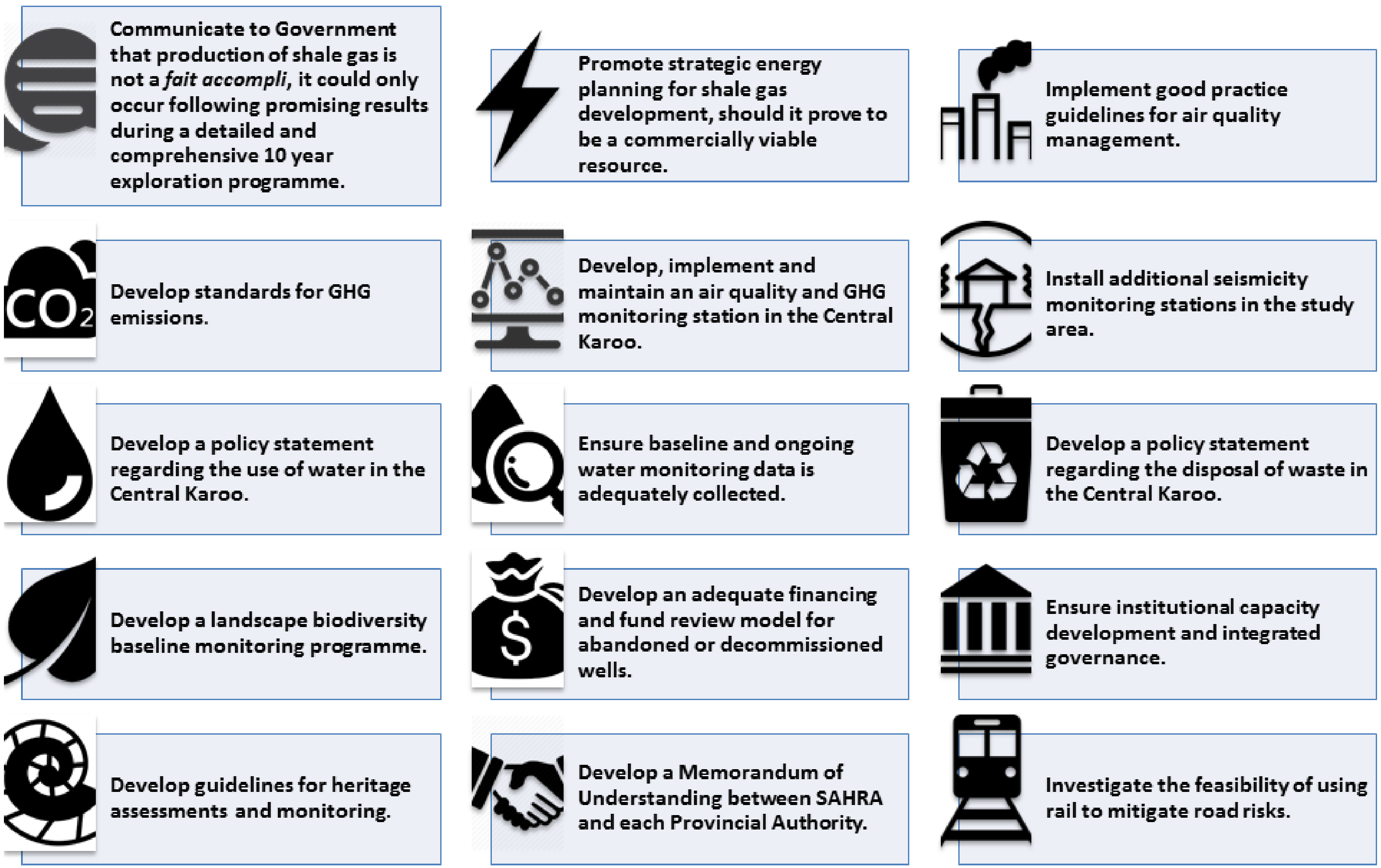

Figure 6–10: Summary of the strategic management actions to assist strategic level risk mitigation

7. CONCLUSION

It is a common misconception that the ‘decision’ regarding shale gas exploration and production is binary: ‘yes’ or ‘no’. In fact, there are a number of decisions, via a number of decision-making processes, made across all three spheres of government and civil society; all of which will be made over a protracted period of time. Most of the decisions which will need to be taken are conditional rather than absolute - a certain activity may be permitted in one location and not another, or with a given set of requisite mitigating actions to reduce risk. All of this will depend on the nature of the activities proposed and the location within which they are proposed. This will be determined, to a large extent, by the site specific environmental assessment processes, such as EIAs which will be required prior to an activity obtaining EA, as discussed in Section 2.6.3.1.

Evidence suggests that the risks associated with the Exploration Only scenario could be mitigated to within acceptable levels. This however depends of the veracity of the specific EIA processes undertaken for decision-making, the quality of baseline and on-going monitoring programmes, the ability of South Africa to develop adequate human capacity and skills in all sectors, the strength of our institutions; and a collective commitment to cooperative and transparent governance. These processes must be guided by the NEMA MIRs, as detailed in Appendix 3 to this report.

The nature of shale gas development makes it relatively easy to avoid sensitive features which pose the greatest risk. For Small Gas and Big Gas, while only a fraction (0.0002 % and 0.0009 % respectively) of the study area will be directly impacted, the risk profile does increase because of indirect and cumulative impacts. The most critical aspect of shale gas exploration and production at significant scale is the development of suitable baseline data for water, air, human health, noise and biodiversity. Adequate data collection may take in the region of 3-5 years to accumulate if it is to be usable in litigation processes into the future.

In South Africa, as a democratic country with a strong developmental focus, it is essential that governance is informed by inclusive, iterative and deliberative knowledge generation and scientific assessment procedures that are based on technically sound, scientifically credible and publically acceptable information, and that involves numerous stakeholders during policy formulation and strategic decision making. Governance relates to all processes of exerting power or decision-making capacity and is a function performed by government, the private sector and civil society by using laws or other participatory processes. The success of ‘resource governance’ is fundamentally dependent on processes which seek to include broader society in both the evidence base which informs the science-policy interface and the subsequent decision-making processes made relative to that shared and co-generated evidence base.

Decisions related to shale gas exploration and production in South Africa can have lasting, and in some cases, irreversible impacts on the Central Karoo. Given the sensitivity of the receiving environment, in particular, the scarcity and value of potable water in the region, even with a relatively non-invasive exploration campaign, there is no margin for error. Effective and functional governance systems, at all levels of government and broader society, need to be in place, even prior to the exploration phase.

This will require a step-wise approach, rooted in the concept of adaptive management which, at its core, rests on the notion that it is crucially important to gather baseline and ongoing information and use it to test critically both the management actions employed to mitigate undesired outcomes and the assumptions which underpin those actions. As a starting point, South Africa is in the advantageous position of being able to accumulate such a dataset and start building the institutions capable of collecting, managing and analysing that data in a responsible and transparent manner.

Ongoing research is also required to ensure that environmental policies and regulations keep pace with new developments. This is not to suggest that no development should ever take place until all risk is mitigated to zero – this is a philosophical and practical impossibility. Rather, if South Africa does choose to proceed with the exploration of shale gas, and assuming an economically and technically suitable reserve that can be developed is discovered, then the decision-making process to arrive at that point must be grounded in scientifically acceptable and publically accepted evidence and participatory processes.

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Strategic Environmental Assessment of Shale Gas Development in the Central Karoo

Phase 3:
Decision Support Tools Report

APPENDIX 1

Engagement, outreach, media, skills development and publications

CONTENTS

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1. BACKGROUND TO STAKEHOLDER ENGAGEMENT

With the key objective of the SEA being the provision of a scientific evidence base for decision makers and stakeholders to better understand the opportunities and risks associated with SGD; the stakeholder engagement process for the SEA was uniquely designed in such a way to ensure stakeholder participation at every stage of the process. This was achieved through the establishment of four 'pathways' of participation, appropriate for different stakeholders. These were: (1) through integrated project governance structures; (2) through the generation of salient questions via stakeholder outreach; (3) through content generation using a multi-author team approach; and (4) through commentary on and review of content by independent peer reviewers and stakeholders.

The SEA was guided by the principles of legitimacy, saliency and credibility. Adherence to the principle of Legitimacy ensured that the process was transparent and conducted in an unbiased manner. The legitimacy of the process, as perceived by the decision makers and the general public, was achieved by the inclusion of the appropriate and relevant organisations and individuals making up the governance groups. Saliency was achieved though the consideration of the all legitimate values, concerns and perspectives of stakeholders, thus ensuring that the outcomes of the SEA process were of relevance to the decision makers and the general public.

Credibility was ensured by maintaining the standards of scientific rigor and technical accuracy with which the assessment was conducted. Essential to achieving credibility for this SEA; numerous distinguished scientists acted as authors, which sought to ensure that the sources of international, local and traditional knowledge were considered trustworthy by all stakeholders. The balanced and inclusive composition of the governance groups and the extensive and transparent expert and public review of the scientific assessment also furthered the credibility of the SEA.

The stakeholder engagement process sought to convey the SEA process and the preliminary outcomes of the scientific assessment to all interested and affected parties (I&APs), as well as to describe the ways in which they can engage in the process. This approach does not substitute that typically followed in an Environmental Impact Assessment (EIA), in which the concerns of the public are captured and responded to, but further adds to it, using those key concerns to help shape the scope of the scientific assessment at a strategic level, thus ensuring that all the material issues are addressed.

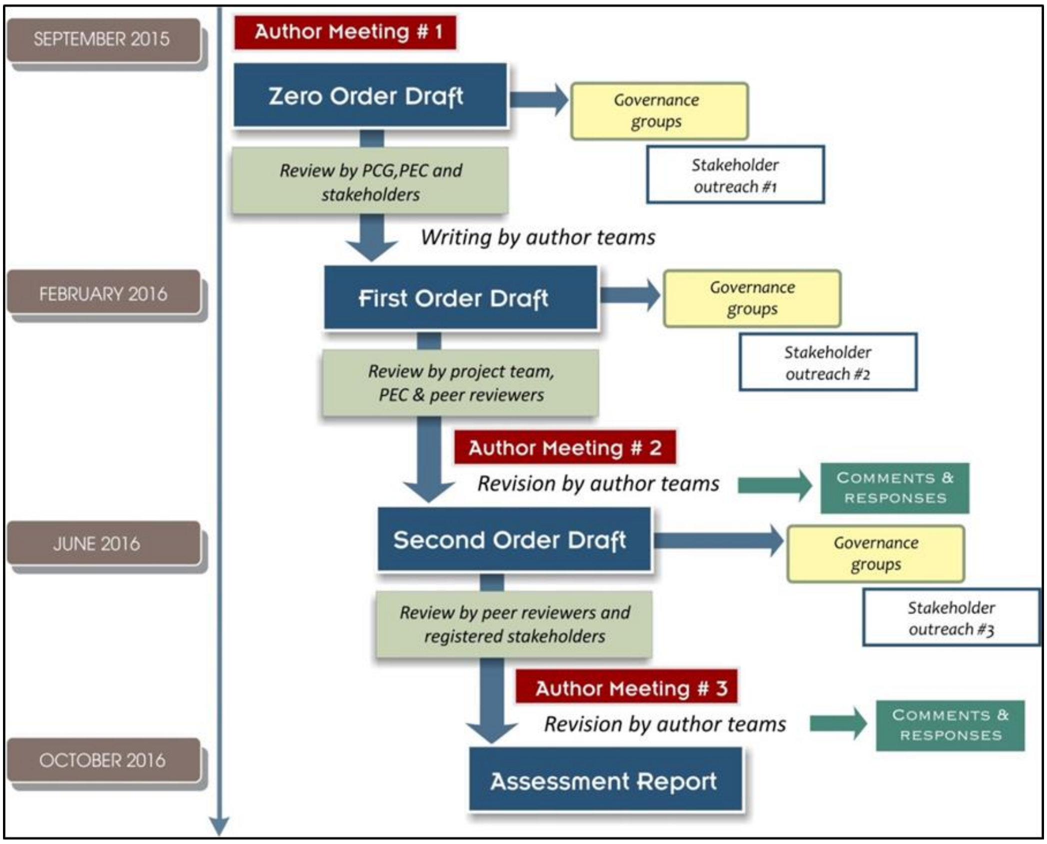

Figure 1: Points of stakeholder interaction throughout Phase 1 and 2 of the SEA process.

The scientific assessment phase of the SEA began with Author Meeting # 1 and the production of Zero Order Draft, followed by the first draft text, tables and figures in the First Order Draft which was sent for national and international peer review. Incorporating the comments from the peer review experts, the multi-author teams developed the Second Order Draft which was sent back to the peer review experts and simultaneously released to the general public for comment. Based on the feedback from the peer review experts and the general stakeholder comments, the final Scientific Assessment was published on 15 November 2016.

The degree of participation throughout the SEA by the governance groups, multi-author teams, expert reviewers and general stakeholders is evident from Figure 1. This approach allowed for full participation and for different types of technical and tacit knowledge to be obtained during the participatory processes. Through discussion and information sharing about the process the stakeholders were able to form a credible vision and understanding of the process. It assisted in making the process salient for them, and improved the likelihood that they will use its outcomes.Typically, governance group meetings and stakeholder outreach sessions were conducted following the development of the Zero, First and Second Order Drafts. Details on the four pathways of participation relating to the governance groups, multi-author teams, stakeholder outreach and the review processes followed are provided in the sections below.

2. PROJECT GOVERNANCE GROUPS

The SEA was governed by two key governance groups, namely the Project Executive Committee (PEC) and the Process Custodians Group (PCG), which strengthened the legitimacy of the SEA.

2.1 Project Executive Committee

The PEC comprised of representatives of the nation and provincial government authorities who commissioned the SEA, as well as those members of government constituting the main users of the Decision- Making Framework (see Table 1 for PEC composition). Where the intended representatives were unable to attend, their alternatives were present on their behalf. Representatives of the project team, namely the CSIR, SANBI and CGS, were also members of the PEC with the objective to brief the PEC, elaborate on issues and convey decisions to the PEC.

Table 1: Project Executive Committee composition

Representing	Member name	Other members
Department of Environmental Affairs (Chair)	Dee Fisher	Simon Moganetsi, Surprise Zwane, Marlanie Sargonum Moodley, Sabelo Malaza, Wilma Lutsch, Patience Sehlapelo
Department of Water and Sanitation	Mkhevu Mnisi	Bayanda Zenzile, Alice Mabasa
Department of Mineral Resources	Mosa Mabuza	Nonthanthla Jali
Department of Energy	Muzi Mkhize	Mmarena Mphahlele, Stella Mamogale
Department of Science and Technology	Somila Xosa	Mere Kgampe, Mmboneni Muofhe, Nametshego Gumbi
Department of Agriculture, Forestry and Fisheries	Lydia Bosoga	Mary-Jean Gabriel, Edwin Mametja, Mpume Ntlokwana
Eastern Cape Department of Economic Development, Environmental Affairs and Tourism	Alistair McMaster	Gerrie Pienaar
Western Cape Department of Environmental Affairs and Development Planning	Paul Hardcastle	Henri Fortuin
Northern Cape Department of Environment and Nature Conservation	Bryan Fischer	Natalie Uys
Agricultural Research Council	Garry Paterson	-
SANBI	Jeffrey Manuel	Kristal Maze

Representing	Member name	Other members
CGS	Henk Coetzee	V.R.K. Vadapalli, Muvhuso Musethsho, Thato Kgari
CSIR	Bob Scholes and Paul Lochner (SEA co-leaders)	
Secretariat	Greg Schreiner (Project Manager), Luanita Snyman-Van der Walt (Project Officer), Megan de Jager and Andile Dludla (Project Interns)	

The key responsibilities of the PEC entailed a project oversight role which involved coordinating and communicating scientific information; ensuring that the project remains within the determined scope, timelines and budget; ensuring that strategic and policy issues are adequately addressed; and evaluating feedback from the PCG where required. The PEC also served to satisfy the requirements of the South African Constitution for cooperative governance between departments and different spheres of government. The PEC convened at strategic points of the SEA, starting with an Inception Workshop in which, inter alia, the scope of the project and mandate was communicated to the PEC.

In addition, six (6) PEC meetings were held throughout the SEA process, which coincided with the outputs of the scientific assessment, namely the Zero, First and Second Order Drafts, and lastly the Decision-Making Framework. The PEC was tasked with reviewing these outputs in order to fulfil part of their mandate to ensure the project remains on scope and that the strategic and policy issues had been sufficiently addressed. Where possible, PEC members also attended the stakeholder outreach sessions held in the Central Karoo and the registered stakeholder workshop in Cape Town, which served to validate the legitimacy of the SEA process to the general stakeholders, as it showed that the process had consolidated and proportional buy-in from the government departments who commissioned the SEA. Details of the PEC meetings, including dates and purpose of each meeting, are provided in Table 2. The notes for the PEC meetings are provided in Appendix 1a.

Table 2: Details of PEC meetings held throughout the SEA process

Date	Meeting no.	Venue	Purpose of the meeting
12-13 February 2015	Inception Workshop	DEA Environment House, Pretoria	Establish a discussion forum to deliberate on and determine strategic issues for the SEA; Draw on existing experience and expertise from the forum, Communicate the principles, scope and approach to the SEA; Integrate the discussion and key topics in order to determine a suitable way forward; and Explain the structure and mandates of the project team, governance groups and multi-author teams.
22 July 2015	1	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Confirm Terms of Reference; Provide background to the SEA process, Provide a summary of outcomes from the Inception Workshop (12-13 February 2015); Provide an update on the SEA management and process, and on the SANBI Bioblitz; and Discuss the shale gas regulatory environment with regards to changes and new developments.
22 October 2015	2	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Provide an update on SEA progress; Provide and confirm SEA Scope of Work in terms of the Zero Order Draft; Provide overview of planned Public Outreach (9-13 November 2015) and confirm roles and responsibilities for PEC members; Convey key points from the 2nd PCG Meeting; and Clarify other issues raised including PEC Mandate, Status of the SEA Process Document, Engagement between PEC and PCG, and the participation of the DRDLR in the PEC.
04 May 2016	3	Demo Room, Building 22, CSIR Pretoria Campus	Provide an update on SEA progress with regards to Public Outreach feedback and programme, Scenarios and Activities Chapter, and the Peer Review Process to be followed; Convey key findings on the identified Strategic Issues in the First Order Drafts.
13 June 2016	4	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Discuss the key issues of concern in the Second Order Draft Chapters of the Scientific Assessment prior to the release of the SOD; Engagement with the Summary for Policy-Makers; and Provide feedback and plans for Public Outreach.
26 September 2016	5	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Provide an update on SEA progress with regards to the Scientific Assessment process and its key findings, and the Public Outreach programme; Discuss the Decision-Making Framework for Phase 3 of the SEA.
23 March 2017	6	ECD Boardroom, Building 23, CSIR Campus, Pretoria	Provide an overview of the key Scientific Assessment findings, discuss the approach to strategic mitigation, limits of acceptable change and the Minimum Information Requirements, specifically the splitting of “Exploration” and “Appraisal” into two regulatory processes. This approach was discussed with and approved by PASA.

2.2 The Process Custodians Group

The PCG comprised of sixteen (16) eminent individuals, representing a broad range of interests from government, NGO's, academia/ research community, and the private sector; which further ensured the legitimacy of the process. The primary objective of the PCG was to ensure the process of collecting, evaluating and presenting the evidence of the scientific assessment was conducted in an independent, rigorous and balanced manner. The organisations represented by the PCG members were selected by the PEC based on their credibility in their respective sectors with regards to having a distinctive mandate, a broad representation, and a proven interest in the SGD debate. The expectation of the PCG members was not to represent their organisations per se, but to reflect the range of opinion within their respective sectors, without making an approving or disapproving judgement towards SGD. The PCG composition is provided in Table 3 below:

Table 3: Members of the Process Custodians Group.

Sector	Organisational home of member	Member name	Other members
Chair	IAIA-SA	Sean O'Bierne	-
Government	Department of Performance Monitoring and Evaluation	Rudi Dicks	Nkhensani Golele, Mukondi Masithi
Government	South African Local Government Agency	Intelligent Chauke	-
Government	Department of Economic Development	Andrew Matjeke	Khathutshelo Sikhitha
Government	Department of Environmental Affairs	Dee Fischer	Surprise Zwane, Marlanie Sargonum Moodley, Patience Sehlapelo
Government / Business	PetroSA	Jessica Courtoreille (withdrew from PCG)	Portia Manuel, Bongani Sayidini
Business	AgriSA	Wayman Kritzinger	Nic Opperman
Business	Onshore Petroleum Agency South Africa	Peter Price	Lizel Oberholzer/ Jane Blomkamp
Business	Business Unity South Africa	Marius Diemont	Laurel Shipalana
NGO	Treasure the Karoo Action Group	Jeanie le Roux	Jonathan Deal, Julius Kleynhans
NGO	World Wide Fund For Nature -SA	Morné du Plessis	-
NGO	South African Faith Communities Environment Institute	Stefan Cramer	-
NGO	Project 90 by 2030	David Fig	-
Research	Water Research Commission	Shafick Adams	Jo Burgess
Research	Human Sciences Research Council	Demetre Labadarios	Temba Masilela, Selma Karuaihe
Research	Square Kilometre Array	Selaelo Matlhane	Adrian Tiplady (withdrew

Sector	Organisational home of member	Member name	Other members
			from PCG to become assessment author)
Research	Nelson Mandela Metropolitan University	Barry Morkel	Moctar Doucouŕe, Maarten de Wit (withdrew from PCG)
Constitutional Body	South African Human Rights Commission	Janet Love	Chantal Kisoon, Angela Kariuki, Nada Kakaza
Project team	SANBI	Jeff Manuel	Kristal Maze
Project team	CGS	Henk Coetzee	V.R.K. Vadapalli, Muvhuso Musethsho, Thato Kgari
Project team	CSIR	Bob Scholes and Paul Lochner (SEA co-leaders)	
Project team	Secretariat	Greg Schreiner (Project Manager), Luanita Snyman-Van der Walt (Project Officer), Megan de Jager and Andile Dludla (Project Interns)	

The innovative concept of the PCG was designed specifically for Phase 2 of the SEA (the Scientific Assessment Phase) to perform a referee role which was not content prescriptive but rather process driven; ensuring that the process followed the pre-agreed guidelines set out in the SEA Process Document[1]; that the multi-author teams had the necessary expertise and balanced representation of well-founded opinions; that all the material issues were covered in the assessment; that the expert peer reviewers were qualified, independent and balanced; and that the expert and stakeholder review comments and queries from stakeholder engagements were adequately addressed and documented. The individual members of the PCG were prohibited from being part of the SEA multi-author teams and expert reviewers; however the organisations from which they were sourced were permitted to provide stakeholder review comments, and nominate authors expert reviewers. Furthermore, these organisations were in no way prevented from expressing their opinions on SGD by means of media engagement, legal action or advocacy.

The PCG met at key junctures during the Scientific Assessment Phase in order to perform the prescribed governance role. As for the PEC, the PCG meetings were conducted in accordance with the scientific assessment outputs, namely the Zero, First and Second Order Drafts; and the meetings were generally held immediately prior to the PEC meetings to allow for reporting of the PCG findings to the PEC (see Figure 1). The PCG is, as far as possible, based on a consensus, however, where an agreement cannot be reached, the majority rule stands, which can be submitted with one or more minority reports if deemed necessary. In addition to communicating and discussing the scientific assessment output reports (ZOD, Scenarios and Activities FOD and SOD, and the 17 Strategic Issues

[1] The SEA Process Document downloadable at http://seasgd.csir.co.za/library/

Chapters); feedback was also provided as to stakeholder engagement progress, public outreach processes and mechanisms for stakeholder commenting, as part of their prescribed mandate. The process leading up to the final publication of the scientific assessment received no objections from the PCG. Details of the PCG meetings, including dates and purpose of each meeting, are provided in Table 4. The notes for the PCG meetings are provided in Appendix 1a.

Table 4: Details of PCG meetings held throughout the Scientific Assessment Phase of the SEA.

Date	Meeting no.	Venue	Purpose of the meeting
22 July 2015	1	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Introduction to the process and the Process Governance Model; Provision of meeting principles; Confirming Terms of Reference for the PCG; Overview of Approach and Scope of the SEA; Discuss the Integrative Specialist Teams.
22 October 2015	2	Ulwazi Room, CSIR Knowledge Commons, Pretoria Campus	Provide an outline of the SEA in terms of objectives, study area and governance; Provide update on Status of SEA project and progress; Discuss comments and responses on Specialist/ Author Team composition and balance; Provide SEA Scope of Work in terms of the Zero Order Draft and Risk Assessment approach; Provide Public Outreach programme for November 2015; Discuss issues such as duration allocated for comment and review, feedback to PEC, and circulation of PCG comments prior to submission to Project Team.
3 May 2016	3	Demo Room, Building 22, CSIR Pretoria Campus	Provide an update on SEA progress with regards to Public Outreach feedback and programme, the Second Order Draft of the Scenarios and Activities Chapter, and the Peer Review Process to be followed for the First Order Draft; Provide preliminary feedback on First Order Drafts.
26 September 2016	4	Executive Boardroom (A222), Building 3, CSIR Campus, Pretoria	Provide an update on SEA progress with regards to the Scientific Assessment process and its key findings, and the Public Outreach programme; Address questions on the process and other matters arising.

3. MULTI-AUTHOR TEAMS

The process leading to the development of the evidence-base in the scientific assessment was highly inclusive, drawing from a broad and balanced range of authorship. In order to advance the principles of credibility and saliency (the latter demonstrating balance and comprehensiveness), the process adopted a multi-author team approach, in contrast to the usual approach of appointing a single consultant per topic. Each of the chapters (strategic issues) had an average of six to eight authors, ranging between four (in the case of the waste chapter) and 20 authors (in the case of the biodiversity chapter).

Authors were selected according to their formal qualifications, publications and experience, as well as widespread peer-group consensus based on their track record of valuable contributions on the topic. The 146 authors of the were drawn from a broad range of employment backgrounds, including research institutions, academia, government, NGOs, private sector consultancies and the shale gas industry. They came from many regions of South Africa, with a range of gender and ethnicities.

There was a deliberate effort to ensure diversity and a balance of interests, disciplinary background, experience and perspectives is in the team, a process which was overseen by the PCG. Remuneration of authors was designed primarily to cover expenses, rather than offer consultant-level fees which may have led to biased findings. Author workshops were hosted at Goudini Spa near Rawsonville in the Western Cape and were attended by Integrating and Contributing Authors[2] (each workshop had 60-70 authors in attendance). In total, three workshops were facilitated, each three days in duration. Table 5 below provides details of the three author workshops.

[2] The Integrating Authors were responsible for ensuring that all the components written by Contributing and Corresponding Authors were delivered on time, and were incorporated in a logical fashion; and that the scope, as decided at the first workshop in the Zero Order Draft, was covered. Integrating Authors ensured that the responses to comments from stakeholders and peer reviewers had been adequately addressed and/or incorporated and documented. The Contributing and Corresponding Authors delivered text, references, tables and graphics to their Integrating Author/s by agreed dates, and according to agreed formats and templates. They assisted in addressing reviewer comments (especially those relating to text they have contributed).

Table 5: Author meetings were hosted throughout the SEA process with specific aims and to produce specific outputs.

Date	Purpose of the meeting	Outputs
Author meeting # 1: 28–30 Sept 2015	Introduction to the process, team, leaders and managers. Author team familiarisation and bonding. Generation and evaluation of scenarios developed for the assessment. Inter and intra team meetings. Zero Order Draft of key issues as they related to each topic.	Scenarios and Activities document with detailed quantification metrics. Integrated Zero Order Draft ready for stakeholder comment and engagement.
Author meeting # 2: 18–20 April 2016	Author teams to work through the comments received on their First Order Drafts, and respond formally to all comments within the structured template, liaise with other teams on overlapping topic issues and plan the way forward to producing the Second Order Draft.	Documented comments and responses trail on the First Order Draft between authors and peer reviewers, Second Order Drafts ready for stakeholder review.
Author meeting # 3: 25–27 July 2016	Author teams to work through the comments received on their Second Order Drafts, and respond formally to all stakeholder comments within the structured template, liaise with other teams on overlapping topic issues and plan the way forward to producing the final drafts for the assessment.	Documented comments and responses trail on the Second Order Draft between authors, peer reviewers and general stakeholders. Final drafts developed, ready for public release.

4. STAKEHOLDER OUTREACH

The seventeen issues addressed in the SEA were generated by a combination of ‘top down’ and ‘bottom up’ dialogues. Top down approaches to selection of topics to be covered included gleaning key issues from the international literature on SGD experiences worldwide – these topics were then debated and agreed with governance groups and stakeholders participating in the SEA process. Bottom up approaches inluded direct engagement with stakeholders and open dialogues about their key concerns as they related to SGD in the Central Karoo, the process of which is described below.

Following the official launch of the SEA by the Minister of the Department of Environmental Affairs, I&APs were invited to register as stakeholders on the SEA website from September 2015, which was the primary, by not exclusive, means of communication. Additional efforts to improve stakeholder registration included a newspaper advertisement notifying I&APs of the opportunity to register, which was placed in The Rapport, the City Press and the Sunday Times in September 2015. Through registration, stakeholders were kept up to date with the progress of the SEA with regards to process documents; minutes for the PEC, PGC, public outreach sessions and stakeholder workshops; and any opportunities for stakeholder engagement including public meetings and commenting periods for the various scientific assessment outputs. Stakeholders who registered as such on the project website were also able to submit comments at any stage of the SEA process, which were taken into consideration and responded to accordingly. Those stakeholders that did not have internet access were able to register and submit queries or concerns manually at the public outreach sessions which were converted into an electronic record. Feedback to these individuals was provided using alternative methods of communication, such as phone call, SMS or written letter. Figure 1 below indicates the points of interaction with general stakeholders throughout the initial two phases of the SEA process.

4.1 Public Outreach Sessions

4.1.1 Public Meetings

Three public outreach sessions were conducted in the Central Karoo towns of Graaff-Reinet in the Eastern Cape, Beaufort West in the Western Cape and Victoria West in the Northern Cape meetings (attendance registers and meeting minutes are provided in Appendix 1a). The first opportunity for public engagement followed the release of the ZOD for public perusal and comment in October 2015 (prior to the first round of public engagement) via the project website, and notification was sent to registered stakeholders. The ZOD was then presented to stakeholders at the first public outreach sessions in the Central Karoo, and at the first registered stakeholder workshop in Cape Town in November 2015 (Public Outreach Round 1a). The release of the ZOD to the public facilitated a highly constructive and open dialogue concerning whether the assessment scope, as define in the Zero Order Draft, covered all the material issues of significant concern. Constructive feedback from stakeholders and goverenance group members led to a number of changes and alterations to the define scope of work, such as the inclusion of an additional topic, 'Human health', in the assessment process. Comments provided on the ZOD were considered for incorporation into the FODs, but were not responded to individually. The preliminary findings of the FODs were communicated and discussed with the same local and stakeholder communities at the second public outreach sessions in Graff-Reinet and Beaufort West in May 2016 (Public Outreach Round 1b) to check that the key issues they raised had been addressed. Their feedback was incorporated via the review process and facilitated where necessary for stakeholders without access to internet, by capturing verbal input at the public meetings for stakeholders without access to internet. Subsequent to the consideration, response and incorporation of the expert and stakeholder review comments of the FODs; the SODs were drafted by the multi-author teams and were released for stakeholder comment over a period of 38 days in June 2016.

The draft findings of the Scientific Assessment Phase were presented and discussed with stakeholders at the third public outreach sessions in the Central Karoo and at the second registered stakeholder's workshop in Cape Town in July 2016 (Public Outreach Round 2). Hard copies and electronic copies (cd's) of the draft SOD's, and hard copies of the Summary for Policy-Makers were sent to several libraries in Graaff- Reinet, Beaufort West and Victoria West, along with comment instruction documents and comment sheets to allow for stakeholders without internet to access the documents and provide comment. All stakeholder comments were documented and responded to in a manner consistent with that of the expert peer review comments, and appropriate stakeholder comments were incorporated into the final scientific assessment. In keeping with the transparency and legitimacy of the SEA process; the expert peer review and stakeholder comments were made publically available on the project website. Any stakeholder queries were addressed at each of the stakeholder engagement sessions and/or via the project website. In most instances the meetings were attended by the same individuals who had also attended previous sessions. It became clear that substantial levels of trust in the process had been established by the time the findings of the assessment were being conveyed, discussed and commented on. As a result many of the stakeholders expressly indicated that whilst they may not agree with every single finding of the assessment, they felt that it had made a valuable contribution as a reliable information basis for future decision-making. By the time of publication, there were in excess of 600 registered stakeholders (see Figure 2).

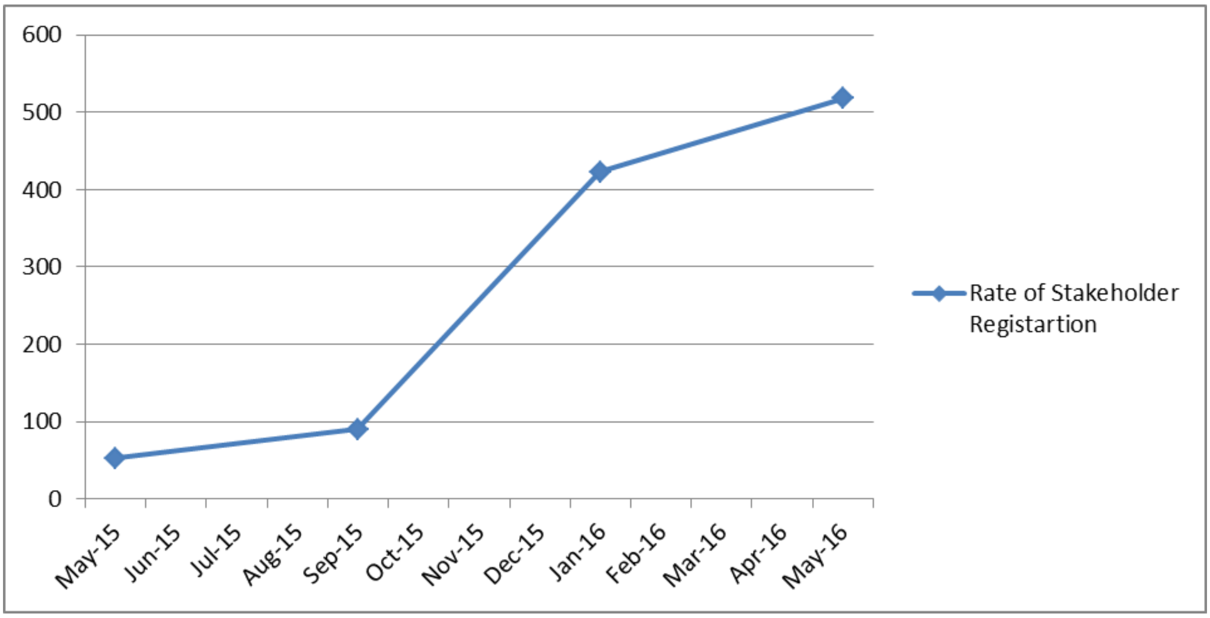

Figure 2: The rate of stakeholder registration over a 12 month period from May 2015 to May 2016, just prior to the release of the Second Order Draft for public review.

From the date of the SEA launch (12 May 2015) until end-June 2015, the management team received 53 online registrations. During the period between early-July 2015 and end-September 2015 a further 37 online registrations were received. During the period between early-October 2015 and end-Jan

2016 there was a substantial increase in online registrations with the management team received 333 registrations.

4.1.2 Local Municipality Meetings

Meetings were also held with the Local Municipalities of the towns in which the public outreach sessions were conducted, namely the Camdeboo Local Municipality, the Beaufort West Local Municipality and the Ubuntu Local Municipality for the second (Public Outreach Round 1b) and third public outreach sessions (Public Outreach Round 2). The Minister of Environmental Affairs, Mrs. Molewa, addressed letters to the Mayor at each municipality, which served to notify the Municipal Offices of the public briefings, and it also requested that a representative from each municipality be present at the public meetings in order to formally open the meeting and introduce the SEA project team. The letter also requested that a meeting be scheduled with the Municipal Offices or identified representatives of the municipality, together with a representative from the department at the Chief Director level, and the project team, prior to the public in order to ensure that the Local Municipalities were adequately informed of the objectives and intended outcomes of the public meetings, as well as the approach to be followed and the key roles and responsibilities of those in attendance meetings (attendance registers and meeting minutes are provided in Appendix 1a). These meetings provided an additional opportunity to inform the local people of the public outreach sessions, as the Local Municipalities were requested to distribute notice of the public meetings (dates and times) through their Local Government structures, namely Ward Councillors, by means of distributing flyers and loud haling. The Municipalities were also requested to have a representative at each of the public meetings to open the meeting and introducing the project team.

4.1.3 Methods of stakeholder communication

Various methods of communication were employed to engage with stakeholders and inform the public of the opportunities for stakeholder engagement. These methods include public meetings (Public Outreach Rounds 1a,b, and 2); the publication of written documents made available on the website, at public meetings and workshops, and at local libraries; interviews with the media and press releases including notification of public meetings on national and local radio stations, advertisements in provincial and local newspapers and via bulk SMS; explanatory materials such as videos on the project website; notification through social media such as Facebook; the distribution of flyers and notice through government structures such as Ward Councillors, the South African Local Government Agency and PEC- and PCG members; and art exhibitions to improve awareness of the SEA process and outcomes.

4.1.3.1 Project Website

As previously noted; the project website was established at the onset of the project, which provided the platform to not only share information with stakeholders on the SEA process and progress throughout, but also to gather information, concerns and comments from stakeholders (Figure 3).

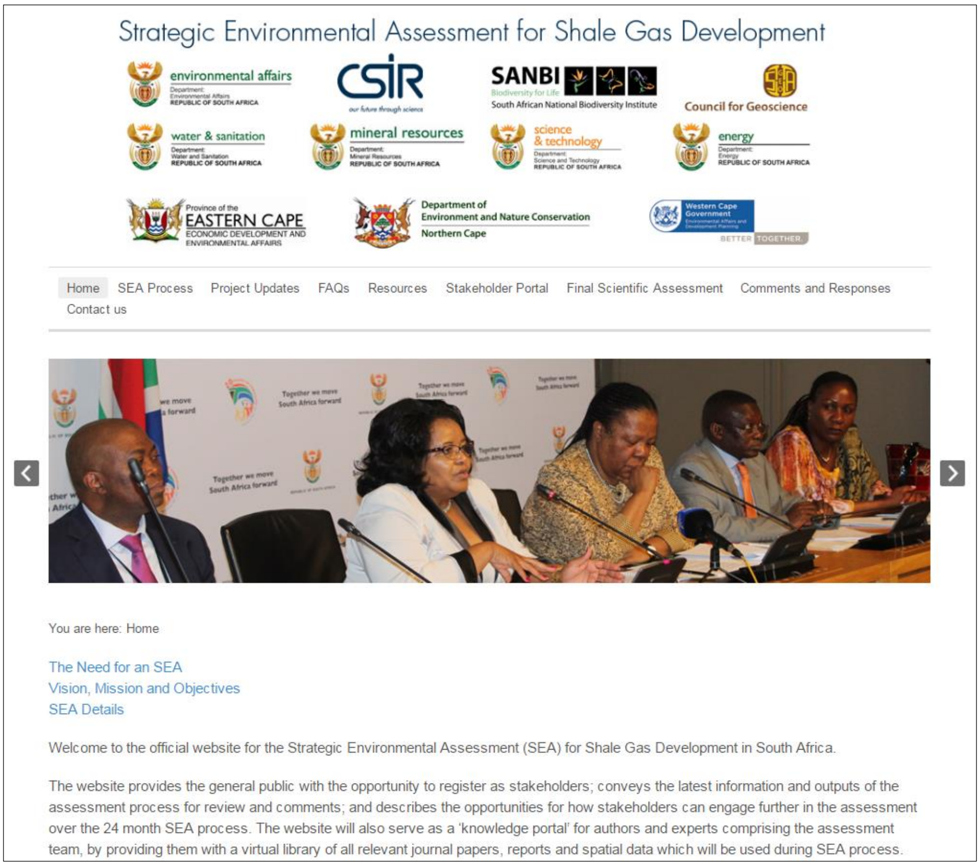

Figure 3: Home page (part of) of the Shale Gas SEA Website (**http://seasgd.csir.co.za/**)

The website was regularly updated with the latest downloadable outputs of the scientific assessment. To date, a total of 14 updates were provided on the website from the SEA launch in May 2015 up to the publication of the final scientific assessment in November 2016 (see Table 6). I&APs were able to register as stakeholders via the website, which allowed them to receive communication about the SEA in terms of progress, outputs and stakeholder engagement. Stakeholders who registered via the website and through manual registration at public outreach sessions were informed by means of email, and where persons did not have an email address, written notices were sent or alternatively, where phone numbers were provided; SMS's were sent.

Table 6: List of project updates on the SEA website

Project Update/ Notification	Date
12 May 2015 - Project Launch	12 May 2015
22 July 2015 - Process Custodians Group Meeting	31 August 2015
31 August 2015 - Shale Gas SEA Process Document now available	31 August 2015
28-30 September - Multi-Author Team Workshop 1	08 October 2015
09-13 November 2015 – Round 1 Public Outreach on the SEA for Shale Gas Development	12 October 2015
21 October 2015 – Zero Order Draft Available for Review and Comment	21 October 2015
22 October – Process Custodians Group Meeting 2	04 November 2015
16-17 May 2016 – Round 1a Public Outreach on the SEA for Shale Gas Development- Graff-Reinet & Beaufort West	11 May 2016
12 May 2016 – Shale Gas Development Scenarios and Activities Summary Document & Video Release	12 May 2016
06 June 2016 – Reminder: Scientific Assessment Planned for Release for Stakeholder Review from 14 June to 15 July 2016	06 June 2016
14 June 2016 – Draft Scientific Assessment for Shale Gas Development Now Available for Stakeholder Review (14 Jun- 15 Jul 2016)	14 June 2016
185- 22 July 2016: Round 2 Public Outreach to Communicate Draft Findings of the Phase 2 Scientific Assessment	07 July 2016
15 July 2016: Comment Period for Draft Chapters Extended to 22 July 15:00	15 July 2016
15 November 2016: Final Scientific Assessment Published	15 November 2016

4.1.3.2 Notification of public outreach sessions

Notices of the public meetings were also advertised on local radio stations such as Radio Gamkaland in Beaufort West and the Mdantsane FM radio station in Graaff-Reinet. For the first round of public meetings (Public Outreach Round 1a) in Graaff- Reinet, Beaufort West, Victoria West and the registered stakeholder workshop in Cape Town; trilingual (English, Afrikaans and isiXhosa) newspaper advertisements were published in the Daily Dispatch, Diamond Fields, Sunday Independent and Weekend Argus. See Figure 4 for an example of the trilingual advertisement.

NOTIFICATION OF PUBLIC BRIEFINGS FOR THE STRATEGIC ENVIRONMENTAL ASSESSMENT FOR SHALE GAS DEVELOPMENT IN SOUTH AFRICA

The Department of Environmental Affairs has appointed a project team, consisting of the Council for Scientific and Industrial Research, the South African National Biodiversity Institute and the Council for Geoscience, to undertake a Strategic Environmental Assessment for shale gas development. As part of the process, 3 public briefings sessions and 1 registered stakeholder workshop have been arranged in the study area.

KENNISGEWING VAN PUBLIKE UITREIKING VIR DIE STRATEGIESE OMGEWINGSTUDIE VIR SKALIEGASONTWIKKELING IN SUID-AFRIKA

Die Departement van Omgewingsake het 'n projekspan, betaande uit die Wetenskap en Nywerheids Navorsingsraad, die Suid Afrikaanse Nasionale Biodiversiteit Instituut en die Raad vir Geowetenskap, aangestel om 'n Strategiese Omgewings-Ondersoek vir skaliegasontwikkeling uit te voer. As deel van die proses is daar 3 publieke uitreik sessies en 1 werkswinkel vir geregistreerde belanghebbendes wat in die studiegebied gaan plaasvind.

ISAZISO NGAMASUNTSWANA EENDABA KU-WONKEWONKE NGOVAVANYO OLUCWANGCISIWEYO LWEMVELO NGOFUNYANISO LWE SHALE GAS EMZANTSI AFRIKA

Abecandelo IwezeMvelo bonyule iCouncil ye Scientific ne Industrial Research, iSouth African National Biodiversity Institute kunye ne Council ye Geoscience ukuba baqhube uhlelo lovavanyo olucwangcisiweyo lwemvelo ngofunyaniso lwe Shale Gas. Malunga nalenkqubo, kuzobakhona amanqanaba amathathu eentlanganiso ezimasuntswana kunye ne ndibano enye yababhalisileyo ngokuchaphazeleka ezobanjelwa endaweni yovavanyo.

Province	Town	Venue	Date and Time
1. Eastern Cape	Graaff- Reinet	Masizakhe Community Hall	09 November 2015; 16:00 - 19:00
2. Northern Cape	Victoria West	Victoria-West Town Hall	10 November 2015; 16:00 - 19:00
3. Western Cape	Beaufort West	Rustdene Community Hall, de Vries Street	11 November 2015; 16:00 - 19:00
Western Cape (Registered Stakeholder workshop)	Cape Town	Iziko Museum	13 November 2015; 10:30 - 15:00

Website: http://seasgd.csir.co.za/ | Email: seashalegas@csir.co.za | Tel: 021 888 2482 | Fax 021 888 8693

Figure 4: Example of the trilingual notifications for SEA public meetings.

For the second rough of public meetings (Public Outreach Round 1b) in Graaff-Reinet and Beaufort West, newspaper advertisements were placed in the Cape Argus in English and Die Courier in Afrikaans in the Western Cape; and in the I'solezwe lesiXHOSA in isiXhosa, the Advertiser and the Herald in English in the Eastern Cape. For the third and final round of public meetings (Public Outreach Round 2), trilingual newspaper advertisements were placed in the I'solezwe lesiXHOSA, the Advertiser and the Herald in the Eastern Cape; Diamond Fields and the Advertiser in the Northern Cape, and the Cape Argus and Die Courier in the Western Cape. All advertisements provided the dates and venues for the meetings in each town; the contact details for the CSIR project team; as well as the link to the project website (see Figure 5).

Figure 5: Examples of notifications of public briefings advertised in the Cape Argus (left) and I'solezwe lesiXHOSA (right).

4.1.4 SEA Media Coverage

Throughout the SEA process, a number of media publications were released across different media outlets including printed and online newspapers, news websites, and magazines. Table 7 below provides details on the media coverage the SEA has received over the course of the SEA process.

1 Table 7: Details of media coverage the SEA has received over the past 24 months.

Strategic Environmental Assessment media coverage			
Title	**Date**	**Publication**	**Link**
Environmental gas appraisal for Karoo	12/05/15	Business Day	http://www.pressreader.com/south-africa/business-day/20150512/textview
SA set to allow shale gas exploration to proceed despite 24-month risk assessment	12/05/15	Engineering News	http://www.engineeringnews.co.za/print-version/sa-set-to-allow-shale-gas-exploration-to-proceed-despite-24-month-risk-assessment-2015-05-12
Gov takes control of Karoo fracking	12/05/15	The Citizen	http://citizen.co.za/uncategorized/380903/government-takes-control-of-karoo-fracking/
SA shale gas regulations within two weeks	12/05/15	Fin24	http://www.fin24.com/Economy/SA-shale-gas-regulations-within-two-weeks-20150512
SA shale gas regulations within two weeks	12/05/15	SABC	http://www.sabc.co.za/news/a/bd04c5804858801692c7bbe1ccb64421/SA-shale-gas-regulations-within-two-weeks-20151205
Omgewingsondersoek oor skalie oplaas hier	13/05/15	Beeld	http://www.pressreader.com/south-africa/beeld/20150513/281814282437657
Omgewingsondersoek oor skalie oplaas hier	13/05/15	Die Burger	http://www.pressreader.com/south-africa/die-burger/20150513/282011850932989
Team to assess fracking established	13/05/15	The Star – Business Report	http://www.iol.co.za/business/news/team-to-assess-fracking-established-1857561
State rethink on shale gas	13/05/15	The New Age – KZN Business	http://www.pressreader.com/south-africa/the-new-age-free-state/20150513/282136404984379
Multibillion-rand probe into shale gas fracking launched	13/05/15	The Star	https://www.pressreader.com/south-africa/the-mercury/20150513/281603829039882
Team to look at potential impact of Karoo shale gas	13/05/15	SouthAfrica.info	http://www.southafrica.info/about/sustainable/shalegas-sea-130515.htm#.WEUJtn0aulk
Meaning of SA's two-year shale gas risk assessment explored	15/05/15	Engineering News	http://www.engineeringnews.co.za/article/meaning-of-sas-two-year-shale-gas-risk-assessment-explored-2015-05-15
Environment fracking out in the open at last	15/05/15	Mail & Guardian	http://mg.co.za/article/2015-05-14-fracking-out-in-the-open-at-last
Scientific Dimension	22/05/15	Engineering News	

Strategic Environmental Assessment media coverage			
Title	**Date**	**Publication**	**Link**
TKAG wants Karoo exploration delayed until conclusion of enviro assessment	22/05/15	Mining Weekly	http://www.miningweekly.com/article/tkag-wants-karoo-exploration-delayed-until-conclusion-of-enviro-assessment-2015-05-22
A sober look at fracking	23/05/15	Weekend Argus – Saturday Edition	
Karoo: the fractious issue of fracking	23/05/15	Pretoria News Weekend	http://www.pressreader.com/south-africa/pretoria-news-weekend/20150523/281689728403128
Anti-frackers welcome impact assessment	26/05/15	The Mercury	http://www.iol.co.za/scitech/science/environment/anti-frackers-welcome-impact-assessment-1863150
A sober look at fracking	28/05/15	Weekend Argus	http://www.iol.co.za/news/a-sober-look-at-fracking-1864698
Calls for moratorium on fracking applications	19/08/15	Cape Times	http://www.iol.co.za/capetimes/call-for-moratorium-on-fracking-applications-1902062
Fracking challenge to state	19/08/15	The Mercury	http://www.iol.co.za/scitech/science/environment/fracking-challenge-to-state-1902136
Top team of 16 experts to examine impact of fracking in 2-year study	02/10/15	Cape Times	http://www.pressreader.com/south-africa/cape-times/20151002/281668253791708
Farmers fear possibility of fracking in province	14/10/15	The Mercury	http://www.kwanalu.co.za/farmers-fear-possibility-of-fracking-in-province/
Consultations on fracking to begin	10/11/15	Diamond Field Advertiser	https://www.pressreader.com/south-africa/diamond-fields-advertiser/20151110/281547994775438
Assessment to establish fracking risk	16/11/15	Cape Times	http://www.iol.co.za/capetimes/assessment-to-establish-fracking-risk-1946187
Dire warning on fracking	11/03/16	Pretoria News	
Shale gas in Karoo? Questions loom	11/03/16	Cape Time	http://www.iol.co.za/business/news/shale-gas-in-karoo-questions-loom-1996405
Mapping the future of fracking - (An environmental assessment on shale gas exploration may bring 'us' and 'them' closer)	12/03/16	Weekend Argus	http://www.iol.co.za/news/mapping-the-future-of-fracking-1997061

Strategic Environmental Assessment media coverage			
Title	**Date**	**Publication**	**Link**
SA drawing on 150 experts as rigorous Karoo shale-gas environ assessment advances	01/04/16	Engineering News	http://www.engineeringnews.co.za/article/sa-drawing-on-150-experts-as-rigorous-karoo-shale-gas-enviro-assessment-advances-2016-04-01
Pasa ups estimate for Karoo shale gas	05/12/16	Dispatch live	http://www.dispatchlive.co.za/business/2016/05/13/pasa-ups-estimate-for-karoo-shale-gas/
International Biological Diversity Day – why SA is the 3rd most biodiverse place on Earth	23/05/16	News24	http://traveller24.news24.com/Explore/Green/international-biological-diversity-day-why-sa-is-the-3rd-most-biodiverse-place-on-earth-20160523
Shale gas exploration not worth it at $50 per barrel	12/07/16	City Press	http://city-press.news24.com/Business/shale-gas-exploration-not-worth-it-at-50-per-barrel-20160708
Shale Gas Development – A Scientific Assessment for South Africa	15/07/16	The HeritagePortal	http://theheritageportal.co.za/notice/shale-gas-development-scientific-assessment-south-africa
Shale gas fails the jobs test	03/09/16	City Press / Fin24	http://www.fin24.com/Economy/shale-gas-fails-the-jobs-test-20160902
WWF pulls apart report on economic benefits of fracking in SA	21/10/16	Fin24	http://www.fin24.com/Opinion/wwf-pulls-apart-report-on-economic-benefits-of-fracking-in-sa-20161021
Karoo fracking risky, experts say	23/11/16	The Mercury	http://www.kwanalu.co.za/karoo-fracking-risky-experts-say/
What the frack! Scientific report finds little sense in fracking	23/11/16	SAPromoMagazine	https://www.sapromo.com/frack-scientific-report-finds-little-sense-fracking/12221
CSIR fracking report shows the downside	27/11/16	City Press	http://www.fin24.com/Economy/csir-fracking-report-shows-the-downside-20161125

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5. PARTICIPATION THROUGH REVIEW

The FOD chapters were submitted to 25 local and 46 international independent experts for peer review – this process was independently managed by the project management team acting in a review editor capacity. Disputes between author teams and peer reviewed were facilitated and managed by the project team until a consentual outcome emerged. While there were a few instances of disagreements between authors and peer reviewers, generally there was widespread and grounded views on what the key issues and levels of risk are.

Experts were nominated by governance groups, stakeholders, authors and recruited by the project management team following approval by the PCG based on experience in relation to SGD or specific knowledge of the Central Karoo socio-ecconomic and ecological systems. Expert reviewers were drawn from government, NGOs, academia, the private sector with many international volunteers coming from the United States of America, Canada, Australia and other European countries. All peer review experts participated in the assessment process on a pro bono basis.

The peer review comments, each submitted as structured page-and-line numbered statements relating to the accuracy, balance and comprehensiveness of the chapter content, were considered and responded to by the author teams during development of the SOD. The responses to every comment were made in a public-domain database on the project website. Responses to comments were required to be sufficiently descriptive for the stakeholders to be able to trace them in the text or understand the basis on which they had been accepted or rejected. The primary criterion was to demonstrate that authors had adequately applied their minds in the consideration of the comments.

The same peer review experts reviewed the revised SOD which was released for broader stakeholder review. The comment provision and response mechanism for the SOD was the same as for the FOD. The collaboration between authors, expert reviewers and knowledgeable stakeholders resulted in the emergence of a variety of knowledges of the study area and particular topics. Table 8 presents the opportunities for review and commenting provided to the governance groups, peer reviewers and public stakeholders during the SEA process.

Table 8: Consolidated summary of opportunities provided to governance groups, peer reviewers and general stakeholders to participate in the review of content material and process issues.

Review item	What was reviewed?	Stakeholder group			
		PEC	PCG	Peer reviewers	General stakeholders
		Dates provided for stakeholder review on content and process			
Approval of author team s	The expertise, balance and credibility of authors		07 – 17 September 2015		
Zero Order Draft	The coverage of all the material issues associated with SGD	21 October – 20 November 2015	21 October – 20 November 2015		21 October – 20 November 2015
Nomination of peer review experts	The nominated peer review experts where sufficiently experienced in aspects related to SGD or have specific knowledge of the Central Karoo socio-ecconomic and ecological systems	18 January – 08 February 2016	05 January – 08 February 2016		Throughout round 1 of public outreach in November 2015 up to 08 February 2016
First Order Draft	The facts, evidence, structure or reports and assessment findings based on cited information	03 March - 29 March 2016		22 February – 18 March 2016	
Second Order Draft	Same as for the First Order Draft and any other content or process isssue a stakeholder wished to comment or question	03 June – 22 July 2016	14 June – 22 July 2016	14 June – 22 July 2016	14 June – 22 July 2016
Approval of adequate response to review comments	The review comments received from expert and stakeholders been adequately addressed and have the responses been adequately documented		28 October – 10 November 2016		
Decision-Making Framework	The project has been delivered on brief and budget. The policy-level questions have been adequately addressed in the SEA	10 March – 07 April 2017 (tbc)			

6. WORKSHOPS, CONFERENCES AND PUBLICATIONS

The project team, including the CSIR, SANBI and CGS participated in numerous of conferences, workshops, and seminars over the course of the SEA, and also published a number of papers during this time.

In August 2015, a DEA representative and former PEC member, Surprise Zwane, presented on the SEA for SGD in South Africa at the 2015 Annual IAIAsa Conference at the Champagne Sports Resort in the Drakensberg, KwaZulu-Natal. Other PEC members from the DEA and project team members were also in attendance. See *Zwane, S., Schreiner, G.O., Fischer, D.,& P.A. Lochner. Strategic Environmental Assessment for Shale Gas Development in South Africa. Proceedings of the 20th Annual Conference of the International Association for Impact Assessment South Africa; 12 – 14 August, 2015*

A Western Cape Intra-Governmental Shale Gas Forum was held in August 2015, at which project member, Greg Schreiner presented an overview of the SEA process. The purpose of the forum was to facilitate information sharing relating to the SEA for SGD, and to advise the Western Cape Government on potential institutional requirements associated with the implementation of shale gas related operations.

In August 2015, Greg Schreiner and Luanita van der Walt attended the Water Research Commission Water Science Plan for Unconventional Gas hosted in collaboration with the University of the Western Cape and North American research institutions. The South African Local Government Association (SALGA) held a Broader Karoo Region Small Town Regeneration and Regional Economic Development Conference in April 2016, at the Beaufort West Youth Hub. The theme of the conference was “Small Towns, New Futures”: Karoo Region; where Greg Schreiner presented an overview of the SEA.

Project partner, SANBI invited the CSIR to participate in the Bioblitz awareness day and launch, in April 2016 in Matjiesfontein (Figure 6). The Bioblitz, which is essentially a rapid biodiversity assessment conducted by means of field surveys at a single site in a short time period (usually a day) using as many observers as possible, including biologists, citizen scientists and general public, was undertaken as a result of significant data gaps within the Karoo region in an effort to improve the overall understanding of the biodiversity of the this region. Project team members, Prof Bob Scholes and Megan de Jager were part of more than 70 people who attended the Bioblitz launch in April 2016, including community members from Beaufort West, individuals who had registered as I&APs for the

SEA and government officials from the Department of Science and Technology, Department of Minerals Resources, and the Northern Cape and Western Cape conservation agencies. In addition to the one day field survey conducted at the launch, two fieldtrips were conducted in August- September 2015 (16 days) in the central and western section of the study area; and in December 2015 (four days) in the eastern section of the study area. Valuable observations of plants and animals were gained during the BioBlitz which saw the initiation of a citizen science engagement in the Karoo where citizens are able to post their images of plants and animals onto the iSpot Citizen Science Portal, as part of the Karoo BioGaps project[3]. To date, 4298 observations have been included on this portal. SANBI is in the process of engaging experts in identifying these postings so that citizen science observations can contribute to the overall datasets of animal and plant distributions feeding into decision making in the Karoo.

Figure 6: Participants of the Karoo Bioblitz awareness day in April 2015, during which seven taxonomic groups were surveyed.

In June 2016, SANBI held a Biodiversity Planning Forum at the Salt Rock hotel and Beach Resort in KwaZulu-Natal, where Prof Bob Scholes, Greg Schreiner and Luanita van der Walt presented on the SEA. As part of the Forum, the CSIR was invited to participate in a learning exchange with The Nature Conservancy (organised by SANBI); focusing on scenario analysis for the impacts associated with hydraulic fracturing for shale gas development, which took place on the two days preceding the Forum. The outputs of this session fed into the Biodiversity Planning Forum. See *Schreiner, G.O & L. van der Walt. 2015. A Strategic Environmental Assessment for Shale gas in South Africa. 12th National Biodiversity Planning Forum. 23-26 June 2015.*

The project team members, Prof Bob Scholes, Greg Schreiner and Luanita Snyman-Van der Walt submitted a paper in August 2016 for publication in a Special Issue on invasives in the African Biodiversity and Conservation (Bothalia) journal in October 2017. The paper is entitled "Scientific

[3] The Karoo BioGaps project information is available at the following link http://www.ispotnature.org/projects/karoo-biogaps/observations/map

Assessments: Matching the process to the problem" and serves to explain how to conduct an assessment. This paper was by invitation, following the 2016 conference on Invasive Alien Species at Goudini, Worcester. See *Scholes, R., Schreiner, G., Snyman- Van der Walt, L. (in press, accepted for publication). Scientific assessments: Matching the process to the problem. Bothalia - African Biodiversity & Conservation. Special Edition.*

In September 2016, project co-leader, Paul Lochner, presented on the SEA at the 35th International Geological Conference (IGC) at the Cape Town International Convention Centre. The conference had over 4000 people in attendance from 117 countries, and over 5000 abstracts for oral and poster presentations. See *Lochner, P.A., Schreiner, G.O. & Scholes R.J. 2016. Key note address: Strategic Environmental Assessment for shale gas development in South Africa. International Geological Congress, 01 September 2016, CTICC, Cape Town*. Paul Lochner also presented on the SEA at the South African Oil and Gas Alliance (SAOGA) networking Breakfast in Granger Bay in September 2016.

In October 2016, the CSIR submitted a chapter entitled "Advancing a participatory and science-based approach to policy formulation for shale gas development in South Africa" for publication in the book; Citizen and other stakeholder participation in unconventional fossil fuel land use decision – making, policy formulation, regulatory practice or other governance mechanisms. The major theme of the book involves a comparative analysis of national governance systems for SGD, regulatory best practice and participation. See *Schreiner, G.O., Scholes, R.J., Snyman-Van der Walt, L., De Jager, M., S, Esterhuyse., Dludla, A., Lochner, P.A., Wright, J., Atkinson, D., Hardcastle, P., Kotze, H. (in press). Advancing a participatory and science-based approach to policy formulation for shale gas development in South Africa. In eds Whitton, J., Cotton, M., Brasier, K. (in press). Citizen and other stakeholder participation in unconventional fossil fuel land use decision-making, policy formation, regulatory practice or other governance mechanisms. London: Routledge.*

A public seminar was held at the University of Cape Town in December 2016, which focused on UCT's contribution to a sound evidence base for decision making as part of the SEA. Presentations were provided by authors of the scientific assessment, namely Prof Harald Winkler, Prof Leslie London, Dr Katye Altieri, Prof Jenny Day, and by project team members Greg Schreiner and Paul Lochner. A Question and Answer session was also held which further included authors Prof Andrea Rother, Matthew Meas, and project team member Luanita Snyman-Van der Walt.

For the 2017 IAIA Annual Conference, Greg Schreiner, Luanita Snyman-Van der Walt of the project team, Lydia Cape (CSIR) and Dee Fischer (DEA) will be presenting on the use of scenarios to model risk in the shale gas scientific assessment for South Africa. This presentation falls into the session focusing on cumulative environmental assessments and climate change.

The final scientific assessment was published in November 2016 as an 18 chapter peer reviewed, ISBN numbered scientific publication. See *Scholes, R., Lochner, P., Schreiner, G., Snyman-Van der Walt, L. and de Jager, M. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. CSIR/IU/021MH/EXP/2016/003/A, ISBN 978-0-7988-5631-7, Pretoria: CSIR. Available at* [*http://seasgd.csir.co.za/scientific-assessment-chapters/*](http://seasgd.csir.co.za/scientific-assessment-chapters/)

7. SKILLS DEVELOPMENT

As part of the Memorandum of Agreement between the DEA and CSIR, skills development and the promotion of research were noted as required outputs of the first milestone of the SEA, which was to be implemented throughout most of the SEA. As such, under the auspices of the SEA, and the funding authority which commissioned the SEA, various CSIR project members were provided financial support in conducting further studies or courses. CSIR project manager, Greg Schreiner obtained accreditation as a Commercial Mediator, which also allows mediation of court-referred disputes.

Disbursement costs such as flights, care hire and accommodation (where necessary) were provided for project intern, Megan de Jager, to conduct fieldwork in October 2016 and February 2017, and attend meetings with mentor and supervisor for her PhD in Environmental Geography which focuses on setting biophysical baseline conditions in the Karoo Basin, prior to the onset of shale gas development, using remote sensing techniques.

Funding was also provided for Megan to attend the 2016 Annual IAIA Conference in Port Elizabeth where she presented her PhD. Course fees and disbursements were provided from the SEA for two courses related to remote sensing at the Nelson Mandela Metropolitan University (presented by the South African National Space Agency) and University of Stellenbosch, which Megan attended in July and November 2016. Megan will be completed with her PhD by end-2018.

The other project intern, Andile Dludla obtained his Post-Grad Diploma (PGD) in Environmental Management from the University of Stellenbosch, which was funded by the shale gas SEA project.

Andile will continue to further his studies and is enrolled for an MPhil for 2017. Funding was also provided for Andile to attend the 2015 IAIAsa Annual Conference in KwaZulu-Natal. Andile will have completed his Masters Degree by end-2017.

Strategic Environmental Assessment of Shale Gas Development in the Central Karoo

Phase 3:
Decision Support Tools Report

APPENDIX 1a

Record of Stakeholder Engagement

CONTENTS

1. ANNEX 1. PROJECT EXECUTIVE COMMITTEE MEETING NOTES (INCL. ATTENDANCE)

1.1 Inception Meeting Notes (12-13 February 2015)

Strategic Environmental Assessment for
Shale Gas Development in South Africa
Meeting Notes

Inception Meeting for the Strategic Environmental Assessment for Shale Gas Development in South Africa.

Date of the meeting

12-13 February, 2015.

Location

DEA Environment House, Pretoria.

List of attendees

Name	Organisation		12 February 2015	13 February 2015
Henk Coetzee	CGS		✓	✓
V.R.K. Vadapalli	CGS		✓	-
Abulele Adams	CSIR		✓	✓
Biffy van Rooyen	CSIR		-	✓
Greg Schreiner	CSIR		✓	✓
Luanita van der Walt	CSIR		✓	✓
Paul Lochner	CSIR		✓	✓
Alf Wills	DEA		✓	-
Dee Fischer	DEA		Joined from 12:00	-
Janine Hambury	DEA		✓	✓
Marlanie Moodley	DEA		✓	✓
Peter Lukey	DEA		✓	✓
Surprise Zwane	DEA		✓	✓
Paul Hardcastle	DEADP (WC)		✓	✓
Alistair McMaster	DEDEAT (EC)		✓	-
Bryan Fischer	DENC (NC)		✓	✓
Ernst Bertram	DWS		✓	✓
Mkhevu Mnisi	DWS		✓	-
Namisha Muthraparsad	DWS		-	✓
Jeff Manuel	SANBI		✓	✓
Kristal Maze	SANBI		✓	-
Bob Scholes	Wits/CSIR		✓	✓

1

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

List of acronyms

CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EMPr	Environmental Management Programme
NGO	Non-Government Organisation
PCG	Process Custodians Group
PEC	Project Executive Committee
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
SIP	Strategic Integrated Project

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Strategic Environmental Assessment for Shale Gas Development in South Africa
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Meeting Notes:

1. *Welcome and introduction*

An opinion exists that the current Environmental Management System in South Africa is delaying development which is driving the need for a more improved and streamlined process. This should be achieved by utilising Integrated Environmental Management Tools which provide flexibility, effectiveness efficiency. One of those tools is the Strategic Environmental Assessment (SEA) which enables the screening of sensitive areas and assists in understanding broad issues within a wider geographic area. SEAs can be used to inform which assessment tools are most suitable at an area and project-specific level.

Shale gas development in South Africa is not currently classified as a SIP. However, it is a national priority and if resources are determined and established to be viable, it could be translated into a SIP. The exploration and exploitation of shale gas is recognised by the Minister as a socio-economic opportunity, but there are also known detrimental environmental impacts to consider. DEA is taking a proactive approach to identify the best tools, processes, and decision-making framework for shale gas development if it occurs.

2. *Workshop outline*

Inputs and Clarifications on "Shale Gas Debate" in South Africa

   - In July 2012, DEA commented on the report of the DMR inter-departmental Task Team Study and recommended a "first-pass" SEA to suggest best practice techniques and environmental management principles to augment the regulatory framework
   - Falcon-Chevron has initiated updates to their EMPr in addition to Bundu. Shell has not initiated an EMPr update process to our knowledge.

- A core message that needs to be communicated throughout the SEA process: Departments, Councils, and Provinces are working together to enable evidence-based decision-making.
- Close collaboration between DEA and DWS is necessary as water is a fundamental issue to we addressed in the SEA.
- An important aspect to consider throughout the SEA process is that shale gas development will only happen if it the resource is economically viable to exploit, it is not a fate complete.
- The SEA process should not provide a platform for the wider political debate on shale gas, but only on the scientific information collected during and relevant to the SEA process. The assessment is thus policy-relevant, but not policy-prescriptive.
- The message that is being communicated from the SEA process on the science should be simple, transparent, honest and robust.
- A high-level commitment has already been made to the exploration of shale gas, which may lead to question why the SEA is being undertaken at this stage. It should be clearly stated that provisional permission has been granted on shale gas exploration – the provision being the environmental aspects that will be informed by the SEA.
- Currently the landscape-scale impact of shale gas is unknown, therefore it must be emphasised that the SEA aims to remove the shale gas risks from a speculative domain and base it on facts.

3. *SEA approach*

Terminological clarifications

3

- The SEA is following a risk-assessment approach, but opportunities are also being considered as "Risk Discounted Benefits".
- The term "expert" for the review teams should rather be indicated as "knowledgeable persons" or "persons with relevant expertise".

- NGOs and Public Interest Groups (PIGs) will add useful comments (they are not scientist or academics), but they are on the ground and may be seen 'expert' on public and community opinions.
- South African authors who have described the Karoo Sense of Place may be considered "experts" on the sense of place Strategic Issue. This is more in line with "softer" issues (compared to hard science) which may require the expertise from people such as lawyers, environment historians, writers etc.
- Agreement on the study area for the study based on the existing Exploration Rights applications from Shell, Bund and Falcon/Chevron.
- The SEA is not a consensus-building exercise, but an evidence-building exercise, additionally the SEA cannot be held up by trying to reach consensus within management of the process. Divergent views and polarisation should be adequately captured through the process.
- Public participation at the local and community scale will contribute to building evidence for social fabric and sensitivities as well as the opportunities for benefit sharing.
- It is important to inform communities of the realistic opportunities from shale gas development and also the detrimental effects it may have on their health and their environment (clear up any misconceptions they may have on the risks/opportunities of shale gas development). The scale at which the study is being conducted does however limit the degree to which the public can be engaged.
- There needs to be an understanding of the 'types' of social contacts which emanate from the drilling programmes and how to implement these in a sustainable manner. There also need to be some kind of provisioning the SEA which considers the legacy impact of shale gas development e.g. well closure, monitoring etc.

4. *Vision and Sustainability Objectives*

Edits to the Draft Vision for Shale Gas Development in South Africa

- Add "institutions" into the vision to entail the implementation of the decision-making frameworks.
- Expand the term "environment" to social, ecological and economical in the actual text.
- The prejudgement that shale gas development will definitely happen, should be removed, therefore a phrase such as "potential shale gas development" or "if shale gas development should occur" must be inserted.

Consideration for the Sustainability Objectives

- Other official documentation such as the MPRDA and the National Water Resources Strategy should be considered for the development of the Sustainability Objectives.

Clarifications on the SEA objectives

- Outputs of the SEA will be assessment tools and a decision-informing framework for the regulation of shale gas activities

Strategic Environmental Assessment for Shale Gas Development in South Africa
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5. *Project governance*

- Department of Mineral Resources (DMR) should be represented on the Project Executive Committee (PEC), however this coordination should be arranged at a high level (e.g. DEA DG to DMR DG).
- To make sure that the local communities within the three provinces (Western Cape, Northern Cape and Eastern Cape) are actively engaged on the process and results of the SEA, the Provincial Governments need to develop a local communication strategy where Municipalities within the study area are kept informed.
- The PEC is responsible for the management of the SEA process (i.e. ensuring that the project is on scope, on time, and on budget) and should function under the principle of cooperation.
- The Process Custodians Group's (PCG) responsibility is to ensure that the SEA process is transparent, sound and managed in a responsible way that does not discredit or compromise the project. The PCG are will be focused on verifying process related aspects of the SEA only e.g. that expert authors have been selected in a credible manner, that review procedures have been implemented in a structured way etc.
- All communications and documents relating to the process should be made public to ensure transparency, except of for the internal discussion of the PEC.
- The Multi-Author Teams need could also fulfill the role of an "Expert Reference Group". All inputs into the SEA may not necessarily be provided by "expert authors" but also by people who have local and indigenous knowledge (such as Farmers Associations, Oil and Gas Associations, Regulators, Parastatals etc.). Documents get value when subjected to a workshop discussion and ensures that information has not been lost and that a wider scope of people, expertise and views are included and considered.
- It is suggested that a PCG be appointed though a forum that is to be facilitated by DEA with the support of the Project Team. PCG members should be 'experts' in process and not necessarily 'experts' in shale gas.
- SALGA should probably be considered for to be a member on the PCG.
- DEA recommended that the governance process should remain flexible should we need to include workshops for key stakeholders and NGOs.

6. *Technical evaluation and socio-economic analysis of shale gas in the Eastern Cape*

- This project is being undertaken by the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism aimed to create a credible environmental baseline (pre- shale gas development) for the Eastern Cape Province, especially to assist in any litigation.
- The outcomes of the study is i) to provide independent, robust, scientific-based advise to the Eastern Cape Government, whilst factoring in the needs of the rural poor communities; and ii) create public sector capacity to identify, monitor, and manage risks.

7. *Opportunities and risks of shale gas extraction in the Western Cape*

- This study considered the pros and cons of shale gas development (focusing on the central Karoo district), and was stimulated by lack information flowing to provincial government.

8. Strategic Issues

- The type of technology used (hydraulic fracturing) will determine the frequency and magnitude of effects on different spheres of issues.
- Consider adding another sphere called "Governance" that deals with the enforcement of policies and frameworks, or Governance/Institutional Capacity could be a cross-cutting theme through Strategic Issues.
- The end-use of the shale gas should be considered as this will also have impacts relating to different impacts e.g. greenhouse gas emissions and employment opportunities.
- Different scenarios need to be considered within 3 broad paradigms namely i) Exploration, ii) Exploitation and iii) Utilisation. Recommendations based on the analysis of these different scenarios should be made.

9. Bioblitz Assessment

- Shale gas development poses a risk to biodiversity. There is a historical trend of 'undersampling' in the proposed study area.
- Key impacts that need to be considered are associated with rivers, drainage lines, and riparian zones (regardless of ephemerality). These areas should be comprehensively represented using effective field methods (e.g. SASS method).
- The Bioblitz Assessment is the only main primary research that will be conducted. Substantial information gaps will be identified by the Multi-Author Teams and may be subjected to primary research where necessary and practical.
- The bioblitz will be undertaken as part of phase 1 of the SEA to inform phase 2 which is the Strategic Assessment.
- The SANBI bioblitz will:
    - Inform species assessments; distribution; threat status
    - Increased confidence on absence/occurrence of species throughout area of interest
    - Contribute to identification of highly sensitive/no-go areas based on species presence.
    - Increases confidence in specialist studies

10. Project Team and Process

- The Public Briefing Sessions have shifted to align with the public commenting period (before the Final Assessment Report).
- The deliverables of the SEA should be explicit "decision-making products" or "decision-support tools" that include Standards, Policy Options and Regulations.
- It will be useful to conclude the SEA with a "Regulators Workshop" or "Institutional Workshop for Capacity Development" to brief regulators and industry on the decision-making products (decision-support tools), build capacity, and add to a discussion on the practicality of the developed tools.
- The sustainability of the SEA and its outputs should be considered; there needs to be a plan on how to address ever-changing technologies, knowledge and science beyond the SEA process.

11. *Discussions on the Media and Communications Strategy*

- There are two spheres of communication which should be considered separately during the SEA process: i) The broader political debate on shale gas ii) The SEA process
- The science should be communicated by the competent scientists, without them making value judgments or commenting on the politics of the broader shale gas discussion. Positions should always be neutral and propaganda statements avoided e.g. there is definitely economically recoverable shale gas.
- A rapid-response mechanism should be implemented to respond to media and communication requests as journalists work on a short turn-around time.
- The Shale Gas SEA website (hosted by CSIR) will serve as an interactive knowledge basis ("Credible information portal").

12. *Closing comments*

- The SEA is going to be challenging and controversial. There needs to be a credible and pioneering approach to this assessment. We do not see ourselves as fitting within the 'usual' client/consultant model, but rather as a science consortium supporting government in the best interests of the country. We see this as a highly collaborative process.
- In order to make a positive difference there needs to be efficient collaboration within the SEA team and throughout the governance structures. Furthermore, the stakeholder engagement that is to be undertaken as part of this process must be meaningful.
- The SEA process will not provide an 'answer' to the wider political debate on shale gas, but only on the scientific information collected during and relevant to the SEA process. The assessment is thus policy-relevant, but not policy-descriptive.
- The language used throughout the SEA process should be robust and help achieve the effective communication. Language needs to be used very carefully through the process to ensure that we communicate honest and credible messages to all involved.
- DMR would be a useful entity to be represented in the PEC, however this coordination should be arranged at a high level.
- The Multi-Author Teams need will also fulfill the role of an "Expert Reference Group". All inputs into the SEA may not necessarily be provided by "expert authors" but also by people who have local and indigenous knowledge (such as Farmers Associations, Oil and Gas Associations and Parastatals).
- Different scenarios need to be considered within 3 broad paradigms namely i) Exploration, ii) Exploitation and iii) Utilisation. Recommendations based on the analysis of these different scenarios should be made.
- There are two spheres of communication which should be considered separately during the SEA process: i) The broader political debate on shale gas ii) The SEA process

Key actions and way forward

Action	Responsible party
Circulate the Draft Shale Gas Vision and Sustainability Objectives for comment (to the Inception Meeting Attendees), and include other relevant documentation in the development of the Sustainability Objectives.	CSIR
Draft a "Governance Operating Document" which will serve as a guideline for the operating the SEA process.	CSIR

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Create a list of explicit SEA deliverables (decision-making products / decision-support tools) to be included in the Detailed Work Plan	CSIR
Develop a website that will be used as a "Knowledge Portal" for the SEA process	CSIR
Department of Mineral Resources (DMR) should be represented in the Project Executive Committee (PEC); this coordination should be arranged at a high level (e.g. DG to DG letter).	DEA
Facilitate a forum for NGOs/Public Interest Groups, Government and Commerce/Private Sectors to select representatives to the PCG, to be implemented in terms of the "Governance Operating Document"	DEA
Draft an internal Media and Communications Strategy (week of 16 February) and the Communications Teams from DEA, CSIR, SANBI and CGS should have a follow-up meeting (preliminary date set for Tuesday, 24 February).	DEA
Launch the SEA early/mid-March, preferably with the DEA Minster	DEA
Develop a complete communications strategy (addressing mechanisms such as how, where, and when to communicate, as well as create a database of media communicants).	Project communications teams (DEA, CSIR, SANBI, CGS)
Provinces need to develop a Local Communication Strategy to efficiently engage with the District and Local Municipalities in the study area	Provincial PEC representatives (Eastern-, Western, and Northern Cape)

1.2 Project Executive Committee Meeting 1 Notes (22 July 2015)

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Project Executive Committee Meeting 1

Date:

22 July, 2015.

Location:

CSIR Pretoria.

List of attendees:

Name	Organisation
Henk Coetzee	CGS
Gerry Pienaar	DEDEA (EC)
Greg Schreiner	CSIR
Luanita van der Walt	CSIR
Paul Lochner	CSIR
Dee Fischer	DEA
Lydia Bosoga	DAFF
Surprise Zwane	DEA
Paul Hardcastle	DEADP (WC)
Patience Sehlapo	DEA
Bayanda Zenzile	DWS
Natalie Uys	DENC (NC)
Muzi Mkhize	DoE
Mkhevu Mnisi	DWS
Jeff Manuel	SANBI
Bob Scholes	Wits/CSIR

Apologies received:

- Representative from DST
- Representative from DMR
- Henri Fortuin – DEADP (Paul Hardcastle as alternative representative)
- Ernst Bertram – DWS.

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Shale Gas Development in South Africa
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List of acronyms

CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DENC	Department of Environment and Nature Conservation
DMR	Department of Mineral Resources
DoE	Department of Energy
DWS	Department of Water and Sanitation
EC	Eastern Cape
EMPr	Environmental Management Programme
IRP	Integrated Resource Plan
NC	Northern Cape
NDP	National Development Plan
NGO	Non-Government Organisation
PASA	Petroleum Agency South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
SANBI	South African National Biodiversity Institute
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SIP	Strategic Integrated Project
SPLUMA	Spatial Planning and Land Use Management Act
TORs	Terms of Reference
WC	Western Cape

Strategic Environmental Assessment for Shale Gas Development in South Africa
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1. Clarifications on Inception Workshop notes (12 - 13 February, 2015)

- At the Inception Workshop it was stated that Shale Gas Development (SGD) is not a Strategic Integrated Project (SIP). Questions arose on whether SGD would not be classified as 'Green Economy' according to the National Development Plan (NDP). Furthermore, the Integrated Resource Plan (IRP) makes provision for SGD, and the infrastructure associated with SGD (such as gas power stations) might fall under SIP 10 (Electricity transmission and distribution for all). However, it was concluded that SGD is not a SIP, but a national priority with downstream opportunities which could contribute to SIPs in the future.

2. Project Executive Committee (PEC) Terms of Reference (TORs) and project background

- Presentation by Surprise Zwane (DEA).

PEC TORs

- The PEC TORs were agreed upon, and are broadly to:
  - Ensure that the project remains on scope, timelines and budget;
  - Check that strategic and policy level questions are addressed sufficiently;
  - Evaluate feedback from the Process Custodians Group (PCG);
  - Be a conduit for and coordinate information.

Spatial planning and SGD

- It was recommended that DEA consider involving the Department of Rural Development and Land Reform in discussions during the SEA with regards to spatial planning implications of SGD. This also relates to the implementation of the Spatial Planning and Land Use Management Act (SPLUMA) and the Spatial Development Frameworks (SDFs) of local municipalities in the SEA study area. This should contribute to understanding SGD from a spatial planning perspective, which can also be seen as an integral part of environmental management.

PEC meetings

- A request was made to ensure that dates on which the PEC is to convene be communicated well in advance to enable PEC members to secure funding and make travel arrangements. It was confirmed that the PEC needs to convene whenever outputs have been produced for discussion and PEC meeting should be held following PCG meetings so that feedback from the PCG can be provided to the PEC. The Project Team will try and provide provisional meeting dates as early as possible, and PEC members are able to ask DEA for assistance if they have any financial constraints that prevent them from attending the meetings. The months of PEC meetings dates are provide in the attached "SEA Process Document".

PCG meetings

- It was established that as the top governance structure of the SEA the PEC would be pro-actively be informed of PCG meetings and the outcomes of such meetings. This is especially important for awareness and information flow to the PEC members, such as the Provincial representatives who has a responsibility to relay relevant information throughout their Departments.

- A suggestion was made that the PEC members to observe PCG meetings. The initial intention wasn't to have the PEC sit in on PCG meetings, as the PCG is a balanced group (approximately 4 x representatives each from government, NGOs, research institutions and industry). Furthermore, the PCG must be allowed to fulfil its function unimpaired. The Petroleum Agency of South Africa (PASA) is not represented on the PEC or the PCG, however PASA are working with the Project Team with regards to understanding the shale gas resource scenarios in the Karoo Basin. It is not the role of the SEA, or PASA within the SEA, to convey updates to the PEC with regards to the progress of shale gas Exploration Rights application processing, but any information available to the Project Team and various structures (such as DMR) that relates to the ever-changing shale gas 'scene' should be shared through the PEC were possible.

Communication on SGD

- If a Government Department (e.g. DAFF, DoE, etc.) is contacted with queries relating to SGD, the query should be responded to by the competent Department in their own capacity and in accordance with their mandate. Queries relating SGD do not have to be relayed to the SEA Project Team (who are only responsible for the SEA process). The PEC was reminded of the fact that the SEA does not represented the overall discussion on shale gas in South Africa which is a government function, other formal governmental communications on SGD should be created as required e.g. through provincial structures.

SEA-policy interactions

- The various Departments and the represented Provinces in the PEC need to understand how Departments make decisions on SGD, how those decisions feed into the SEA, and how information from the SEA feeds into Department policies – this will contribute to the PEC meeting their mandate.

3. *Summary of Inception Workshop and SEA progress*

- Presentation by Greg Schreiner (CSIR).

Study area

- The extent of the study area was informed by the areas currently under applications for Explorations Rights (by the operators Shell, Bundu, Falcon). In October 2014, the DMR Minister confirmed this and was quoted in parliament as saying "there are currently five (5) applications to explore for shale gas in the Karoo area. Applications were received from Falcon (x1), Bundu (x1) and Shell (x3). The applications have not been assessed and therefore no applications have been approved or refused. DMR are currently in the process of augmenting the regulatory framework. Once the regulatory framework is augmented, the processing of applications will commence". It was acknowledged that additional desk-top Technical Cooperation Permit applications have been submitted to PASA in the last 4 years, but that many of these had expired. Considering that PASA's sweet spot reserve estimates are succinctly aligned with the current Exploration Right applications, this region represents the obvious area to initiate the "first pass" SEA process.

- The official shapefiles from PASA delineating the existing Exploration Rights applications were used to define the study area (with a 20 km buffer around existing Exploration Rights application areas). The study area includes 27 local municipalities and encompasses 171 811 km².

Scope

- Even though Coalbed Methane is also an unconventional gas, this SEA will only consider shale gas.
- The scopes of the Strategic Issues should be shared with the PEC in the form of a 'Zero Order Draft'. These will only be defined after the first author workshop and available from mid-October 2015. The PEC should meet in October after the teams have been determined and the scope has been defined.
- The description of the SGD scenarios and activities is on an accelerated timeframe to feed into the author workshops planned for end-September. This can be made available to the PEC once completed in draft format (available end September) and will provide the technical scope of SGD.

Timelines

- The PEC should convene at key junctures where there is material on the table to discuss. A detailed project plan should be provided to the PEC which also indicates the key points of PEC intervention. This has been attached as the SEA "Process Document".

Author workshops

- A request was made to have PEC members attend author workshops, as observers to gain information. It was agreed that PEC members can make themselves available at those workshops in an observer capacity as required.

4. *SANBI Bioblitz update*

- Presentation by Jeff Manuel (SANBI)
- Key challenges facing the Bioblitz are the seasonal opportunities to gather biodiversity data and obtaining the Threatened or Protected Species (TOPS) permits from Provincial Authorities.
- The Bioblitz will include landscape functionality and ecological type information. Furthermore, the biodiversity information also has links to the water component and aspects such as sense of place, but the Bioblitz does not have scope to provide primary data into components other than the biodiversity component.

Strategic Environmental Assessment for Shale Gas Development in South Africa
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5. *Key actions and way forward*

Action	Responsible party	Timeframe
1. Consideration to include Department of Rural Development and Land Reform in the SEA process	DEA	-
2. The communication teams of the involved Departments to meet to convey a common messages, goals and language relating to SGD.	DEA	-
3. Provide the PEC with the SEA study area map, shapefile and rationale.	CSIR	Mid - August 2015
4. Circulate meeting dates, agendas, notes, and a short communique explaining the key outcomes and issues identified from PCG meetings which should be considered, discussed, and responded to by the PEC if required	CSIR	Mid - August 2015
5. Provide the PEC with a detailed SEA project plan which includes: o Timeframes; o Scope; o Anticipated PEC interaction points; o Conceptual scope for SGD scenarios.	CSIR	Mid - August 2015
6. Provide a letter to SANBI to streamline the process of obtaining TOPS permits from Provincial Authorities.	DEA	-
7. Present approach of the SEA to Western Cape DEA&DP Shale Gas Forum to inform SGD planning by the Western Cape Government.	CSIR	06 August 2015
8. PEC to convene for Meeting #2 in October following the first specialist workshop	PEC	October 2015

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1.3 Project Executive Committee Meeting 2 Notes (22 November 2015)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Project Executive Committee Meeting 2

Date:

22 November, 2015.

Location:

Knowledge Commons, CSIR Pretoria.

List of attendees:

Name	Organisation
Bob Scholes	Wits/CSIR
Dee Fischer	DEA
Gerry Pienaar	DEDEA (EC)
Greg Schreiner	CSIR
Kristal maze	SANBI
Luanita van der Walt	CSIR
Marlanie Moodley	DEA
Mkhevu Mnisi	DWS
Mmboneno Muofhe	DST
Muvhuso Musetsho	CGS
Muzi Mkhize	DoE
Nametshego Gumbi	DST
Nhlahla Jali	DMR
Paul Hardcastle	DEADP (WC)
Paul Lochner	CSIR
Somila Xosa	DST
Stella Mamogale	DoE
Thato Kgari	CGS

Apologies received:
Jeff Manuel (SANBI)
Nandi Malumbazo (CGS)

Absent:
Bayanda Zenzile (DWS)

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List of acronyms

ASSAf	Academy of Science of South Africa
BID	Background Information Document
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DENC	Department of Environment and Nature Conservation
DMR	Department of Mineral Resources
DoE	Department of Energy
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
IMC	Inter-Ministerial Committee
PASA	Petroleum Agency South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
SANBI	South African National Biodiversity Institute
SALGA	South African Local Government Agency
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SKA	Square Kilometre Array

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1. *Introductions and adoption of the PEC Meeting #1 Notes*

- The Project Executive Committee (PEC) adopted the PEC Meeting #1 Notes.

Action items from PEC Meeting #1

Action	Status
1. Consideration to include Department of Rural Development and Land Reform (DRDLR) in the SEA process	A letter had been sent to DRDLR, but no nomination has been made.
2. The communication teams of the involved National Departments to meet to convey a common messages, goals and language relating to Shale Gas Development (SGD).	Communications teams have not met as of yet. As a start, there need to be an agreed PEC media statement about the shale gas SEA process. This, along with the ministerial media launch briefing document, will be circulated with the meeting notes to the PEC on 04 November
3. Provide the PEC with the Strategic Environmental Assessment (SEA) study area map, shapefile and rationale.	This action has been completed.
4. Circulate meeting dates, agendas, notes, and a short communique explaining the key outcomes and issues identified from Process Custodians Group (PCG) meetings which should be considered, discussed, and responded to by the PEC if required	This action has been completed. Agenda item on 22 October dealt specifically with key messages communicated from the PCG to the PEC. PCG meeting notes are available to the PEC
5. Provide the PEC with a detailed SEA project plan which includes: o Timeframes; o Scope; o Anticipated PEC interaction points; o Conceptual scope for SGD scenarios.	This action has been completed with the publication pf the SEA process document on 17 August.
6. Provide a letter to South African National Biodiversity Institute (SANBI) to streamline the process of obtaining TOPS permits from Provincial Authorities.	SANBI to provide feedback permitting processes for the bioblitz and if any are required from DEA
7. Present approach of the SEA to Western Cape DEA&DP Shale Gas Forum to inform SGD planning by the Western Cape Government.	CSIR presented to DEA&DP on 06 August
8. PEC to convene for Meeting #2 in October following the first specialist workshop.	PEC Meeting #2 (current meeting) held ion 22 October, 2015.

2. *Update on project progress*

- Presentation by Greg Schreiner (CSIR) and Bob Scholes (Wits/CSIR)

Scenarios and Activities

- There are three SGD scenarios being considered in the SEA (exploration only, small scale production, large scale production). Each of these scenarios is compared with a counterfactual

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'base-case' scenario in which no SGD occurs. These scenarios and the SGD activities associated with each are described in Chapter 1 of the SEA in the Scenarios and Activities Document.

- The SEA is considering the exploration (including exploration hydraulic fracturing), production and decommissioning (including potential legacy/post-decommissioning risks) (e.g. full life-cycle) of SGD. The spatial and temporal extent of the issues considered is determined extent to which a risk can still be considered material.

3. *Zero Order Draft*

<u>SEA Assumptions</u>

- General shared assumptions that are taken into account by all the author teams are stated in the Scenarios and Activities Document, which includes detailed break-down of the SGD activities that may be expected. Within each Strategic Issue, authors may also make relevant assumptions where necessary such as in the water resources section where they may make assumptions about the most plausible water availability options.

<u>Human health</u>

- The Human Health Strategic Issue will focus on common pollution vectors such as water and air and how contamination might affect people in the region.

<u>Radio astronomy</u>

- Light and dust pollution need to be considered by the author teams.

<u>Sustainability objectives</u>

- It was mentioned that the limits of acceptable changes should be based on developed sustainability objectives which will then be very useful for EIA decision making on shale gas activities.

<u>Institutional capacity</u>

- Institutional readiness, skills, human resources and capacity to deal with environmental change brought about by SGD are raised by many stakeholders. The Academy of Science of South Africa (ASSAf) has completed an internationally peer reviewed report on South Africa's institutional readiness for shale gas development. This report is currently with the Minister of DST, the project team have not managed to get access to the report through ASSAf.

<u>Impact of the SEA on current Exploration Areas Licensing</u>

- Currently there is sufficient information and legislation to allow the permitting processes to unfold. The SEA will augment any policy going forward and shouldn't be anticipated as a block to the current licensing processes.

<u>Relevance of the SEA</u>

- The SEA and its results may be kept relevant, taking into account a rapidly changing industry, by revisiting and augmenting the results with new relevant information in a few years' time.

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Alignment of the SEA with current research

- The multi-author team approach ensures that authors are included in the team that are widely involved with shale gas research in South Africa. These authors are also well-connected and have access to many different research projects for data. Furthermore, the SEA will always be followed by Environmental Impact Assessments (EIA) that need to flag and address new issues that did not arise during the SEA.

4. *Feedback on public outreach*

- Presentation by Greg Schreiner (CSIR)

Public Briefings Round 1

- There are two rounds of public briefings planned for the SEA. Round 1 is to be held on 09 – 13 November 2015 with the purpose of informing stakeholders of the SEA process and to register additional stakeholders.
- PEC members are invited to represent at the public briefings.
- There is a call to the PEC, and especially the Provincial Governments, to distribute word of the public briefings throughout their networks to ensure that the meetings are well-attended.

Western Cape DEA&DP Shale Gas Forum

- Western Cape Shale Gas Forum is a task team that also includes the affected municipalities in the SEA study area. The mandate of this Forum is to i) advise the Western Cape Government on the state of readiness for SGD; ii) facilitate information flow from SEA and into SEA; iii) build capacity and awareness. On 29 October 2015 there is a meeting planned with the Municipal Managers of the affected municipalities which provides an opportunity to distribute information on the public briefings.

Communications

- The Inter-Ministerial Committee (IMC) who launched the SEA represents cooperative Government buy-in into the process. The press release for the SEA launch may be used as a reference and shared position for all represented on the IMC and to facilitate a shared vision on the policy-relevant questions the SEA will address.

5. *Feedback from the PCG*

Transport of stakeholders to public briefings

- Request for Provincial Governments to facilitate the provision of transport for stakeholders from neighbouring to the public briefings.
    - At such short notice this may not be achievable. However, the Provincial Governments will mention it to the Local and District Municipalities.

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Inclusion of poor communities in the outreach programme

- The Project Team will facilitate registration of stakeholders with preferred method of communication to include people who do not have internet access.
    - It was suggested that a national interdepartmental communication strategy be developed for shale gas development, on how to share information consistently, beyond public briefing sessions. Furthermore, a national communication strategy could serve as a framework for information flows that could be facilitated by environmental education centres at various levels over the lifespan of the SEA. The representative from DMR indicated that DMR has a shale gas communications strategy that has been approved by cabinet, therefore there is a need to identify how communication processes and initiatives can be aligned.
    - It is proposed that the South African Local Government Agency (SALGA), who is represented on the PCG, should rather be sit on the PEC as a representative of relevant decision-makers at a local authority level.
    - Municipalities should be consulted for recommendations on to how best to reach communities, especially rural communities within their areas.

Advertisements of public outreach to municipalities

- Advertisements with regards to the public outreach sessions will mainly be facilitated by the project team and DEA through newspaper adverts, email invitations, radio (if possible), direct interaction with all District and Local Municipalities in the study area. There is also the expectation that Provincial Governments can assist by distributing advertisements for public briefings and the SEA Background Information Document (BID) within their Local Government networks, such a District- and Local Municipalities and ward councillors.

6. *Other issues raised*

Clarification of PEC mandate

- The PEC needs to be mindful of how they need to function in order to reach their mandate. The SEA is a science-policy interface focused on a co-generation of information. The substantive mechanism for the PEC to contribute to this is through the review of draft reports, thereby interacting with the content and confirming that it is sufficient to answer policy-relevant questions.

SGD seminar

- A recommendation was made to present a SGD seminar as an information sharing tool to Provincial and Local Government as well as other stakeholders. This seminar should focus of what SGD entails, not just on what the SEA process entails. This is along the lines of what is planned for the registered stakeholder outreach planned in Cape Town on 13 November 2015 as part of the first rounds of the public outreach sessions.

PEC Meeting #3

- PEC Meeting #3 scheduled for April 2016 to discuss the output of the SEA First Order Draft

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7. Key actions and way forward

Action	Responsible party	Timeframe
1. Project Team and DST interface on the status and availability of the ASSAf study.	Project Team	04 November
2. Release updated itinerary of Public Briefings Round 1 to PEC.	Project Team	04 November
3. Re-circulate the Shale Gas SEA IMC launch press release to PEC.	Project Team	04 November
4. Produce a short description on how the SEA augments SGD processes, systems and legislation going forward, towards a shared vision on the policy-relevant questions the SEA will seek to address.	Project Team	04 November
5. PEC (especially Provincial Government) to distribute the notice of the public briefings.	PEC	November 2015
6. Inform SALGA that there have been requests for them to represent on the PEC instead of the PCG. SALGA are to make a decision on where they feel they would be best represented.	Project Team and SALGA	04 November
7. DEA to review the SEA process document and decide on the status of the document to guide the mandate of the two governance groups and whether any changes need to be made.	DEA	End-2015
8. PEC to convene for Meeting #3 around April/May 2016 following the release of the First Order Draft of the SEA.	PEC	April/May 2016

1.4 Project Executive Committee Meeting 3 Notes (04 May 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Project Executive Committee Meeting 3

Date:

04 May, 2016.

Location:

Demo Room, Building 22, CSIR Pretoria.

List of attendees:

Name	Organisation	
Bob Scholes	Wits/CSIR	
Bryan Fisher	DENC NC	
Dee Fischer	DEA	
Edwin Mametja	DAFF	
Garry Paterson	ARC (o.b.o. DAFF)	
Greg Schreiner	CSIR	
Henri Fortuin	DEADP WC	
Jeffrey Manuel	SANBI	
Lydia Bosoga	DAFF	
Megan de Jager	CSIR	
Mkhevu Mnisi	DWS	
Muzi Mkhiza	DoE	
Nhlanhla Jali	DMR	
Paul Hardcastle	DEADP WC	
Paul Lochner	CSIR	
Thato Kgari	CGS	
Viswanath Vadapalli	CGS	

Apologies received:

- Gerrie Pienaar (DEDEA EC)
- Kristal Maze (SANBI)
- Marianie Moodley (DEA)
- Stella Mamogale (DoE)

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List of acronyms

AAA	Astronomy Advantage Area
ARC	Agricultural Research Council
ASSAf	Academy of Science of South Africa
BW	Beaufort West
CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
CT	Cape Town
DAFF	Department of Agriculture, Forestry and Fisheries
DEADP WC	Department of Environmental Affairs and Development Planning Western Cape
DENC NC	Department of Environment and Nature Conservation Northern Cape
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DPME	Department of Mineral and Energy
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMI	Electromagnetic Interference
EMPr	Environmental Management Programme
FOD	First Order Draft
GFR	Graaff-Reinet
GTL	Gas-to-Liquid
IAIAsa	International Association for Impact Assessment South Africa
IMC	Interministerial Committee
NMMU AEON	Nelson Mandela Metropolitan University Africa Earth Observatory Network
NORM	Naturally Occurring Radioactive Material
PCG	Process Custodians Group
PEC	Project Executive Committee
SAEON	South African Environmental Observation Network
SAIAB	South African Institute for Aquatic Biodiversity
SALGA	South African Local Government Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SKA	Square Kilometre Array
USA	United States of America
VW	Victoria West
Wits	University of the Witwatersrand
ZOD	Zero Order Draft

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1. *Introduction and adoption of PEC Meeting #2 notes*

Actions from PEC Meeting #2 (22 October, 2015)

1. Project Team and DST interface on the status and availability of the ASSAf study.	Request for access to the ASSAf study was made in mid-2015, but it has not yet been made available. Rudi Dicks (on the PCG) and Dee Fischer (DEA) to follow up for availability within next 2 weeks to enable authors to use for SODs.
2. Release updated itinerary of Public Briefings Round 1 to PEC.	This action was completed via Dropbox link on 04 November 2015.
3. Re-circulate the Shale Gas SEA IMC launch press release to PEC.	This action was completed via Dropbox link on 04 November 2015.
4. Produce a short description on how the SEA augments SGD processes, systems and legislation going forward, towards a shared vision on the policy-relevant questions the SEA will seek to address.	The PEC Statement on SGD was produced on the 27 October and was shared with the PEC via Dropbox on 04 November 2015.
5. PEC (especially Provincial Government) to distribute the notice of the public briefings.	This action was completed.
6. Inform SALGA that there have been requests for them to represent on the PEC instead of the PCG. SALGA are to make a decision on where they feel they would be best represented.	SALGA were informed of the requests, but no feedback has been provided as yet. Notification and request to distribute notification of Round 1b public briefings were provided to SALGA at the Broader Karoo Region Small Town Regeneration & Regional Economic Development Conference in Beaufort West on 07 April 2016.
7. DEA to review the SEA process document and decide on the status of the document to guide the mandate of the two governance groups and whether any changes need to be made.	This action was completed by 30 November 2015.
8. PEC to convene for Meeting #3 around April/May 2016 following the release of the First Order Draft of the SEA.	Peer Review of the FOD's began on 22 February, and the comments were shared with the author teams prior to the 2nd Multi-Author Workshop on 18-20 April 2016.

The PEC members approved the meeting notes from PEC Meeting #2.

2. *Update on project status and progress*

- Presentation by Greg Schreiner (CSIR)
- The PEC are reminded of the project management role they are mandated to fulfil, which includes ensuring the project remains on scope and within timelines; checking that strategic and policy level questions are sufficiently addressed; evaluating feedback from the PEC; and coordinating and acting as a conduit of information e.g. through provincial forums.

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- With reference to the presented timeline for the entire SEA, it was indicated that the project is now in Phase 2 of the Scientific Assessment. The First Order Drafts (FODs) of the Scientific Assessment have been peer reviewed, and these comments have been addressed by the author teams who are in the process of drafting the Second Order Drafts (SOD's). The SOD's are to be submitted by the author teams by 31 May 2016, after which they will be released for public comment. Thereafter a Final Scientific Assessment Report will be finalised, which marks the end of Phase 2 of the project. This Final Scientific Assessment Report will provide the information basis for Phase 3. It was noted that the Scenarios and Activities chapter was completed before phase 2 as to provide the framework against which author teams can base their specialist assessments.

Questions:

- Paul Hardcastle (DEADP WC) queried how the author teams will integrate linkages between mitigation measures and limits of acceptable change into the risk mapping.
    - Greg Schreiner (CSIR) responded by noting that the project team will start to compile the risk mapping once the SOD's are received. The Project Team provided the authors with spatial information for the FODs and we will use the updated/ additional spatial information provided by the author teams in the SODs for this purpose as well. Risk mapping is performed with and without mitigation, in order to assess how the risk profiles change.

<u>Outreach feedback and programme</u>

- Three public briefings took place in Graaff- Reinet, Beaufort West and Victoria West on 10-12 November, and one full day stakeholder workshop was held in Cape Town at the Iziko Museum on 13 November. These locations were chosen to represent the three provinces of the study area based on accessibility and relatively large population sizes.
- People were able to register as stakeholders by filling in a form at the public briefings, which were incorporated into the SEA registered stakeholder database, which currently comprises ~450 registered stakeholders.
- Common concerns which arose at the public briefings included 1] a need for greater municipal and ward involvement in the public briefings, 2] governance/ policing (of regulations) issues, should shale gas development (SGD) be permitted to take place, and 3] the 17 strategic issues of the SEA and ensuring that all sensitive topics have been considered.
- Key learnings from the first round of public briefings, with particular reference to the first concern noted previously, resulted in the distribution of letters from the Minister of Environmental Affairs to the offices of the affected local municipalities, notifying them of the next round of public briefings to take place in May. In the letters the Minister requested the local municipalities to distribute notice of the public briefings (dates and times) through the Local Government structures, namely through Ward Councillors to encourage and promote attendance at the briefings.
- Additional key learning included pre-meetings with municipalities to introduce the process to the community in a more formalised manner.
- The SOD's of the strategic issues chapters will be released for public comment mid-June, with 4 weeks provided for commenting.

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- Round 2 public briefings are planned for 18-22 July 2016, with public meetings in Graaff- Reinet, Beaufort West and Victoria West, a full day workshop in Cape Town, and a full day PEC workshop.

Questions:

- Muzi Mkhiza (DoE) queried whether the district and local municipalities are involved throughout the SEA process and whether they are provided with the briefing notes for public engagement so that when questions are asked etc. everyone is able to provide the same answer, particularly with regards to timeframes?
    - Greg Schreiner (CSIR) agreed that it is a challenge to ensure the municipalities are up to date on the process and informed of the timeframes. It was evident from the round of public briefings in November how the SEA process differs from Environmental Management Programmes (EMPr's) and the Department of Mineral Resources (DMR) public participation process in early 2016, which may be disorientating to municipalities. An interdepartmental communication strategy would be beneficial to clearly convey purpose of public meetings at the outset.
    - Dee Fischer (DEA) emphasised that it is difficult to place a sense of urgency around SGD, because municipalities have other pressing matters and they don't know what their roles are in terms of the SEA and shale gas, so it should be an item for the Interministerial Committee (IMC) when the SEA is completed and more info is available on licensing procedures and timings. The IMC should then make municipalities a priority, and the municipality's responsibilities within each scenario should be clearer once the SEA is completed. It was suggested that at some point the IMC should invite municipal managers to communicate the scenarios and timeframes, thus making them for more tangible and understandable for municipalities.
    - Paul Hardcastle (DEADP WC) added that the information from the FODs is already being used to inform discussion on regulatory readiness.
  - Greg Schreiner (CSIR) implored the PEC to mobilise their structures for the public briefings in May 2016 and to invite representatives from Government to attend the full day PEC workshop planned for 13 June 2016.

<u>Scenarios and Activities SOD</u>

- The Scenarios and Activities SOD has been made available to the author teams for their assessments. The data on which the resource probability map is based provides the specialist teams with an area where SGD is most probable, but this is not definitive and further work still needs to be done. The resource probability map was compiled by overlaying 4 existing studies examining shale gas resource probability, namely the EIA model, Doug Cole by CGS 2014, Petroleum Agency 2015, and NMMU AEON 2015 models to generate a synthesis model. The Shale Gas Resource Probability map should not be published in isolation (without the 17 strategic issue chapters) to ensure the information conveyed therein is not misleading. The four scenarios are unpacked in great detail in the Scenarios and Activities Chapter, which provides a spatial indication of the footprint SGD, would potentially have. International Peer Reviewers have assisted significantly with these calculations. The Chapter is will be made available for public comment in July. The graphic representation of the potential footprint of the well pads is merely conceptual and the representations have not considered sensitive features or associated buffers.

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Questions:

- Paul Hardcastle (DEADP WC) questioned the discrepancy in number of well pads between the SOD and FOD of the Scenarios & Activities Chapter.
    - Greg Schreiner (CSIR) responded by stating that in the peer review it was indicated that modern technology increases the amount of gas that can be produced from each well pad and so fewer wells are required, thus lowering the number of well pads in the SOD.
- Viswanath Vadapalli (CGS) queried the potential implications if a reserve of more than 20tcf was discovered.
    - Greg Schreiner (CSIR) noted that such a discovery (say in the region of 30Tcf) would not materially change the footprint of the big gas scenario, or how the gas is utilised downstream.
- Edwin Mametja (DAFF) raised a question as to the size of the workforce that could be expected over the full lifecycle of SGD.
    - Greg Schreiner (CSIR) stated that all data that is quantifiable and explained has been included for each scenario including number of labourers etc.

Peer Review Process of FODs

- Based on the accepted strategic issues presented in the ZOD, peer review experts were identified for each strategic issue from the extensive literature collection of the shared library, as well as through recommendations from stakeholders, the PEC, PCG and authors.
- Peer reviewers are independent from the assessment writing process, and represent universities, consultancies, government agencies and others. A minimum of 2 peer reviewers was required for each chapter, with more complex and double chapters (i.e. surface and groundwater resources) having up to 6 peer reviewers. The chapters were reviewed by 45 international and 26 South African experts, predominantly from the USA and Australia, and also from Canada, France, the Netherlands, UK and Japan.
- Peer reviewers were provided with the ZOD and FOD of the Scenarios and Activities chapter for context, and an allocated time, which was suitable to the SEA timeframe for the peer review process, was provided to the experts within which to submit their comments. Comments were provided in a standardised template form, and additional reference materials were provided by some expert reviewers to the author teams. Author teams have responded to every comment and are in the process of incorporating the relevant comments into the SOD's.
- FODs were circulated to the PEC on 3 March 2016, and comments were received up until 14 April 2016 (6 weeks).
- As a mandated item for the PCG, the manner of author responses to the peer review and registered stakeholder comments will be checked by the PCG.

3. *SANBI BioBlitz*

- Presentation by Jeffrey Manuel (SANBI).
- As a result of the Karoo being severely under sampled, there is low confidence in predicting impacts relating to SGD in the Karoo. Accordingly, the foundational biodiversity knowledge must be improved, namely by means of mobilising existing records and fieldwork.

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- The assessment covers plants and animals, including invertebrates and is conducted over 113 days through coordinated inputs from a range of specialists and partner institutes, such as SAEON, SAIAB and museums etc.
- Bioblitzes are planned for spring, mid-summer, and late summer, but due to drought and poor rainfall the schedule had to be revised.
- The assessments on 11 taxanomic groups have been conducted in August and December, and focused largely on plants, invertebrates, using a stratified sampling approach. An Open Day was held on 15 April 2016, with ~80 participants and sampling still underway.
- The window to inform assessments has lapsed (only done ~50% of planned work so far), but it is imperative to continue to improve spatial accuracy for inclusion in phase 3 and implementation of the shale gas SEA; SKA SEA and implementation; and uranium mining applications.
- Going forward:
    - Efforts expended in mobilising existing data and pilot field studies have provided a good sense of just how significant the data gaps are and where
    - Imperative to continue with assessments in coming Spring and Summer
    - Successfully retrieved funding from NRF for BioGaps project: filling biodiversity info gaps to support development decision making in the Karoo
    - 3 year programme, aligned with SAEON long term monitoring shale gas project
    - Designed to complement areas targeted for shale gas development.

Questions:

- Bryan Fisher (DENC NC) queried what SANBI's association is with conservation agencies?
    - Jeffrey Manuel (SANBI) replied by noting that a large amount of data come from these agencies, particularly with regards to fauna. Work is being done in conjunction with the agencies to the extent where there is capacity.
- Bryan Fisher (DENC NC) questioned whether the assessment will take place in winter and autumn?
    - Jeffrey Manuel (SANBI) stated those seasons were decided upon in which the most information could be gathered. It is done to specifically inform the risk assessment of biodiversity chapter. The BioGaps Project will be a more complete assessment, aimed at improving our knowledge of the Karoo.

4. Preliminary feedback on Chapter First Order Drafts (FODs)

- Presentation by Greg Schreiner (CSIR)
- Each chapter follows a particular structure which includes an Executive Summary; Introduction and Scope; Key potential impacts and their Mitigation; Risk Assessment; Best Practice Guidelines and Monitoring Requirements; Topic on which information is inadequate for decision- making; and References.
- The Risk Assessment follows a well- structured risk evaluation process, which involves defining the nature of the impact, mapping the receiving environments, defining mitigation technologies and consequence levels for each type of impact for each scenario. Each chapter provides spatially explicit risk maps which identify key issues that need to be addressed in terms of guidelines and regulations. The project team will use the risk assessment information to produce a risk surface for each type of impact, and subsequently a

composite risk map will be created with reference to mitigation and another risk map without mitigation to give an indication of how risks may proliferate across the production scenarios.

- Author teams are asked to consider what the implications are with respect to monitoring to end of activity, and in some cases beyond end of activity.

Surface Water and Groundwater

Water availability in study area is severely constrained, which may be compounded by cumulative use from activities such as road construction for SGD and uranium mining. Surface spills on-site and along transport routes are most likely causes of contamination. Legacy impacts are highly likely, necessitating baseline and ongoing monitoring. Limited infrastructure and capacity for water management is a constraint. There is potential to develop non-potable groundwater resources at a limited scale. SGD provides a learning opportunity to improve understanding of local water resources.

Questions:

- Viswanath Vadapalli (CGS) commented that the Department of Water Affairs & Sanitation (DWS) is in the process of conducting baseline monitoring prior to fracking.
    - Greg Schreiner (CSIR) noted that the DWS study is quite broad and over a non-specific study area, while baseline monitoring needs to be site-specific.
    - Mkhevu Mnisi (DWS) confirmed the said study is over a broad area, and DWS will be consulting Danita Hohne about her work relating to sampling SOEKOR boreholes and methane analysis in the Karoo.
    - Greg Schreiner (CSIR) noted that Danita is on the Groundwater author team for the Scientific Assessment.
- Garry Paterson (ARC) commented that in most Environmental Impact Assessments (EIAs), surface and ground water are treated separately, and mitigation cannot be combined.
    - Greg Schreiner (CSIR) explained that the surface and ground water chapter is treated as a double chapter, and baseline monitoring will be specific to surface and ground water, as separate issues.
- Bryan Fisher (DENC NC) queried whether the water chapter examines the reuse and recycling of water.
    - Greg Schreiner (CSIR) noted that this topic is discussed in the Waste Planning and Management Chapter.
- Paul Hardcastle (DEADP WC) commented on the possibility of well failure and groundwater pollution at some point of SGD, and as such, groundwater monitoring exercises are key tasks and its incorporation into legislation/ policy/ regulations is important.
    - Dee Fischer (DEA) reiterated that one of the key outputs of the SEA are guidelines for pre- and post- baseline monitoring.

Loss of Biodiversity

The SEA study area has high levels of biodiversity, which is largely threatened by landscape fragmentation due to linear infrastructure e.g. roads and powerlines. Impacts have cascading effects on species and processes, thus requiring landscape level mitigation; achieved by means of prohibiting certain activities in high risk areas. Risk mapping will inform development planning. Cumulative effects and effectiveness of mitigation must be monitored, and environmental compliance applied to areas of medium low and low biodiversity sensitivity. Cumulative and unforeseen impacts and effectiveness of mitigation must be monitored.

Planning & Infrastructure

Towns close to SGD will expand significantly, increasing service delivery demand. The construction of private local access road networks and well pads are expected to impart largest direct impact; requiring consideration of regional Spatial Development Frameworks. Increased heavy vehicle traffic on regional roads associated with SGD will require increased governance and law enforcement. Integrated spatial planning will be essential.

Questions:

- Paul Hardcastle (DEADP WC) queried the issue of opportunity cost in relation to the relative scarcity of construction material, of which much is required for SGD. Therefore, it is assumed local authorities will have to source it from afar. Local demand and supply of such resources need to be protected and it should be ensured that SGD does not deplete the cheaper resources.
    - Greg Schreiner (CSIR) stated that relevant recommendations to avoid this are made in the Scientific Assessment.
- Dee Fischer (DEA) questioned whether any consideration has been given to rail in the assessment, as railway lines are located seemingly close to the "sweet spot".
    - Greg Schreiner (CSIR) confirmed that the railway must be considered in the Scientific Assessment as a potential means to alleviate potential impacts.

Visual

Key risks which may affect identified scenic visual hotspots in the Karoo include visual fragmentation, the transformation of the Karoo's pastoral nature or wilderness to one of industrial character, and the potential effect of secondary activities.

Economics

Positive macro-economic impacts of SGD may be realised; whereby the risk of exchange rate appreciation is considered manageable; the risk of crowding out other sectors is low provided SGD does not compete with local water users or pollutes supplies; and there is opportunity for employment at large scale production, of which up to 35% of positions could be filled by locals. Adversely, local government finances are likely to suffer significant strain and risks to farm property values are likely. Financial and compensation mechanisms must be implemented to ensure adequate financial provision by the state to land owners to cover use of their land and in cases where environmental and other damages cannot be mitigated.

Questions:

- Bryan Fisher (DENC NC) noted that local government is already under strain, and queried whether the Economics Chapter assesses means of financially supporting local government/ communities.
    - Greg Schreiner (CSIR) confirmed that planning and mechanisms to support local government is discussed therein.
    - Viswanath Vadapalli (CGS) reaffirmed that wastewater treatment plans will fall in under the mandate of the application companies, and furthermore local facilities don't have

adequate capacity at present to support SGD; which is addressed in the Waste Planning and Management Chapter.

- Dee Fischer (DEA) responded further by querying the local governments' responsibility to support SGD, while it should ultimately support itself. SGD should be commercialised and not be categories as a government activity. Consideration should be given to commercialising/ industrialising agricultural land, which would increase leasing rates and afford local municipalities the potential opportunities to support themselves. Such recommendations are expected from the Scientific Assessment.
- Paul Hardcastle (DEADP WC) commented further, making reference to the polluter based principle, which employs mechanisms of contribution by developers to foot the bill(s) for maintenance which may arise prematurely or are unforeseen.
- Greg Schreiner (CSIR) confirmed that a Pennsylvanian peer reviewer brought these recommendations to the authors' attention.

- Lydia Bosoga (DAFF) queried whether food security was considered in this chapter.
  - Greg Schreiner (CSIR) confirmed it was addressed in the Agriculture Chapter, with reference to the Agricultural sectors contribution to food security.

Energy

South Africa has 3 gas supply options, including 1] imported pipeline gas, 2] imported Liquefied Natural Gas, and 3] domestic supply options. High volumes of shale gas would enable integration of more renewables, and support an improved trade balance, as well as reduce exposure to international market volatility. Shale gas can be used in other economy sectors e.g. GTL, and could improve energy delivery to historically disadvantages populations. Energy planning risks are minimal, but stranded gas infrastructure investment is possible.

Noise

The Karoo has noise levels ~10 dB lower than typical levels, making it a quiet area. Noise risks are derived mainly from vehicle traffic, which will likely be localised and over a short duration for the exploration phase. The construction, operation and decommissioning phases are likely to cause noise impacts within 5 km proximity from drilling sites, thus requiring individual Noise Impact Assessment for proposed sites to in accordance with SANS 10328 to determine the likelihood and severity of these impacts.

Questions:

- Thato Kgari (CGS) queried whether the technical regulations for the Astronomy Advantage Area (AAA) have been considered in this chapter.
  - Greg Schreiner (CSIR) confirmed that this issue is addressed in the Electromagnetic Interference (EMI) Chapter.
- Bryan Fisher (DENC NC) commented that short duration intermittent noise could be more irritating than a consistent noise and the psychological impact this noise may cause should be taken into consideration.
- Paul Hardcastle (DEADP WC) suggested a potential exclusion zone around sensitive areas.
  - Greg Schreiner (CSIR) noted there is a minimum 5km distance that well pads can be located next to each other, which provide exclusion/ buffer areas.

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Earthquakes

SGD increases the likelihood of low magnitude earth tremors. Heritage buildings and poorly constructed low-cost housing are most vulnerable. The risk of earthquakes from SGD can be reduced to very low by ensuring the location of fracking sites are more than 20 km from towns and through the continued regulations against waste disposal by deep injection.

Heritage

Heritage resources are distributed in various densities throughout study area, but the actual distribution of resources is poorly known. Some categories of heritage are more sensitive than others based on landscape character e.g. river valleys are more sensitive than open plains. The significance of impacts may be reduced by micro-siting infrastructure, including buffer zones, and implementing mitigation measures during all phases of SGD. Improvement will be required to the currently limited institutional capacity for the application of the National Heritage Resource Act.

Electromagnetic Interference with the SKA

Being a uniquely South African situation, the South African Radio Astronomy Service is a key standard which provides protection threshold levels for radio astronomy. Five classes of separation distance are prescribed with legislated mitigation requirements for each class, to reduce the detrimental impact to acceptable levels of change. There is a strict limitation on the types of equipment that can be used within the "buffer/ exclusion zones" surrounding each spiral arm.

Questions:

- Dee Fischer (DEA) queried whether the red area on the image, labelled as Class 5, is an exclusion zone.
  - Greg Schreiner (CSIR) stated that this is not necessarily the case, but sensitivity is very high for this class, which implies some areas will ultimately not be allowed for development.
  - Paul Hardcastle elaborated further stating that the requirements are so stringent within that area that it basically is an exclusion zone.
  - Muzi Mkhiza (DoE) noted that thresholds are placed in these areas rather than having exclusion zones, and that these thresholds should be used to determine what exactly constitutes an exclusion zone.
  - Bob Scholes (Wits/ CSIR) stated further that the thresholds apply to specific/ exact locations in terms of the SKA spiral arms. It may be that an activity is allowed given certain situations e.g. not in direct line of sight/ over a hill.
  - Thato Kgari (CGS) reiterated that the regulations provide a list of activities and instruments prohibited within certain proximity to the SKA area, which should be included in this chapter.
- Garry Paterson (ARC) queried the timeline for the completion of the SKA and whether it would run parallel to SGD.
  - Bob Scholes (Wits/ CSIR) indicated that the SKA would run parallel with entire lifecycle of SGD.

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Air Quality & Greenhouse Gas Emissions

Shale gas presents a risk of increased emissions, as well as opportunities to reduced emissions if gas is used in addition to-, or displaces coal or other low-carbon sources. There is a moderate risk for occupational exposure from air pollutants, particularly silica. For large scale SGD, the risk of fugitive methane emissions is assessed as high without mitigation, and moderate with mitigation and best practice.

Questions:

- Paul Hardcastle (DEADP WC) raised concern of flaring of gas during exploration.
    - Greg Schreiner (CSIR) noted that the regulations do have recommendations for flaring.

Human Health

The health status of the present local population is below national average; making them more vulnerable to adverse human health effects. Key risks are occupational i.e. exposure to toxic chemicals during shale gas operations which could cause short term dermal and respiratory symptoms. Negative health impacts through air, water and noise pollution may be experienced by people living close to shale gas infrastructure. The application of mitigation and exclusion zones may reduce such impacts. Baseline monitoring is crucial.

Questions:

- Viswanath Vadapalli (CGS) commented that the people living in the study area are predominantly poor, which reflects the negative health issues. Job opportunity via SGD may help improve economic status and access to health care.

Social Fabric & Sense of Place

Rapid in-migration could result from "boomtown" conditions in the local economy due to large investments in small town areas. Rapid development is associated with disruption of the social fabric and feelings of insecurity, and the capacity to meet demands for basic services is likely to be exceeded, at least in medium term. Benefits of local economic multipliers may enhance opportunities, however, local governance processes and institutions require strengthening to enhance positive outcomes and minimize unintended ones. Sense of place values will be positively and negatively affected by SGD, and some effects may prove irreversible.

Waste

The application of waste management hierarchy is important i.e. cleaner production, minimisation, re-use, recycle, treatment and disposal. Under current legislation, hazardous mining-related waste requires specialised disposal sites and procedures, however if this legislation were to change, SGD wastes could be legally disposed in municipal landfills which are currently inadequate for this purpose. Leach management and treatment must be a pre-requisite for disposal of waste to landfills due to chemical additives and leachable NORMs. The application and enforcement of waste management provisions within the Petroleum Exploration and Development Regulations (2015) is mandatory and should not be relaxed with future amendments.

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Questions:

- Paul Hardcastle (DEADP WC) emphasises that a close link must be made in policy and legislation and how minimum requirements must be set. Paul also queried that if drill cuttings are not radioactive, would it be disposed of at general waste facilities?
    - Greg Schreiner (CSIR) confirmed that that the KARIN project, which has drilled up to 700m, has not brought up Naturally Occurring Radioactive Materials (NORMs) thus far.
    - Dee Fischer (DEA) noted further that the waste management hierarchy is key function, regardless of legislation. Additionally, drill cuttings can be organically processed.
- Muzi Mkhize (DoE) raised the issue that policy changes are a drawn out process, so it would help to extract these issues at this stage so we can start thinking about it to make policy making/change potentially smoother/ easier. The concern is timing; where policy could delay everything, when it could have moved in sync with development.
    - Dee Fischer (DEA) responded by noting that policy development is not a part of this process, instead policy already exists, with hierarchy. Government will need to examine how to implement the recommendations coming from the SEA.
    - Paul Hardcastle (DEADP WC) argued that certain issues have best practice, which may have policy, and thus policy development should be an outcome from this process.

<u>Tourism</u>

Tourism is a key sector, with capacity to drive economic growth and rural upliftment. Three main tourist groupings can be identified, each with different sensitivities. Main negative impacts are focused around traffic densification from trucks and noise. Mitigation opportunities may be enhanced through the recognition and protection of tourism nodes and routes, which could reduce impacts. Current management of tourism in the study area is fragmented; therefore integrated tourism management is required.

<u>Agriculture</u>

The land capability of the study area is moderate to low. Provided the threat to groundwater resources is adequately managed, SGD will not significantly impact long term productivity; however it will place the privacy and security of land users at risk, particularly through the risk of livestock theft. Natural agricultural resources are protected by existing policy, legislation and regulation, but enforcement is required. Local economic development associated with SGD will stimulate local markets of agricultural products and increase income from land rental and infrastructure. Long term monitoring and evaluation is required to determine effectiveness and efficiency of mitigation measures.

Questions:

- Dee Fischer (DEA) queried how baseline monitoring would be employed in the Agricultural sector, and who would be responsible.
    - Greg Schreiner (CSIR) explained that economic activity per farm could be measured at present and compared to that in 2030.
    - Bob Scholes (Wits/ CSIR) explained further that DAFF runs specific agricultural census, and Statistics South Africa would play a role. These are quite comprehensive and the intensity level at which they are conducted could be increased in the area of SGD.

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- Dee Fischer (DEA) commented that the onus of potential negative impacts of SGD on agriculture would be difficult to place on developers.
    - Bob Scholes (Wits/ CSIR) offered a suggestion in which a dedicated monitoring unit be employed and financed out of licensing fee payable by developers to cover issues of incremental costs etc.
- Paul Hardcastle (DEADP WC) raised the issue of potential destabilisation should the local knowledge base (as labour force) be removed from the farms to opportunities in SGD. Additionally, the availability of water for agriculture after treatment may be limited, which is a concern since farmers require a consistent sustainable water source for long term agricultural benefits.
- Lydia Bosoga (DAFF) queried whether the chapter provides recommendations for mitigation should land owners impose land use changes, and what the implications would be for food security.
    - Greg Schreiner (CSIR) explained that SGD would not significantly alter land use or marginalise productivity of agriculture in the region.
- Garry Paterson (ARC) noted that much of the Karoo is specialised agriculture i.e. sheep farming, which is successful because of the specialist environment of the Karoo.
    - Greg Schreiner (CSIR) stated that the author team has realised positive spin off opportunities which may in fact enhance agriculture in the area.
- Garry Paterson (ARC) noted that the land capability map does in fact include a climate component, which is a limiting factor. Furthermore, there may be enough small scale irrigation schemes in the Karoo for opportunity for small scale specialised farming that is not yet present in the Karoo. DWS has developed a 30m data source that may be useful.

4. *Key actions and way forward*

	Key Actions	Responsible party	Timeframe
1	Share presentations, meeting notes, attendance register with the PEC.	Project Team	End-May
2	Share Second Order Drafts of 17 strategic Issues Chapters with the PEC.	Project Team	Early-June
3	Distribute notices of the public outreach session to Local and District Municipalities.	Project Team	Mid-June
4	Distribute final public outreach itinerary to the PEC	Project Team	Mid-June
5	Release SODs to stakeholders for comment (and Share consolidated comments spreadsheet for each strategic issue).	Project Team	14 June
6	PEC Workshop prior to SOD release		13 June
7	Provide comments to the author teams on the SOD's (Project team will collate all public/ stakeholder comments (including the comments made by the general public, via website). Comments will not be responded to individually)	Project Team	14 June - 15 July
8	Public Outreach, Round 2 (GFR, BW, VW & CT)	Project Team	18- 22 July
9	Multi-Author Team Workshop #3	Project Team	25-27 July
10	Final draft of Scientific Assessment due	Project Team	22 August
12	PEC Meeting #4 to discuss decision-making framework		15 Aug
13	Phase 2: Scientific assessment (final outputs)	Project Team	Mid-Oct
14	Phase 3: Decision-making framework (draft outputs)	Project Team	Dec 2016

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15	Phase 3: Decision-making framework (final outputs)	Project Team	Feb 2017

1.5 Project Executive Committee Meeting 4 Notes (13 June 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Project Executive Committee Meeting #4

Date:

13 June, 2016.

Location:

Knowledge Commons, Ulwazi Room, CSIR Pretoria.

List of attendees:

Name	Organisation
Andile Dludla	CSIR
Bob Scholes	Wits/CSIR
Bryan Fisher	DENC NC
Dee Fischer (Chair)	DEA
Faheima Daniels	SANBI
Greg Schreiner	CSIR
Henk Cetzee	CGS
Muzi Mkhize	DoE
Paul Lochner	CSIR
Somila Xosa	DST
Stella Mamogale	DoE

Apologies received:

- Henri Fortuin and Paul Hardcastle (DEA&DP WC)
- Kristal Maze and Jeff Manuel (SANBI)

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List of acronyms

AAA	Astronomy Advantage Area
ARC	Agricultural Research Council
ASSAf	Academy of Science of South Africa
BW	Beaufort West
CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
CT	Cape Town
CTL	Coal-to-Liquid
DAFF	Department of Agriculture, Forestry and Fisheries
DEADP WC	Department of Environmental Affairs and Development Planning Western Cape
DENC NC	Department of Environment and Nature Conservation Northern Cape
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DPME	Department of Mineral and Energy
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMI	Electromagnetic Interference
EMPr	Environmental Management Programme
FOD	First Order Draft
GFR	Graaff-Reinet
GTL	Gas-to-Liquid
GUMP	Gas Utilisation Master Plan
IEP	Integrated Energy Plan
IMC	Interministerial Committee
NMMU AEON	Nelson Mandela Metropolitan University Africa Earth Observatory Network
NORM	Naturally Occurring Radioactive Material
PCG	Process Custodians Group
PEC	Project Executive Committee
SAEON	South African Environmental Observation Network
SAHRA	South African Heritage Resource Agency
SAIAB	South African Institute for Aquatic Biodiversity
SALGA	South African Local Government Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SKA	Square Kilometre Array
USA	United States of America
VW	Victoria West
ZOD	Zero Order Draft

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1. *Introduction and adoption of PEC Meeting #3 notes*

Dee Fischer (Chair from DEA) opened the meeting by going through the Agenda and indicating that the purpose of the PEC meeting was to discuss the Second Order Draft of the 18 Chapters of the Scientific Assessment (Phase 2) of the overarching SEA, which will be released to the public tomorrow (14 June), unless there are any significant issues raised during the PEC meeting.

Apologies from Paul Hardcastle and Henri Fortuin (DEA&DP WC) were registered. In addition they informed Greg Schreiner (Project Manager) that they had no objecti0on to the SOD chapters being released for stakeholder review.

Muzi Mkhize thanked the team for participating on the PEC and indicated that he will no longer be part of the PEC as he will be leaving the Department of Energy (DoE).

Actions from PEC Meeting #3 (27 May, 2016)

	Key Actions	Responsible party	Timeframe
1	Share presentations, meeting notes, attendance register with the PEC.	Project Team	End-May
2	Share Second Order Drafts of 17 strategic Issues Chapters with the PEC.	Project Team	Early-June
3	Distribute notices of the public outreach session to Local and District Municipalities.	Project Team	Mid-June
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14	Phase 3: Decision-making framework (draft outputs)	Project Team	Dec 2016
15	Phase 3: Decision-making framework (final outputs)	Project Team	Feb 2017

The PEC members approved the meeting notes from PEC Meeting #3.

2. *Preliminary feedback on Summary for Policy Makers Document (SPM)*

- Presentation by Greg Schreiner (CSIR)
- A brief introduction on to the document was made, highlighting the chapter structure, their contents as specified in the content page, and risk assessment.

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Chapter 1: Scenarios and Activities

A description of the 4 scenarios; Baseline reference, Exploration only, Limited production of 5 Tcf and Extensive production of 20 Tcf was presented according to the contents on the SPM.

Chapter 2: Energy Planning

Presentation:

Many policies are moving towards gas to power options, and the three supply options are provided for in the document. The primary risk associated with Energy Planning is the state making the assumption that shale gas will materialise before there is any evidence that shale gas development could ever materialise into a production phase.

Questions:

- Dee Fischer (DEA) questioned whether a larger Big Gas scenario could materialise.
    - Greg responded by saying that the GUMP assumes a there is a 9 trillion cubic feet (tcf) find, the scenarios in the assessment straddle these very well. These are also considered plausible scenarios by industry. Bob Scholes (WITS) added that an increase in the Big Gas scenario (from say 20 tcf to 30 tcf) would not make a qualitative difference to the risks, only quantitatively. What is important is having a balance across the scenarios to see how risk changes qualitatively i.e. from 0 tcf – 20 tcf.
- Dee Fischer (DEA) also suggested that authors should get the GUMP document to provide more content.
    - Greg Schreiner (CSIR) indicated that authors had access to the draft GUMP document, and they have indicated where that information was used in the report.
- Dee Fischer asked whether it is credible to use a document that is not yet in the public domain. She asked DOE whether there is an indication of when GUMP will be released to the public.
    - Muzi Mkhize (DoE) mentioned that there has been no go ahead to release the document to the public, there are still on-going internal discussions and he has no clear indication in terms of its time frame. He added that DoE in principle are keen to get the document into the public domain. He did not have any objection to the Energy Chapter using the draft GUMP to inform their study.

Chapter 3: Air Quality (AQ)

Presentation:

There is a high risk for occupational exposure from air pollutants resulting from SGD without mitigation, reduced with mitigation. Under scenarios of small and big gas development there is a moderate risk of local community exposure to air pollutants. There is insufficient information on AQ and GHG concentrations in the Karoo to form a reliable baseline against which to measure the impacts of SGD.

Questions:

- Muzi Mkhize (DoE) asked whether there is any recommendation in the chapter on what energy mix should be chosen and in turn, how it would affect GHGs?

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  - Greg Schreiner (CSIR) highlighted that the authors are not mandated to say which option should be made or preferred to go ahead, their responsibilities is to sketch out the risks and opportunities associated with various options.
- Somila Xosa (DST) followed up on the issue of AQ particulate matter from trucks etc., that there should be a way to address these issues if fracking does proceed. It is clear that Silica will affect the workers, however it is not clear how the impacts of AQ on community members will be mitigated. He also recommended that with regards to GHG, projects such as project mthombo which looked at liquid fuels etc. be considered.
- Bryan Fischer (DENC) suggested that dust modelling be a prerequisite so provinces can start planning for towns that will be affected by the start e.g. in the Northern Cape the iron ore mining activity has resulted in plant death from plant leaf pores becoming blocked by iron ore dust.
  - Greg Schreiner (CSIR) responded by saying that would be best during the EIA phase where it would be done for site specific area and development plan so that the modelling could trace particulates back to their point source.
- Muzi Mkhize (DoE) queried the displacement of energy, whether it is based on the quantity?
  - Bob Scholes (WITS) responded by saying that as part of the IEP there is an energy quantity requirement, which indicates the breakdown from from gas, coal, renewables, nuclear etc.
- Dee Fischer (DEA) mentioned that the quantity is not explicitly defined on the document, it is just summarised.

Chapter 4: Earthquakes

Presentation:

SGD by hydraulic fracturing increases the likelihood of low-magnitude earth tremors. Heritage buildings made of unbaked clay bricks, and poorly-constructed low-cost housing are the most vulnerable. Locating sites of hydraulic fracturing more than 20 km from towns, and continuing to forbid waste disposal by deep injection, reduces the risk of earthquakes resulting from SGD to very low.

Questions:

- Dee Fischer (DEA) questioned the "20km radius from town", that it does not state where this number comes from, there is no support for this recommendation.
  - Greg Schreiner (CSIR) suggested that it is to achieve a moderate - low risk but noted Dee Fischer's concern.
- Dee Fischer (DEA) stressed that the issue is the '20km' is based on what? That is the issue. Bob Scholes (WITS) concurred and noted it as a matter to be looked into moving forward.
- Somila Xosa (DST) pointed out that the word 'towns' is concerning because property in GFT can be of same value as a house outside the town. Settlements might need to be considered, he suggested that we rethink the word 'towns' as it might seem as if that the study is only protective of towns
- Muzi Mkhize (DoE) raised a concern that 20km becomes prescriptive, and queried if the issue is around human safety or safeguarding the heritage valuable? What are we aiming to protect?

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   - Bob Scholes (WITS) indicated that we are aware that we do not have to be policy descriptive and that was communicated to the authors. And added that protection is a combination of both human safety and heritage.
- Henk Coetzee (CGS) mentioned that in earthquake or tremor activities no one actually gets killed by the natural disasters but it is death related to falling objects. He also added that mentioning poorly constructed houses will be an acknowledgement of poorly constructed houses being built in the future. There are cases where miners use poorly constructed house as an excuse to damages on their houses whereas it is related to their activities.

Chapter 5: Water Resources

Presentation:

Water availability for SGD in the study area is severely constrained. Improved water resources monitoring both before and during SGD is an imperative and surface, groundwater and wetland reserve determination .There is a shortage of laboratories in South Africa to undertake the necessary water chemistry analysis for monitoring in relation to SGD. Surface spills on-site and along transport networks are the most likely source of water resource contamination. Cumulative impacts from other activities will compound water scarcity and quality concerns. Post-SGD legacy impacts on water resources will occur, Central Karoo landowners are mainly reliant on groundwater resources for domestic and stock water supplies. Lack of infrastructure and institutional capacity for water management is a constraint. SGD provides a learning opportunity that will improve understanding of local water resources

Questions:

- Dee Fischer (DEA) queried the issue of shortage of laboratories to undertake necessary water chemistry analysis, whether this is the case now or will also be an issue 20years from now as well. It should be specified that the analysis is for baseline monitoring. Not all issues will be dealt by Government, some issues are not duties of government, there are instruments such as the polluter pays principle etc. that will be paid by responsible parties.

Chapter 6: Waste Planning and Management

Presentation:

SGD will generate substantial volumes and new types of waste in the study area, the table are on chapter 1 of the report. Potential waste from SGD must be managed in an integrated way in-line with the waste management hierarchy and the principles for integrated waste management in South Africa. Mining-related waste, including that from SGD, is currently classified as hazardous, thus requiring specialized disposal sites and procedures. Municipal landfills are currently completely inadequate for this purpose and could have health impacts if people are exposed to it. Application of the waste management provisions within the 2015 Petroleum Exploration and Development Regulations are adequate to reduce the waste-related risks to low, if rigorously enforced

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Questions:

- Dee Fischer (DEA) suggested that the image of waste disposal hierarchy be removed from the slide because it is not relevant for liquid waste. She added she would like more discussion around the issues of wastewater treatment facilities and what treatment will be required for this sort of liquid rather than landfill sites. She also advised that the last point on " Application of the waste management provisions within the 2015 Petroleum Exploration and Development Regulations are adequate to reduce the waste-related risks to low, if rigorously enforced" be removed from the power point slide.

Chapter 7: Biodiversity and Ecosystems

Presentation:

Greg Presented on a sensitivity map of the study area which identified areas as being of Very High ecological importance and sensitivity are irreplaceable. He also mentioned Impacts on species, ecosystems and ecological processes extend well beyond the actual activity or physical footprint. The major concern is that the extensive linear infrastructure associated with SGD will result in fragmentation of the landscape. The Very High and High sensitivity areas make up an estimated 55 % of the study area. Only 5 % of the study area is formally protected. Offsets in areas of Very High and High sensitivity, environmental compliance in areas of Medium-Low and Low ecological importance and sensitivity required. The cumulative and unforeseen impacts of SGD on biodiversity, as well as effectiveness of mitigation, must be monitored.

Questions:

- Dee Fischer (DEA) requested the "Offsets in areas of Very High and High sensitivity" be removed from the slide as this will send the wrong message to the mining industry.
  - Bob Scholes (WITS) mentioned that we need to attempt to balance both sides where we have to mention offsets as a possible mitigation option.
- Henk Coetzee (CGS) asked if the land use maps were also overlaid on the sensitivity maps?
  - Bob Scholes (WITS) confirmed that this is the case

Chapter 8: Agriculture

SGD will not have a significant impact on productivity if the threat to ground water resources is addressed. Sufficient policy, legislation and regulation exist to protect the natural agricultural resources, but there needs to be enforcement. Local economic development associated with SGD will stimulate local markets for agricultural products and increase income from the rental of land and infrastructure. SGD will put the protection of the privacy and security of landowner and labourers at risk, primarily through the risk of livestock theft.

- Somila Xosa (DST) raised a query which was raised at the Public Briefing where a member of the community asked about the different timeframes between the SANBI bioblitz which will be completed in five-years' time and the SEA which will be completed next year, how will that affect the SEA?

- Greg Schreiner (CSIR) explained that SANBI bioblitz was initially meant to assist the biodiversity component of the SEA, and a lot of the SANBI bioblitz data has gone into the chapter. The SEA will use the data available currently and cannot wait until the bioblitz is completed.
- Bob Scholes (WITS) suggested that we add in the document that there is ongoing research but the current information is sufficient for the assessment.

Chapter 9: Impacts on Tourism

Presentation:

Tourism as a growing economic sector with the capacity to drive growth and uplift rural areas. Three tourist groupings are identified, each with different sensitivities, main negative impacts on tourism traffic densification from trucks ferrying materials needed for shale gas operations and associated noise. Negative impacts on the tourism sector would increase the risk of losses of employment and value addition to local economies. Recognition and protection of tourism nodes (e.g. niche towns) and routes (e.g. N9 and mountain passes) will enhance mitigation opportunities to reduce impacts. Current management of tourism in study area is fragmented, integrated tourism management is required. He also touched on the Tourism Map

Questions:

None

Chapter 10: Impacts on the Economy

Presentation:

Shale gas development could deliver highly significant economic opportunities, but the extractive nature of SGD also brings economic risks. High volumes of shale gas would support an improved trade balance and reduce exposure to international market volatility and exchange rate risk. Measures for benefit maximisation in the study area must be implemented Greg mentioned that what they have proposed a model similar to the renewable energy projects. Local government finances are likely to be put under significant strain. The risk that SGD could 'crowd out' other sectors is generally low if SGD does not compete with local water users, or pollute supplies. Financial mechanisms to ensure adequate financial provisions allowing the state to deal with externalities are required. Risks to property values on farms are likely to decrease. Property values in towns, on the other hand, are likely to increase due to increased economic activity. Adequate and unambiguous compensation mechanisms should be put in place. Greg also touched on a table depicting the different scenarios and the number of jobs that would be created for each stage.

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Questions:

- Bryan Fischer (DENC) probed about the jobs created whether the low skilled jobs will be sourced from local people because there is an indication from Shell that they will migrate workers from other countries.
    - Greg Schreiner (CSIR) mentioned that 15 to 35% of low skilled workers will be locally based according the estimates in the assessment.
- Dee Fischer (DEA) queried on a point on the presentation slide "Measures for benefit maximisation in the study area must be implemented", she asked why is this the case for shale gas whereas other mines did not have this option, financial provisions should be based on the current financial provisions. She also added that the proposed model for renewable energy should not be used because the mining industry is different. Dee also asked if there has been any work done with regards to determining how much the mine has to provide for housing of employees working on site, or is it governments' responsibility?
- Muzi Mkhize (DoE) suggested that maybe the chapter can also look at SADC regional planning in terms of economy, there might be some neighbouring countries such as Mozambique etc. who are also interested in tapping into the shale gas discovery in the country.
- Somila Xosa (DST) interrogated the statement on the presentation slide "Risks to property values on farms are likely to decrease", saying that if you are in the oil and gas industry getting a house near the sight maybe a priority, therefore increase price, therefore it depends on how you look at it. Unless there is a criteria used to measure decrease and increase of property value.
    - Dee Fischer (DEA) mentioned that the Wind and Solar SEA looked at contractual conditions of the farmers and lessons on the international valuation.

<u>Chapter 11: Social Fabric</u>

Large investments in small-town areas will create 'boomtown' conditions in the local economy which will stimulate in-migration. Demands on water reticulation, electricity, sewerage, schools, clinics and local roads are likely to exceed capacity at least in medium-term. Rapid development and change is associated with disruption of the social fabric and feelings of insecurity. Benefits of local economic multipliers may enhance opportunities. Local governance processes and institutions should be strengthened to minimize unintended outcomes and enhance positive ones. Key mitigation: Integrate SGD in a phased manner into local government planning (IDP & SDFs), budgeting and implementation process.

Questions:

- Somila Xosa (DST) suggested that it might not necessarily create a 'boomtown' but more of a 'boom and bust' town.
- Following up on the previous question Henk Coetzee (CGS) asked whether a decommissioning phase scenario where lots of infrastructure being left for the municipality to deal with has been considered.
    - Greg Schreiner (CSIR) said it is addressed by the chapter
- Dee Fischer (DEA) enquired that if it assumed that there will be an influx of people, do you necessarily need new infrastructure to cater for those people? "Demands on water reticulation,

electricity, sewerage, schools, clinics and local roads are likely to exceed capacity at least in medium-term" conveys a message that the municipality will not be able to cope, how true is this?
    - Bob Scholes (Wits) asserted this point that municipalities will not be able to cope and that is also addressed in the spatial planning chapter.
- Dee Fischer (DEA) suggested that it might be necessary to do an assessment at a strategic level which looks at the assumptions of municipalities having to rezone, this assessment can look at the regional planning in terms of municipalities and be done before shale gas development proceeds.

<u>Chapter 12: Human Health</u>

Presentation:

Health status of present local population is below national average making them more vulnerable to adverse human health effects. People living close to shale gas infrastructure can anticipate negative health impacts through air, water and noise pollution →apply mitigation and exclusion zones to reduce impacts. Workers will be directly exposed to toxic chemicals during shale gas operations →short-term dermal and respiratory symptoms. Uncertainties in the chemicals to be used and evidence of the health impacts that might be expected are the major restriction in the health impact section of this study. Potential health impacts resulting from SGD will require that baseline monitoring for air and water quality, as well as baseline health monitoring including additional health symptoms associated with SGD.

Questions:

- Dee Fischer (DEA) queried what is meant by 'baseline health monitoring', all the other chapters are clear on their baseline monitoring.
    - Greg Schreiner (CSIR) stated that they will have to specify what they mean by baseline health monitoring. He added that human health impacts are a result of air, water etc. which lie within other chapters.
    - Dee Fischer (DEA) suggested that it may be useful to look at international standards on minimum requirements for human health.
- Somila Xosa (DST) asked what are the recommendations for baseline monitoring on human health issues? Should it perhaps look at health institutions such as clinics etc. and request data from them?
    - Dee Fischer (DEA) responded by saying that approach would be subjective because in some cases you cannot disclose health status of patients and a few clinics disclose certain diseases, therefore it would be difficult to get such information.

<u>Chapter 13: Sense of Place</u>

Presentation:

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There is not one, but are several, "senses of place" in the Karoo. Shale gas development in the Karoo will affect sense of place values, both positively and negatively. Strategic level assessments are not able to provide detailed analyses of senses of place but they can draw limits of acceptable change based on the existing landscape and its land use.

Questions:

- Dee Fischer (DEA) highlighted the fact that the FOD was not useful to her, and no relevant link was made between the impact of shale gas development and sense of place. It needs to be drastically improved or be left out from the study.
    - Bob Scholes (WITS) concurred with Dee in that it was poorly done but it should not be left out, we should use the public review process to assist in making it better.
    - Muzi Mkhize (DoE) and Somila Xhosa (DST) echoed Bob Scholes sentiments of including it in the chapter because it will provoke debate and has always been part of the process work-plan.

<u>Chapter 14: Impacts on Visual and Scenic Resources</u>

Presentation:

SGD and its associated secondary developments, without mitigation, is likely to lead to the visual fragmentation of Karoo landscapes, and transformation of its pastoral or wilderness character to an industrial connotation in the affected areas. Study identified scenic visual 'hotspots' that could be affected by SGD, key risks arising from SGD are the visual fragmentation of Karoo landscapes. There is no standard approach to mapping or rating the value of scenic resources in South Africa.

Questions:

- Dee Fischer (DEA) suggested that the visual mapping can be used as a start point for sense of place.

<u>Chapter 15: Impacts on Heritage</u>

Presentation:

Heritage resources are distributed in variable densities throughout the study area but the actual distribution of resources is poorly known. River valleys, rocky ridges and the undulating uplands tend to be more sensitive than the open plains for some categories of heritage. Micro-siting of the infrastructure (including buffer zones) and the implementation of mitigation measures during all phases will help to reduce the significance of the impacts. Current institutional capacity in terms of application of the National Heritage Resource Act is limited and improvement will be required

Questions:

- Dee Fischer queried the "Current institutional capacity in terms of application of the National Heritage Resource Act is limited and improvement will be required" statement on the presentation slide, saying that she does not agree with this.

- Bob Scholes (WITS) indicated that the observation amongst people in this industry is that the SAHRA have to authorise every application document which creates a backlog in applications awaiting approval/authorisation.
- Paul Lochner (CSIR) indicated that for the Wind and Solar SEA the authorities responsible for heritage applications were able to work efficiently in that process.

Chapter 16: Noise generating activities

Presentation:

The Karoo area is a quiet area. Residual day- and night time noise levels are approximately LAeq 33 dBA and 25 dBA respectively, 10 dB below the typical levels. Exploration phase noise impact is likely to be localised and of short duration, primarily from trucks. The construction, operation and decommissioning phases will likely cause noise impacts for humans and animals on sites within at least 5 km of the drilling sites. There is additionally a risk of road noise impacts emanating from the surrounding roads due to increased heavy goods vehicle road traffic. Proposed sites will need individual Noise Impact Assessments in accordance with SANS 10328 to determine the likelihood and severity of these impacts.

Questions:

- Dee Fischer (DEA) commented that the minimum requirements for heritage and noise fit perfectly.

Chapter 17: EMI noise

Presentation:

South African Radio Astronomy Service is a key standard which provides protection threshold levels for radio astronomy. Electrical motors, switchgear, spark-ignited engine motors and communication devices are the types of equipment used in SGD which can potentially cause EMI. The key mitigation is to exclude EMI-generating sources for up to 40 km for the most sensitive parts of the SKA. 5 classes of sensitivity are prescribed, each with varying degrees of required mitigation in order to reduce the detrimental impact to acceptable levels of change.

Questions:

- Dee Fischer (DEA) was concerned about the EMI from SKA having an effect on the 'sweet spot', and about the SKA affecting SGD and how the SKA mitigation requirements eventually lead to 'no go zones'. She also raised concerns about DST instructing DMR to sterilize the land for 20 years which could be difficult to implement.
    - Somil Xosa (DST) mentioned that there is a clear arrangement on the hydraulic fracturing regulations regarding SKA activities. He added that there have been discussions for the past 18 months between astronomers, DST, PASA, DMR etc. therefore this issue is being looked into at a very high political level.
    - Muzi Mkhize (DoE) stated that it is clear that this is a matter between the policy makers of DMR and DST, and hopefully they will reach consensus on the issue.

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Chapter 18: Integrated Planning and Infrastructure

Presentation

Towns in close proximity to SGD will experience growth exceeding projections based on past trends → increasing service delivery demand. The largest direct impact is expected to result from the construction of private local access road networks and well pads which may require consideration of regional Spatial Development Frameworks. Regulatory uncertainties and limited municipal capacity to facilitate an ongoing processes of land use and land development applications. The increase in traffic by heavy vehicles on regional roads will be substantial →require increased governance and law enforcement, integrated spatial planning will be essential but governance capacity is limited.

Questions:

- Dee Fischer (DEA) queried the statement "Regulatory uncertainties and limited municipal capacity to facilitate an ongoing processes of land use and land development applications", adding that local government normally rezone land as mining area once they have received mining permit. She also highlighted that SPLUMA does not get involved in land use change applications; it sets a framework for provincial authorities to follow.
    - Greg Schreiner (CSIR) mentioned that the LUPA is still applicable in the Western Cape and this can cause procedural uncertainty with regards to land use and land development applications.

3 *Update on project status and progress*

Outreach feedback and programme

- Greg Schreiner (CSIR) presented feedback on the past public outreach meetings, he gave an indication of the growth in attendance for the previous meetings; he attributed the significance growth and success of meetings to the ministerial letters to the municipalities which resulted in a great deal of local support. The radio and SMS communication also assisted significantly. The attendance and representation of national government .
- Round 2 schedule will take place, Graaff- Reinet, Beaufort West and Victoria West will be from 18 – 20 July 2016, a one day break then one in Cape Town on 22 July 2016 at Iziko Museum. The purpose of the Outreach #2 is to present the draft finding on the independent Scientific Assessment. The material that will be released to the stakeholders include; Released summaries and chapters on 14 June on website, SODs (high & low res), commenting forms, 30 days stakeholder comment = 14 June to 15 July (excl. 16 June), hard copies & CDs to libraries. Summary documentation will be provided at meetings, Draft findings to be presented on powerpoint at outreach if possible, and comments on findings to be captured at outreach.
- Stakeholders will be notified of meetings via Letters from DEA Minister, Emails, Sms's, District and Local Munics., Radio and Newspaper adverts (local and provincial)

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Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Key Dates going forward

1.	Release of SOD for registered stakeholder comment, 14 June
2.	30 days public comment (14 June to 15 July)
3.	Collate all public/stakeholder comments and send to specialists, 22 July
4.	Public outreach planned for week of 18-22 July □ additional comments
5.	Specialist workshop (AM#3) on 25-27 July at Goudini
6.	PEC meeting # 5, Phase 3 on 15 August
7.	Final draft Scientific Assessment by 22 August
8.	PCG #4 on 26 Sept 2016
9.	Phase 2: Scientific Assessment (final output), mid-October 2016
10.	Phase 3: Decision-Making Framework (draft outputs), end-2016
11.	Phase 3: Decision-Making Framework (final outputs), Feb 2017

Questions:

- Greg Schreiner (CSIR) asked if Dee Fischer (DEA) has received the municipal letters that need to be signed by the minister for their participation.
  - Dee Fischer (DEA) said she has received them and has submitted them to the relevant channels, she is not sure when they will be signed.
- Somila Xosa (DST) appealed that government should attend the public meetings to convey the same message to the public. It is also useful to reflect on the issues raised by community members which may not be directed at SEA process but may occur as a result of SGD. He suggested that perhaps other members or officials i.e. provincial officials should also be part of the public meetings to address these concerns.

4 *Key actions and way forward*

- PEC approved release of SOD to public on June 14 2016.

Key Actions	Responsible party	Timeframe
Share presentations, meeting notes, attendance register with the PEC.	Project Team	End-June
Distribute notices of the public outreach session to Local and District Municipalities.	Project Team	End-June
Distribute final public outreach itinerary to the PEC	Project Team	End-June
Public Outreach, Round 2 (GFR, BW, VW & CT)	Project Team	18- 22 July
Multi-Author Team Workshop #3	Project Team	25-27 July
Final draft of Scientific Assessment due	Project Team	22 August
PEC Meeting #4 to discuss decision-making framework		15 Aug
Phase 2: Scientific assessment (final outputs)	Project Team	Mid-Oct
Phase 3: Decision-making framework (draft outputs)	Project Team	Dec 2016
Phase 3: Decision-making framework (final outputs)	Project Team	Feb 2017

1.6 Project Executive Committee Meeting 5 Notes (26 September 2016)

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Strategic Environmental Assessment for Shale Gas Development in South Africa:

Project Executive Committee Meeting #5

Date:

26 September, 2016.

Location:

CSIR Executive Boardroom, Building 3, CSIR Pretoria

List of attendees:

Name	Organisation	
Bob Scholes	Wits/CSIR	
Dee Fischer (Chair)	DEA	
Gerry Pienaar	DEDEA (EC)	
Greg Schreiner	CSIR	
Henk Coetzee	CGS	
Henri Fortuin	DEADP (WC)	
Jeffrey Manuel	SANBI	
Kristal Maze	SANBI	
Luanita Snyman-Van der Walt	CSIR	
Megan de Jager	CSIR	
Mpume Ntlokwana	DAFF	
Paul Hardcastle	DEADP (WC)	
Simon Mogabetsi	DEA	
Somila Xosa	DST	

Apologies received:
Paul Lochner
Gerry Pienaar (excused himself early for flights)

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List of acronyms

AAA	Astronomy Advantage Area
ARC	Agricultural Research Council
ASSAf	Academy of Science of South Africa
BW	Beaufort West
CGS	Council for Geoscience
CSIR	Council for Scientific and Industrial Research
CT	Cape Town
CTL	Coal-to-Liquid
DAFF	Department of Agriculture, Forestry and Fisheries
DEADP WC	Department of Environmental Affairs and Development Planning Western Cape
DENC NC	Department of Environment and Nature Conservation Northern Cape
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DPME	Department of Mineral and Energy
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMI	Electromagnetic Interference
EMPr	Environmental Management Programme
FOD	First Order Draft
GFR	Graaff-Reinet
GTL	Gas-to-Liquid
GUMP	Gas Utilisation Master Plan
IEP	Integrated Energy Plan
IMC	Interministerial Committee
MIRs	Minimum Information Requirements
NMMU AEON	Nelson Mandela Metropolitan University Africa Earth Observatory Network
NORM	Naturally Occurring Radioactive Material
PCG	Process Custodians Group
PEC	Project Executive Committee
SAEON	South African Environmental Observation Network
SAHRA	South African Heritage Resource Agency
SAIAB	South African Institute for Aquatic Biodiversity
SALGA	South African Local Government Agency
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SKA	Square Kilometre Array
USA	United States of America
VW	Victoria West
ZOD	Zero Order Draft

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1. *Introduction and adoption of PEC Meeting #4 notes*

Dee Fischer (Chair from DEA) opened the meeting by going through the Agenda and indicating that the purpose of the PEC meeting was to provide an update on the progress of the Strategic Environmental Assessment (SEA) with specific reference to the scientific assessment process, the outreach programme and key findings; and to discuss Phase 3 (Decision Support Framework) of the SEA.

Actions from PEC Meeting #4 (13 June, 2016)

	Key Actions	Status
1	Share presentations, meeting notes, attendance register with the PEC.	Completed, 04 July 2016
2	Distribute notices of the public outreach session to Local and District Municipalities.	Completed, emails notifying the municipalities of the outreach sessions was sent in June 2016
3	Distribute final public outreach itinerary to the PEC	Completed, 04 July 2016
4	Public Outreach, Round 2 (GFR, BW, VW & CT)	Completed, 18- 22 July 2016
5	Multi-Author Team Workshop #3	Completed, 25-27 July 2016
6	Final draft of Scientific Assessment due	Completed, September 2016
7	Phase 2: Scientific assessment (final outputs)	Completed, final drafts have been received from author teams. To be electronically published end October 2016.

Following the identification of some spelling errors, the PEC members approved the meeting notes from PEC Meeting #4.

2. *Preliminary feedback from Process Custodians Group Meeting #4*

- Greg Schreiner (CSIR): The key issue raised during the PCG meeting #4 was that there is a level of discomfort around their mandate concluding at the end of Phase 2 and that their participation/ input is not required in Phase 3. It was clearly stated during the meeting that their mandate was process related; however, there is opportunity to discuss potential workshops and meetings as part of Phase 3, which PCG members could attend as representatives of their respective organisations rather than as PCG members.
    - Paul Hardcastle (DEADP WC): The role of the scientific assessment doesn't come to an end at the conclusion of the scientific assessment phase, and there is also a process as to how the scientific information is used in policy formulation. This is where the unease is experienced by the PCG. Perhaps we need to find a way of how a "process" is driven around formulating evidence-based policy.
    - Bob Scholes (Wits): From discussions it was clear that the minimum; the information flow needs to continue, and that the people are kept adequately informed, thereby ensuring that the process is transparent. This may satisfy the PCG to an extent.
    - Greg Schreiner (CSIR): The outputs of Phase 3 will most probably be gazetted which would follow the required public participation process, where stakeholders can interact with the Phase 3 outputs.
- Henk Coetzee (CGS): There may be an issue if the PCG members "sign off" on the scientific assessment but then the information being gazetted differs from that of the scientific assessment. Government needs

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to ensure that gap doesn't occur and the information coming out of the scientific assessment is linked to the outputs of Phase 3.

3. *Update on project status and progress*

Presentation by Greg Schreiner (CSIR)

Where are we in the Strategic Environmental Assessment?

With reference to the presented timeline for the entire SEA, it was indicated that the project is now almost at the conclusion of the Scientific Assessment Phase. This conclusion will see the final Scientific Assessment Report, which will include all 18 strategic issues chapters, being electronically released by the end of October 2016, and hardcopies of the report are expected to be released early 2017.

Scientific assessment timing

The scientific assessment process was conducted over a period of roughly one year, and involved multiple author meetings and review processes by the PCG, PEC, expert reviewers and stakeholders of the Zero Order Draft (ZOD, First Order Drafts (FODs) and Second Order Drafts (SODs). The scientific assessment process reaches completion at the end of October 2016, with the release of the final scientific assessment report.

Outreach process

A total of three rounds of public meetings were held during the scientific assessment phase, which took place in November 2015, and May and July 2016. Lessons learnt from the first public outreach included improving the distribution of the notice of the public meetings. Therefore, ministerial letters were sent to affected local municipalities requesting the local municipalities to distribute notice of the public briefings (dates and times) through the local government structures, namely through Ward Councillors to encourage and promote attendance at the briefings. Pre-meetings with municipalities also occurred, and in the last outreach of the scientific assessment phase, meetings were also held with the Laingsburg Farmers Association. A workshop was held in Cape Town for registered stakeholders as part of the first and last outreach session in May 2015 and July 2016, respectively.

Scientific assessment approach

The scientific assessment has 18 chapters, with the development scenarios being applied across each of the strategic issues. Each chapter has a similar structure, including an Executive Summary; Introduction and Scope; Key potential impacts and their mitigation; Risk assessment; Best practice guidelines and monitoring requirements; Topics on which information is inadequate for decision-making; and References. Consistent methodology is applied for the risk assessment, which is based on explicit locations in relation to existing surface features, as determined by the teams of experts. An example of a risk assessment is provided for *Biodiversity and ecological impacts* in the presentation, which includes the risk profile with and without mitigation.

<u>Questions:</u>

- Paul Hardcastle (DEADP WC): The spatial reflection of risk is supposed to inform the final risk maps, however only some chapters had spatial reflection. Limits of acceptable change (LACs) doesn't come through in all the chapters. To what extent is best practice implemented to result in the final risk (with mitigation)? This is an important factor and should be made clearer in the chapters.

  - Greg Schreiner (CSIR): Spatial mapping is only possible for certain chapters; and so sensitivity was spatially mapped where possible (i.e. the Energy, GHG, social fabric, economics etc. chapters do not have a spatial components). We pushed as much as possible to make things as spatially explicit as possible. Risk is shown as a manifestation of impacts in the sensitive areas. Each chapter, where possible, will have the sensitivity maps translated into risk maps in the final report. LAC is a difficult concept and it works well for some chapters where there are best practice manuals etc., and so for some chapters it is easier to define LACs, and this is highlighted in the report. LACs were provided where possible. Best practice guidelines and monitoring are described and provided in the report. As part of Phase 3, we need to condense this to those that should be taken forward. The risk assessment considered the risks with and without mitigation which is the worst and best case scenarios. With mitigation assumes the best practice guidelines described in the chapters.

- Paul Hardcastle (DEADP WC): We need to understand the extent of the exclusion areas and where they are on a map and how they relate to one another.
  - Bob Scholes (Wits): Essentially 35% of the area is an exclusion set, excluding Protected Areas. An additional 20% may very well be avoided due to the restrictive conditions under which development would be required to occur.
- Henk Coetzee (CGS): It needs to be explicitly stated as to how mitigation reduces consequences and, more importantly, the assumptions these mitigated risks are based on.
  - Greg Schreiner (CSIR): A screening tool being developed by DEA can be used by the public. We committed to using sensitivity maps which are used to generate risk maps and make them available for the DEA screening tool (due for March 2017). These layers will be fed into this tool so that it can be publically accessible.
  - Dee Fischer (DEA): This will make the information "live". It is a different way of screening for developments in sensitive areas going forward. It would be possible to consider making exclusion zones in areas of high sensitivity/ high risk, as this part of the Terms of Reference for the SEA.
- Henk Coetzee (CGS): Is there any way of managing map scales? Such as finer scales to identify smaller scale features, to avoid the danger that mapping at a regional scale may be too broad a scale for certain sensitivities such as groundwater.
  - Bob Scholes (Wits): Each strategic issue was mapped at the finest scale available/ possible. Different databases will have variable resolution, but it is advisable to utilise the finest resolution possible.
  - Dee Fischer (DEA): The screening tool is merely a flag and a site assessment and site visit must still be done for verification purposes. Each sensitivity class is tied to a protocol which will provide information as to what is required, for example, what kind of assessment is required, what kind of fieldwork is necessary? Such protocols are an ideal output of Phase 3. It would be ideal to include data that is being regularly obtained, for example in the Western Cape data is obtained at a fine scale and this can be implemented

into the screening tool. Information needs to be able to be regularly updated (e.g. every 5 years).

- Greg Schreiner (CSIR): A recommendation received for the Biodiversity and ecological impacts chapter is to not permit development in very high sensitivity areas. At this scale, would such a recommendation be appropriate, keeping in mind that incorrect information must not be gazetted?
    - Jeffrey Manuel (SANBI): Yes, especially given landscape level planning. This approach was followed more so for Biodiversity than for other chapters, since the Karoo is mostly homogeneous. It will depend on what the area recommended for exclusion entails in terms of the other strategic issues as well.
    - Paul Hardcastle (DEADP WC): At the landscape level, we can already determine no-go areas but we must be prepared that this can change and it should be ground-truthed.
    - Dee Fischer (DEA): Caution should be given against broad no-go area recommendations, since these will remain as only recommendations, i.e. actions need to be tied to outcomes. We need to emphasise that finer scale work must be done as a second phase to the recommendations, with the intended purpose to gazette those recommendations.
- Bob Scholes (Wits): Care should be taken to avoid unintended consequences. There are circumstances in which one may prohibit development but we need to be very thoughtful about exclusion areas. For example, prohibiting the development of a short road due to high sensitivity and constructing a much longer road somewhere else could cause far more damage than the shorter road would have.
- Paul Hardcastle (DEADP WC): It is important to look at cumulative sensitivities. We need to be careful of the policy decisions that will stem from the risk assessments and the identification of no-go areas with and without mitigation.
- Henk Coetzee (CGS): The delineation of no-go areas must be surveyable and the method/ reasoning behind the decision must be explicitly well defined.
- Greg Schreiner (CSIR): An action to be taken involving the creation of a composite risk map across the scenarios, with and without mitigation.

Scientific assessment findings- comments and questions

<u>Chapter 2- Energy Planning</u>

- Henk Coetzee (CGS): The chapter does show that energy planning for gas is being undertaken regardless of whether shale gas materialises, but SGD is an input in that energy planning.
    - Bob Scholes (Wits): There is no major planning change or policy with regards to SGD.
    - Greg Schreiner (CSIR): The Department of Energy (DoE) need to publish the Gas Utilisation Master Plan (GUMP) so it can guide gas infrastructure development in South Africa which currently operates in a paucity of policy.

<u>Chapter 3- Air Quality</u>

- Paul Hardcastle (DEADP WC): Air quality may not be suitable for spatial mapping, but there may be setbacks for this strategic issue.
    - Greg Schreiner (CSIR): Mapping is possible for Air Quality, particularly where there are 10 km buffers around towns, but Greenhouse Gas Emissions cannot be mapped since it is a global risk.

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Chapter 5- Surface – and Groundwater

- Paul Hardcastle (DEADP WC): Surface spills are more noticeable in the short term/ immediately, while groundwater contamination is not immediately identifiable.
    - Greg Schreiner (CSIR): The majority of groundwater contamination is by surface spills, based on currently available data.
    - Henk Coetzee (CGS): Surface spills can be identified immediately and they are relatively easy to mitigate.

Chapter 6- Waster Planning

- Paul Hardcastle (DEADP WC): Waste management is a cumulative concern.
- Bob Scholes (Wits): A specific recommendation revolves around the type of waste produced by SGD, and we need to determine the type of waste since it may be possible to dispose of non-hazardous waste at existing municipal works. Currently there are no hazardous waste facilities in the Central Karoo.
    - Dee Fischer (DEA): If this is the only recommendation then this is a very weak chapter. It shouldn't have been about disposal but rather about treatment. Liquid waste is not supposed to go to disposal sites. There needs to be more depth to this chapter. With minimum requirements this could have been a pertinent input. In needs to move further from these recommendations; there could have been powerful policy statements.
- Paul Hardcastle (DEADP WC): How does one reduce the risk of transport pollution and on site treatment? It should be indicated how different risk profiles change based on different potential scenarios.
    - Greg Schreiner (CSIR): The report has indicated five ways to treat waste from SGD based on best practise. The decision support framework can be crafted based on their (the authors) recommendations.

Chapter 8- Impacts on Agriculture

- Mpume Ntlokwana (DAFF): SGD is a competitive land use and involves the movement of vehicles which could impact agriculture.
    - Somila Xosa (DST): It should be indicated (in presentations) that SGD and agriculture are not mutually exclusive. The report should be explicit about how land use will be changed and people may be displaced.
    - Greg Schreiner (CSIR): It isn't a competitive land use as it will have a small footprint. Also, if the water is not contaminated, SGD can co-occur with agriculture. SGD may provide infrastructure which is much needed for agriculture, in this area specifically. It speaks to the coexistence of the land uses, if water contamination is mitigated along with other mitigation requirements.
- Paul Hardcastle (DEADP WC): Provided comment on the socio-economic impacts of shale gas on agriculture. There is a fine balance of farmers and workers in the Karoo. Farm workers with specialised knowledge may be lost by those leaving the agriculture sector for "easier" money by SGD. This displacement is concerning.
    - Bob Scholes (Wits): This issue is described in other chapters as well. Even though this may be the case, there is little that can be done to avoid this. The actual number of jobs for unskilled workers is from the agricultural sector is low.

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Chapter 10- Impacts on the Economy

- Bob Scholes (Wits): The policy importance of this chapter is the fact that different economies are similar, which means we need to explore trade-off policies.
- Paul Hardcastle (DEADP WC): Was there much criticism about the job numbers provided, as these differ from previous estimates? How does one deal with revenue streams which have policy implications?
  - Greg Schreiner (CSIR): There was not much criticism on this issue to his knowledge, there very constructive and insightful comments and debate with stakeholders and peer reviewers. Remember, only direct employment is estimated in the assessment. Other assessments, such as those undertaken by Econometrix assume a number of downstream multipliers
  - Bob Scholes (Wits): The Economics chapter does indicate how the benefits from SGD would be realised/ spread.

Chapter 12- Human Health

- Dee Fischer (DEA): For baseline monitoring- do people give permission to be tested? This is a very large requirement for an applicant. What would need to be tested for and is it a reasonable suggestion?
  - Greg Schreiner (CSIR): This needs to be dealt with through the vectors which impact human health e.g. water and air.
  - Bob Scholes (Wits): This is not an insurmountable recommendation, but this chapter suggests establishing a better method for monitoring than what the current health statistics provide, such as a sub-sampling approach which would require prior consent. It would not make sense to implement this on a 1-to-1 application basis. But, unless there is a baseline in place, there would be no way to determine any potential future issues. We need to find an ethical way to establish a baseline.
  - Henk Coetzee (CGS): There are protocols for testing, and it is difficult especially with notifiable diseases, but with more obscure or non-contagious public health problems it becomes more difficult. Monitoring should be done on a primary health care level and not on an individual basis. It should be made clear that monitoring is not mitigation.
- Somila Xosa (DST): There is unintentional messaging in the statement "people in the Karoo are less healthy because they are poor". Are people of the same economic profile elsewhere also less healthy? Does it necessarily mean that if someone is poor, they are less healthy?
  - Greg Schreiner (CSIR): One of the major reasons that people in the Central Karoo are less healthy than the national average is because they are poor and have limited access to adequate medical facilities.
  - Bob Scholes (Wits): The bold fact that people in this environment are below the national health status is true. Malnutrition, (lack of) access to healthcare, poorer water quality etc. contribute to this status in this area.

Chapter 13- Sense of Place Values

- Bob Scholes (Wits): This chapter essentially recommends that sense of place specialist studies be done as part of EIAs, but it is important to determine a standard by which these should be done. Sense of place research must be conducted to establish proper methodologies, and only then might it be considered a

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"specialist study" during an EIA. Theoretical guides need to be provided as to how to conduct such a sense of place study for an EIA. Often, globally, senses of place issues are the major resistance to development.

- Paul Hardcastle (DEADP WC): It would be even more beneficial to find a way to deal with sense of place in a strategic manner.
- Greg Schreiner (CSIR): Sense of place issues are generally included in visual and heritage specialist studies, so there is some tangible sense of place outputs at a broader level, considering all senses of place, but it is not as descriptive as an independent sense of place study.

<u>Chapter 17- Interference with SKA: Electromagnetic Interference (EMI) "noise"</u>

- Dee Fischer (DEA): Are there any requirements for the sensitivity classes since they will be needed for the protocols.
    - Greg Schreiner (CSIR): Classes will be required. Should the SKA area be regarded as a no-go area?
    - Dee Fischer (DEA): If development is proposed in the area indicated in red; then the applicant must approach SKA and they will determine the level of study that is required and the likelihood of receiving authorisation in this area is very low. But these classes are viewed as flags rather than no-go areas.
    - Bob Scholes (Wits): The red zone does not imply that all development is prohibited here, but the SKA has to determine if and where in this zone the development would be possible, and the level of detail of the studies required. The overall structure is essentially an experiment which has not been done before, so there is a level of uncertainty as to what the restrictions would be.
    - Somila Xosa (DST): Emphasises that no development should impact or compromise the SKA. Optical astronomy (SALT) is also a very important consideration for SGD, not only in terms of visual impacts but also in relation to seismicity.
    - Greg Schreiner (CSIR): The visual chapter has accommodated for this and provided a buffer around SALT of around 15km showing high sensitivity.

Decision Making Framework

The scientific assessment feeds into the decision support framework with the intended outputs being 1) sensitivity mapping for the DEA screening tool; 2) an exploration Environmental Management Programme (EMPr) framework, which is translated from the 17 strategic issues, outlining the key objectives for each of the strategic issues. It will also identify the primary risks and key management actions to mitigate those risks; what the key monitoring requirements are prior to exploration; what the LAC are related to those risks. 3) The Minimum Information Requirements (MIRs) which describes a process for Environmental Authorisation will be gazetted. A MIR draft is available and a workshop is planned for December 2016. 4) Recommendations to Cabinet, with a meeting planned with Cabinet in mid- 2017; and 5) Feasibility of using freight rail to offset traffic impacts (discussions to be had with Transnet).

A draft outline for the Decision Support Framework includes 1) Background to the SEA in terms of the process, governance, scenarios, participation etc.; 2) Shale gas exploration in South Africa which describes prospectivity, applications for Exploration Rights and timelines; 3) Activities and impacts associated with exploration; 4) Sensitivity of the receiving environment; 5) Composite exploration risk map including higher- and lower risk regions; 6) EMPr framework for exploration; 7) Best practice principles such as polluter pays, precautionary, financial provisioning and local beneficiation; 8) Institutional capacity considerations; 9) Augmentation of existing legal framework; and 10) The MIRs: A Process for Environmental Authorisation.

Questions and comments:

- Dee Fischer (DEA): Potential exclusion areas must be added to the decision support framework. Also, all recommendations need to be implementable with a responsible party indicated.
- Paul Hardcastle (DEADP WC): Need to be clear about the lessons learnt through the SEA, and how it can apply beyond SGD, to other types of development.
- Paul Hardcastle (DEADP WC): With regards to the draft outline of the Decision Support Framework; best practice principles should be moved to point 3) and should feed into/inform the activities and impacts associated with exploration.
- Bob Scholes (Wits): Many Departments will need to be involved in the workshop. What is the procedure to engage with them and how do we ensure it gets onto their agendas?
    - Dee Fischer (DEA): It must be very clearly stated as to what is expected from the Departments. These decision support aspects cannot be done independently, but has to be very specific points/actions that they (Departments) can actually perform. All the recommendations from the report need to be brought forward and packaged, and a discussion must be had as to the way forward ("park the recommendations").
    - Bob Scholes (Wits): Key actions need to be pulled out, and we need to identify who the lead departments are, what other players are needed, policy interaction points that exist or need to exist, and what Department it relates to. What process needs to be followed for something to reach fruition?
    - Dee Fischer (DEA): The PEC can indicate some of the recommendations they feel strongly about.
- Paul Hardcastle (DEADP WC): Will the workshop include only the PEC or will all the relevant stakeholders be notified?
    - Dee Fischer (DEA): The PEC can convene for a morning session and the broader stakeholder parties can meet in the afternoon.
    - Greg Schreiner (CSIR): The workshop in December should go broader than MIRs. The PEC will be invited and other broader players. Material will be circulated to the PEC prior to the workshop. The next PEC meeting is planned for mid-February, but the Project Team will interact with the PEC in December 2016 and January 2017.

4. *Key actions and way forward*

Key Actions	Responsible party	Timeframe
Share presentations, meeting notes, attendance register with the PEC.	Project Team	End Oct 2016
Create a composite risk map with and without mitigation	Project Team	End Oct 2016
Final Scientific Assessment Report publication (electronic)	Project Team	End Oct 2016
Final Scientific Assessment Report publication (hardcopy)	Project Team	Early 2017

Minimum Information Requirements Workshop	Project Team & PEC	06 Dec 2016
Draft decision support framework	Project Team	End Feb 2017
Final PEC Meeting #6	Project Team	End Feb 2017
Final decision support framework	Project Team	End March 2017

Other action items, as captured in the email from Simon Moganetsi on 04/11/2016 09:24 AM:

- CSIR to check if municipal rezoning is required for pilot wells (setting up of infrastructure)
- CSIR to have another workshop with DEA, DMR, DWS and PASA reps (authority that would give authorisation to the process)
- CSIR need to check with DWS if Water Catchment Management Agencies are mandated to issue water use licences
- DEA need to check with SANRAL who does the railway line planning (I will do this from my side [Simon])

2. ANNEX 2 PROCESS CUSTODIANS GROUP MEETING NOTES (INCL. ATTENDANCE)

2.1 Process Custodians Group Meeting 1 Notes (22 July 2015)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Process Custodians Group Meeting 1

Date:

22 July, 2015.

Location:

CSIR Pretoria.

List of attendees:

Name	Organisation
Bob Scholes	Wits/CSIR
Chantal Kisoon	SAHRC
Dee Fischer	DEA
Greg Schreiner	CSIR
Henk Coetzee	CGS
Jeanie le Roux	TKAG
Jeff Manuel	SANBI
Jessica Courtoreille	PetroSA
Luanita van der Walt	CSIR
Maarten De Wit	SEAON
Marius Diemont	BUSA
Morné du Plessis	WWF-SA
Mukandi Masithi	DPME
Nkhensani Golele	DPME
Patience Sehlapo	DEA
Paul Lochner	CSIR
Peter Price	ONPASA
Salaelo Matlhane	SKA
Sean O'Beirne (Chair)	IAIA-SA
Shafick Adams	WRC
Stefan Cramer	SAFCEI
Surprise Zwane	DEA

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Waymann Kritzinger	AgriSA	Sharlene.matthews@agrisa.co.za	042 235 1531

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List of acronyms

CER	Centre for Environmental Rights
CGS	Council for Geoscience
COGTA	Department of Cooperative Governance and Traditional Affairs
CRL	Culture, Religion, Language (Constitutional Body)
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DWS	Department of Water and Sanitation
EC	Eastern Cape
EIA	Environmental Impact Assessment
EWT	Endangered Wildlife Trust
IMC	Inter-Ministerial Committee
NC	Northern Cape
PASA	Petroleum Agency South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
SANBI	South African National Biodiversity Institute
SANEDI	South African National Energy Development Institute
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
TORs	Terms of Reference
WC	Western Cape

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1. *SEA overview and points of clarification*

- Presentation by Prof. Bob Scholes (Wits/CSIR)
- South African Cabinet has made decision to lift moratorium on the processing of shale gas Exploration Rights application, and exploration for shale gas will continue. Given this, DEA wants to determine a phased approach to shale gas development (SGD). DEA and the SEA process cannot deliver a 'yes – no' answer to SGD, but can only assess existing information towards creating an evidence-based regulatory framework, thereby informing the conditions under which SGD could occur, if the resource is proven to be a viable one. DEA envisages that the SGD process should occur in a step-wise (phased) manner where an action (i.e. exploration) is followed by a phase of consideration and analysis to determine if and how next SGD steps are taken, and monitoring is continually carried out before and during all development phases.

<u>Hydrocarbon resource considered in the SEA</u>

- Even though Coalbed Methane is also an unconventional gas, the SEA will only consider shale gas. That is the scope of the SEA which has been determined by the government issued Terms of Reference for the project.

<u>Target audience and users of the SEA</u>

- The main user of the SEA is the Government consortium who commissioned the study and who will use it for decision-making purposes. Other important audiences and users include the SEA governance groups, industry, NGOs, scientists as well as general stakeholders looking to engage with information on shale gas.

<u>SEA Process</u>

- The SEA aims to i) describe the activities associated with SGD and where it is likely to occur; ii) identify and assess the key risks and opportunities of SGD within those areas; and iii) based on the evidence available, make recommendations for monitoring, decision-making, best practice etc.
- It is crucial that the Project Team has a clear understanding of what SGD entails and how it might unfold in South Africa. Technical information on the activities associated with SGD should be delivered by industry representatives and other experts in the form of a Scenarios and Activities Document (which would form as an introductory Chapter in the SEA report).
- There were some uncertainties on the detailed SEA process from the PCG members, to assist in generating a higher level of clarity, a detailed '*Process Document*' has been included in the information distributed to the PCG.

2. *Project governance and PCG TORs*

- Presentation by Prof. Bob Scholes (Wits/CSIR).
- The broad mandate of the PCG is to verify that the SEA process is credible, legitimate, and salient – i.e. the PCG has the role of 'refereeing' or officiating an established, recognised process put before them.

- The attendees agreed to their broad functional role/TORs as members of the PCG. These are provided in final revised format in the attached *Process Document*.
- Participating as a member of the does not disqualify you from other forms of participation and recourse as required.
- The approach to PCG conventions aims to be broadly consensual (as opposed to consensus dependant) and minority views will be captured where there is an 'agree to disagree' situation.
- Recommendations, concerns and points of impasse within the PCG that cannot be acted upon by the Project Team at the PCG meetings are relayed to the PEC who will act accordingly within their mandate to instruct the Project Team as needed.
- The PEC was asked to nominate additional representatives to the group if required in order to achieve a broad interest base and balance in the group. The following recommendations were made.

Additional nominations to the PCG

Nomination	Made by	Response
Department of Agriculture (especially with regards to protection of high potential agricultural land)	Waymann Kritzinger (AgriSA)	Department of Agriculture Forestry and Fisheries (DAFF) has been nominated to the PEC.
Centre for Environmental Rights (CER)	Marius Diemont (BUSA)	CER declined informal invitation to act as a representative on the PCG, selecting to act as a 'third party' oversight role.
Emerging farmers, farm workers, farm dwellers. Representative body to be identified.	Stefan Cramer (SAFCEI)	Many of the other organisations and individuals on the PCG represent the interest of these people; however, if a specific community representative from a legitimate organisation can be identified this should be communicated to the Project Team.
Council for Traditional Leaders via National or Provincial Department of Cooperative Governance and Traditional Affairs (COGTA)	Mukandi Masithi (Presidency – DPME)	District and Local communities are represented through the South African Local Government Agency who sit on the PEC. The addition of another government department to the PCG would sway the balance of the group.
Other Constitutional Bodies (SAHRC only constitutional body) such as the Gender Commission and Culture, Religion, Language (CRL)	Chantal Kisoon (SAHRC)	It is the Project Teams position that Constitutional Bodies are adequately represented on the PCG by the SAHRC. It is not the intention to invite all of the South African Constitutional Bodies to the PCG, but to maintain a balance in the group.
Endangered Wildlife Trust (EWT) (PCG or other collaborative role like Specialist Team)	Jeanie Le Roux (TKAG)	Experts affiliated with EWT have already been identified to serve as Corresponding Authors on the actual SEA report.
CANSA-SA	Morné du Plessis (WFF-SA)	The Project Team have proposed that experts from this organisation will be better suited providing inputs to the report in the human health sections of the Water,

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		Air Emissions, Social Fabric etc. Chapters
Engineer with technical knowledge	Maarten de Wit (SAEON)	*Peter Price, already on the PCG, is an Engineer with direct experience in gas development*
South African National Energy Development Institute (SANEDI)	Shafick Adams (WRC)	DoE are represented on the PEC. SANEDI are undertaking a study on the feasibility of shale gas in South Africa. DEA part of the steering Committee for this study. There is therefore interaction between DEA and SANEDI on the shale gas development topic already, having them on the PCG could constitute a conflict of interest.

3. *Study area, Strategic Issues and Specialist Teams*

- Presentation by Greg Schreiner (CSIR)

<u>Study area</u>

- The extent of the study area was informed by the areas currently under applications for Explorations Rights (by the operators Shell, Bundu, Falcon). The official shapefiles from the Petroleum Agency of South Africa (PASA) delineating the existing Exploration Rights applications were used to define the study area (with a 20 km buffer around existing Exploration Rights application areas). The study area includes 27 local municipalities and encompasses 171 811 km².
- Additional stressors (such as proposed Uranium mining in the study area) will be acknowledged and considered in the SEA by the Specialist Teams if there are imminent development proposals on the table (the development proposals need to be more than a theoretical possibility, and must have received some kind of policy/government 'green light' e.g. the SKA or a development proposal which has received Environmental Authorisation. However, impacts associated with stressors other than SGD will not be assessed. These other stressors form part of the dynamic baseline of the Karoo where stressors such as climate change and land-use change are constantly driving changes, even in the absence of SGD.
- A materiality rule will be applied with regards to the potential of impacts originating within the study area, but having an effect beyond the boundary of the study area. If an impact of significance extends beyond the study area, it will have to be considered. An example is in the instance in the river-borne pollutants which may have downstream impacts beyond the delineation of the study area or the effects of GHGs on climate change (which has an international impact).

<u>Specialist Teams</u>

- The Project Team proposes having expert authors to serve on the Specialist Teams. The role of the PCG is to approve the author teams based on expertise and balance, and suggest other authors if necessary.

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4. *Discussion points*

Stakeholder engagement

- The mechanisms which exist for broad stakeholder engagement during the SEA process are outlined in the Process Document under the "Briefings and outreach rounds" section. These include (amongst others included in the Process Document):
  - Regional outreach (information sharing) meetings in the affected provinces (EC, WC, NC) to inform stakeholders of the SEA process (Round 1) and then findings (Round 2);
  - Stakeholder consultation and communication during the SEA process in through the website (http://seasgd.csir.co.za/). Registered stakeholders are also able to comment and provide input on SEA 'report chapters' through the website. Any person who has access to the website may ask questions about the process in an interactive blog. Queries are responded to by the Project Team;
  - Mechanisms will also be put in place to assist stakeholders who do not have internet access to be able to comment on the SEA 'report chapters';
  - Part of the sharing of information and receiving feedback will also be achieved through structures such as Provincial Government (to reach District and Local Municipalities), SALGA and the SEA governance structures.
- The SEA is not an EIA, and stakeholder engagement will not be approached in a traditional EIA sense where stakeholders are asked to raise their concerns and key issues. The SEA itself has gone through a process of identifying the key issues through mechanisms such as extensive literature studies.
- There are concerns from the PCG that the stakeholder consultation proposed for the SEA process is not sufficient and that some of the challenges will include:
  - Tensions in the Karoo around land, especially in smaller communities;
  - Access to information;
  - Opportunity to provide input into the SEA.

PCG Information sharing

- Information and discussions from PCG meetings is not confidential. As such, PCG members are free to report back to their constituencies, and share information with other stakeholders. However, there are exceptions where information might not be shared with the PCG – for example in the event that information such as the last known locality of a critically endangered species.

Human rights

- Human rights issues are anticipated to be an issue which cross-cuts many of the strategic issues assessed during the SEA. There were concerns from the PCG that human rights and a "human rights based approach" would not be sufficiently incorporated and addressed as the SEA has not isolated human rights as a "Strategic Issue", ie as a topic chapter by itself, with a dedicated team. The Project Team reiterated that human rights are a cross-cutting Strategic Issue which needs to be addresses in many of the issue topics such as economics, social

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fabric, rights to resources such as water, rights to a safe environment, access rights to ecosystem services etc, and they consider this to be a more appropriate approach. The Vision of the SEA was formulated by considering two key information sources, one of which was the National Development Plan 2012, the other was the South African Constitution, both of which have a strong rights basis.

SEA outputs and decision-making by Government

- Concerns were raised around SGD unfolding under auspices of Government, and that Government will make decisions without due consideration of evidence presented by the SEA. A decision was taken by Cabinet to undertake the SEA, which implies that many Ministries are involved and responsible for using the scientific evidence presented in a responsible manner. The Inter-Ministerial Committee (IMC) consists of many Departments (DEA, DWS, DMR, DoE, DST) which each have their own mandate; however there would not be a steamrolling of one Department's mandate over another.

5. *Key actions and way forward*

Action	Responsible party	Timeframe
1. Consider and evaluate nominees to the PCG to determine whether they are appropriate, will contribute to a balanced group, and available. Contained herein.	Project Team	04 Aug, 2015
2. Provide the PCG with a "Process Document" describing the detailed SEA Process, public consultation, the structure and purpose of the PCG and a timeline of meeting dates for PCG engagement.	Project Team	04 Aug, 2015
3. Provide Integrating and Contributing Specialist Authors' composition, information and *curriculum vitaes* to PCG members for review.	Project Team	End Aug/early Sep, 2015

2.2 Process Custodians Group Meeting 2 Notes (22 October 2015)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Process Custodians Group Meeting 2

Date:

22 October, 2015.

Location:

Knowledge Commons, CSIR Pretoria.

List of attendees:

Name	Organisation
Andrew Matjeke	Dept. Econ. Dev.
Angela Kariuki	SAHRC
Barry Morkel	AEON/NMMU
Bob Scholes	Wits/CSIR
Dee Fischer	DEA
Greg Schreiner	CSIR
Henri Fortuin (as observer)	Western Cape DEA&DP
Janet Love	SAHRC
Jeanie le Roux	TKAG
Thato Kgari	CGS
Kristal Maze	SANBI
Luanita van der Walt	CSIR
Muvhuso Musetsho	CGS
Marius Diemont	BUSA
Marlanie Moodley	DEA
Paul Hardcastle (as observer)	Western Cape DEA&DP
Paul Lochner (as facilitator)	CSIR
Peter Price	ONPASA
Portia Manuel	PetroSA
Selaelo Matlhane	SKA-SA
Wayman Kritzinger	AgriSA

Apologies received:
- Morne du Plessis (WWF)
- Sean O 'Beirne (PCG Chair)
- Shafick Adams (WRC)
- Stefan Cramer (SAFCEI)
- Jeff Manuel (SANBI)

Absent:
- Rudi Dicks (DPME)
- Intelligent Chauke (SALGA)

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List of acronyms

ASSAf	Academy of Science of South Africa
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DWS	Department of Water and Sanitation
GHG	Greenhouse gas
PCG	Process Custodians Group
PEC	Project Executive Committee
SALGA	South African Local Government Agency
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
ZOD	Zero Order Draft

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1. Introduction and adoption of PCG Meeting #1 notes

Actions from PCG Meeting #1 (22 July, 2015)

- Consider and evaluate additional PCG nominations: Project Team provided responses to the nominations in the meeting notes from 22 July. The PCG approved composition and balance of the group based on these responses from the project team.
- Process Document to explain the SEA process: A SEA Process Document was compiled and released to the PCG on 17 August
- List and *Curriculum Vitaes* and biosketches of Expert Authors: List released to PCG on 07 September for a 10-day comment period. The comments and response on the author team composition and balance is a discussion point of PCG Meeting #2 (see Section 3).

The PCG members approved the meeting notes from PCG Meeting #1.

2. Update on project status and progress

- Presentation by Greg Schreiner (CSIR) and Bob Scholes (Wits/CSIR)

Scenarios and Activities

- The SEA scenarios assume a SGD lifespan up to the year 2050. However, the expert authors will comment on mitigation required if a material risk is expected beyond that timeframe. This will account for potential latency of impacts (like in the example of acid mine drainage associated with gold mining). There aren't different scenarios for each potential future in relation to risks, as they will translate into too many risk assessments. The SEA is therefore considering three plausible main SGD scenarios, namely 1] exploration only, 2] small-scale production, and 3] large-scale production, which incorporates a broad range of impacts that could occur and at what scale they may occur. Each scenario also includes the decommissioning of wells. Existing information on local economic development planning and municipal development plans are being considered by, amongst others, the Economics-, Social Fabric-, and Land, Infrastructure and Settlement Development Author Teams.

3. Author team balance and composition

- Experts in the context of this SEA are not only highly qualified academics, but knowledgeable persons who are regarded by the community (social credibility) to have specialised expertise in a certain field (e.g. artists and farmers).

Discussion on comments and response report for author team balance

- A list of Authors, biographical sketches and CVs was presented to the PCG on 07 September. Comments were received from 07-17 September and the Project Team responded to the comments on 24 September in a document comments and responses report.
- The PCG agreed that 10 days was a sufficient amount of time for the members to provide responses.
- The author nominations and recommendations received from the PCG were put to the author teams to consider.

- Based on the consensual view in the PCG, Human Health has been added as a separate Strategic Issue to be considered by an expert Author Team.
- The PCG formally approved of the author teams based on composition and balance; and that the comments made by the PCG had been responded to by the project team in an adequate manner.

4. *Zero Order Draft (scope of study)*

- Presentation by Bob Scholes (Wits/CSIR)
- The Zero Order Draft (ZOD) is an expanded table of content that broadly delineates the SEA scope of study.
- The PCG, along with general stakeholders, have an opportunity to consider and comment on the ZOD until 20 November 2015. Comments will not be responded to individually but will be collated together with comments from the broader public and presented to the author teams.

Scope of work

- The SEA is considering the exploration (including exploration hydraulic fracturing), production and decommissioning (including potential legacy/post-decommissioning risks) of SGD. The spatial and temporal extent of the issues considered is determined extent to which a risk can still be considered material.

Agriculture

- High potential agricultural land must be considered.

Air Quality and Greenhouse Gasses

- Dust pollution will be considered by the Air Quality and Greenhouse Gas (GHG) Emissions Team.

Waste

- Radioactivity is mainly considered by the Waste Team looking at potential radioactive material in the produced water after drilling and hydraulic fracturing, and how this waste should be managed.

Land restitution

- Land restitution and tenure security effects on the various communities within the study area should be considered by the Agriculture- and Social Fabric Teams.

Land use

- The effect of shale gas development on the country's renewable energy programme needs to be considered.

Uranium mining

- The scope of the SEA focuses on SGD specifically, recognising a dynamic baseline scenario which includes competing land uses and change drivers (although uranium mining in the Karoo is only at this stage a theoretical possibility and not an actual activity contributing to a baseline risk scenario).

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Institutional capacity requirements

- Institutional considerations relating to coordination and competent authority capacity within Local, Provincial and National Government needs to be considered. A study on the institutional readiness of South Africa for shale gas development has been completed by The Academy of Science of South Africa (ASSAf) for DST. The ASSAf study has not been released into the public domain by DST.

Financial provisioning

- Many of the impacts and risks associated with SGD lie after decommissioning of wells - not just in relation to environmental impacts, but also around financial provisions funds for retired wells and the accountable and responsible parties for financial provisions of retired wells. This needs to be considered as part of the SEA. Comment from DEA: Under the 'One Environmental System' DEA is the policy writer for all environmental damage caused by mining activities, and has finalised financial provisioning which speaks to the requirements of i) annual rehabilitation and funds for rehabilitation, which motivates continuous rehabilitation where possible, and ii) consideration of latent negative environmental effects.

5. *Risk assessment process*

- Presentation by Bob Scholes (Wits/CSIR).
- The risk is considered as probability times consequence, and the risk assessment considers:
    - Low probability, high consequence events;
    - High probability, low consequence events;
    - In the presence and absence of best-practice mitigation and management;
    - Considers risk both spatially and across the different development scenarios.
  - A request was made for the approach to the risk assessment and how risks are being measured. This is contained within the SEA Process Document which is available within the PCG information repository and the project website for all to view.

6. *Public outreach: round 1*

- Presentation by Greg Schreiner (CSIR)
- Three public briefings in Graaff-Reinet, Beaufort West and Victoria West and once stakeholder workshop in Cape Town are scheduled in the week of 09-13 November 2015.
- These public outreach session have been advertised in provincial newspapers in the three provinces in the study area (Eastern Cape, Western Cape and Northern Cape) as well as in one national newspaper according to DEA. The three provinces and the South African Local Government Agency (SALGA) have also been asked to assist with distributing the public outreach schedule and the SEA Background Information Document (BID). The three provinces are also tasked with distributing information to the Local- and District Municipalities in the study area.
- Stakeholder registration and comment will be facilitated at the public briefings for people who do not have computers or internet access. Communications with these stakeholders will most likely occur via SMSs or post, to ensure as far as possible that no-one is excluded based on internet accessibility.

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7. *Feedback to PEC from the PCG*

- Proposal for provincial governments to facilitate the provision of transport for stakeholders from neighbouring communities to the public briefings.
- How to include the poor communities in the outreach programme?
- Communication of public outreach to municipalities?

8. *Key actions and way forward*

	Key Actions	Responsible party	Timeframe
1	Share presentations, meeting notes, attendance register with the PCG, updated spreadsheet of author teams for each strategic issue.	Project Team	04 November
2	Share draft "Chapter 1" (Scenarios and Activities Document) with the PCG.	Project Team	04 November
3	Distribute notices of the public outreach session to Local and District Municipalities.	Project Team	30 October
4	Distribute final public outreach itinerary to the PCG	Project Team	04 November
5	Provide feedback to the author teams on the importance of issues relating to: - High potential agricultural land - Air quality and dust emissions - Land restitution - Land use and the effect on renewable energy - Radioactive waste - Institution capacity considerations	Project Team will consolidate these comments into the comments on the ZOD which are presented to the author teams	Ongoing
6	Provide comments on the ZOD sent to the PCG on 13 October. Project team to collate comments and forward to author teams (including the comments made by the general public, via website). Comments will not be responded to individually	PCG and Project Team	13 October - 20 November 2015
7	PCG Meeting #3 following peer-review of the First Order Draft.		April/May 2016 (TBC)

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2.3 Process Custodians Group Meeting 3 Notes (03 May 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Process Custodians Group Meeting 3

Date:

03 May, 2016.

Location:

Demo Room, Building 22, CSIR Pretoria.

List of attendees:

Name	Organisation
Andrew Matjeke	Econ. Dev. Dept.
Bob Scholes	Wits/CSIR
Bongani Sayidini	PetroSA
David Fig	Project 90x2030 & others
Dee Fischer	DEA
Greg Schreiner	CSIR
Julius Kleynhans	TKAG
Kristal Maze	SANBI
Megan de Jager	CSIR
Nada Kakaza	SAHRC
Paul Lochner	CSIR
Peter Price	ONPASA
Rudi Dicks	DPME
Sean O'Beirne	IAIA-SA
Selaelo Matlhane	SKA-SA
Stefan Cramer	SAFCEI
Thato Kgari	CGS
Viswanath Vadapalli	CGS
Wayman Kritzinger	AgriSA

Apologies received:
- Shafick Adams (WRC)
- Barry Morkel (AEON)
- Morne du Plessis (WWF)

Absent:
- Intelligent Chauke (SALGA)
- Jeff Manuel (SANBI)
- Demetre Labadarios (HSRC)
- Marius Diemont (BUSA)

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Contents

List of acronyms

ASSAf	Academy of Science of South Africa
BW	Beaufort West
CSIR	Council for Scientific and Industrial Research
CT	Cape Town
DEA	Department of Environmental Affairs
DPME	Department of Mineral and Energy
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMI	Electromagnetic Interference
FOD	First Order Draft
GFR	Graaff-Reinet
GTL	Gas-to-Liquid
IAIAsa	International Association for Impact Assessment South Africa
NORM	Naturally Occurring Radioactive Material
PCG	Process Custodians Group
PEC	Project Executive Committee
SALGA	South African Local Government Agency
SANS	South African National Standards
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SKA	Square Kilometre Array
USA	United States of America
VW	Victoria West
Wits	University of the Witwatersrand
ZOD	Zero Order Draft

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1. Introduction and adoption of PCG Meeting #2 notes

Actions from PCG Meeting #2 (22 October, 2015)

Action	Status
1. Share presentations, meeting notes, attendance register with the PCG, update spreadsheet of author teams for each strategic issue.	This action was completed via Dropbox on 04 November 2015.
2. Share draft "Chapter 1" (Scenarios and Activities Document) with the PCG.	This action was completed via Dropbox on 04 November 2015.
3. Distribute notices of the public outreach session to Local and District Municipalities.	Notices were distributed on 30 November 2015.
4. Distribute final public outreach itinerary to the PCG	This action was completed on 04 November 2015.
5. Provide feedback to the author teams on the importance of issues relating to high potential agricultural land, air quality and dust emissions, land restitution, land use and the effect on renewable energy, radioactive waste and institution capacity considerations.	Comments on the importance of these issues were consolidated into the comments on the ZOD and presented to the author teams on 30 November 2015.
6. Provide comments on the ZOD sent to the PCG on 13 October. Project team to collate comments and forward to author teams (including the comments made by the general public, via website). Comments will not be responded to individually.	Comments on the ZOD by the PCG and general public were presented to the author teams on 30 November 2015.
7. PCG Meeting #3 following peer-review of the First Order Drafts.	Peer Review of the FOD's began on 22 February, and the comments were shared with the author teams prior to the 2nd Multi-Author Workshop on 18-20 April 2016. PCG meeting #3 was held on 03 May

The PCG members approved the meeting notes from PCG Meeting #2.

2. Update on project status and progress

- Presentation by Greg Schreiner (CSIR)
- With reference to the presented timeline for the entire SEA, it was indicated that the project is now in Phase 2 which is the Scientific Assessment Phase. The FOD's of the strategic issues chapters have been peer reviewed, and these comments have been addressed by the author teams who are in the process of drafting the Second Order Drafts (SOD's). The SOD's are to be submitted by the author teams by 31 May 2016, after which they will be released for public comment. Thereafter a Final Assessment Report will be finalised, which marks the end of Phase 2 of the project. This Final Assessment Report will provide the information basis for Phase 3.

Outreach feedback and programme

- Three public briefings took place in Graaff- Reinet, Beaufort West and Victoria West on 10-12 November, and one full day stakeholder workshop was held in Cape Town at the Iziko Museum on 13 November.

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These locations were chosen to represent the three provinces of the study area based on accessibility and relatively large population sizes.

- People were able to register as stakeholders by filling in a form at the public briefings, which were incorporated into the SEA registered stakeholder database, which currently comprises ~450 registered stakeholders.
- Common concerns which arose at the public briefings included 1] a need for greater municipal and ward involvement in the public briefings, 2] governance/ policing (of regulations) issues, should shale gas development (SGD) be permitted to take place, and 3] the 17 strategic issues of the SEA and ensuring that all sensitive topics have been considered.
- Key learnings from the first round of public briefings, with particular reference to the first concern noted previously, resulted in the distribution of letters from the Minister of Environmental Affairs to the offices of the affected local municipalities, notifying them of the next round of public briefings to take place in May. In the letters the Minister requested the local municipalities to distribute notice of the public briefings (dates and times) through the Local Government structures, namely through Ward Councillors to encourage and promote attendance at the briefings.
- Additional key learning: pre-meetings with municipalities.
- The project team communicated to the PCG that the SOD's of the strategic issues chapters will be released for public comment mid-June, with 4 weeks provided for commenting.

Questions:

- David Fig (Project 90 x 2030) queried whether the registered stakeholder database was openly available from the Shale Gas SEA website.
    - Greg Schreiner (CSIR) and Bob Scholes (Wits/CSIR) responded by stating that due to the Protection of Personal Information Act (2013), the CSIR is unable to share the information on the database as this would require permission from the stakeholders, but the CSIR would be able to provide metadata.
    - Greg Schreiner (CSIR) suggested a one page synopsis of metadata be provided to the PCG, which will include such information as the number of people from which provinces; and number and types of organisations.
    - The PCG members agreed to this suggestion.
- Wayman Kritzinger (AgriSA) asked whether the Ministerial letters were addressed to all the municipal managers in the SEA study area.
    - Greg Schreiner (CSIR) responded by noting that letters were addressed only to municipalities in which the meetings will/ or have taken place. In addition, SALGA have been given the responsibility of notifying the Local Municipalities of the public briefing details.
    - Wayman Kritzinger (AgriSA) raised concern that only a small portion of the provinces affected by the SEA will be represented at the meetings. He suggests contacting the District Municipalities in the affected provinces and requesting them to communicate the information to the Local Municipalities in their districts.
    - Sean O'Beirne (Chair/ IAIAsa) reiterated that the SEA public briefings are not to be likened to an Environmental Impact Assessment (EIA) public participation process, but the shale

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  - gas SEA public briefings are intended to reach a representative sample of people who are then able to transfer the information to other affected parties.
  - Sean O'Beirne (Chair/IAIAsa) thereby suggested contacting the District Municipalities for this purpose for next round of public outreach in July.
- Bongani Sayidini (PetroSA) asked what the expectation of the PCG is to attend the public briefings.
  - Greg Schreiner (CSIR) responded by stating that there is no expectation for PCG members to attend the briefings, and feedback will be provided to the PCG at the next PCG meeting as to the outcome of the public briefings. Greg requested PCG members to distribute notice of the briefings through the relevant channels.

<u>Scenarios and Activities SOD</u>

- The Scenarios and Activities SOD has been made available to the author teams for their assessments. The data on which the resource probability map is based provides the specialist teams with an area where SGD is most probable, but this is not definitive and further work still needs to be done. The Shale Gas Resource Probability map should not be published in isolation (without the 17 strategic issue chapters) to ensure the information conveyed therein is not misleading. The four scenarios are unpacked in great detail in the Scenarios and Activities Chapter, which provides a spatial indication of the footprint SGD, would potentially have. Peer Reviewers have assisted significantly with these calculations. The Chapter will be made available for public comment in June. The graphic representation of the potential footprint of the well pads is merely conceptual and the representations have not considered sensitive features or associated buffers.

Questions:

- Wayman Kritzinger (AgriSA) queried whether the economic trade-off between farming, with low profit margin over a longer time period, and SGD, with high profit margins over a relatively shorter time period, was considered in the Scenarios and Activities Chapter.
  - Bob Scholes (Wits/CSIR) responded by noting that the Scenarios and Activities Chapter does not constitute an assessment, but instead provides an input which the other chapters can use as a departure point for their assessments. The assessment is a separate step which is included in the specialist studies/ strategic issues chapters.

<u>Peer Review Process for FODs</u>

- Based on the accepted strategic issues presented in the ZOD, peer review experts were identified for each strategic issue from the extensive literature collection of the shared library, as well as through recommendations from stakeholders, the PEC, PCG and authors.
- Peer reviewers are independent from the assessment writing process, and represent universities, consultancies, government agencies and others. A minimum of 2 peer reviewers was required for each chapter, with more complex and double chapters (i.e. surface and groundwater resources) having up to 6 peer reviewers. The chapters were reviewed by 45 international and 26 South African experts, predominantly from the USA and Australia, and also from Canada, France, the Netherlands, UK and Japan.
- Peer reviewers were provided with the ZOD and FOD of the Scenarios and Activities chapter for context, and an allocated time, which was suitable to the SEA timeframe for the peer review process, was provided to the experts within which to submit their comments. Comments were provided in a

standardised template form, and additional reference materials were provided by some expert reviewers to the author teams. Author teams have responded to every comment and are in the process of incorporating the relevant comments into the SOD's.

- As a mandated item for PCG, the manner of author responses to the peer review and registered stakeholder comments must be checked by the PCG.

3. Preliminary feedback on Chapter First Order Drafts (FODs)

- Presentation by Bob Scholes (Wits/CSIR)
- Each chapter follows a particular structure which includes an Executive Summary; Introduction and Scope; Key potential impacts and their Mitigation; Risk Assessment; Best Practice Guidelines and Monitoring Requirements; Topic on which information is inadequate for decision- making; and References.
- The Risk Assessment follows a well- structured risk evaluation process, which involves defining the nature of the impact, mapping the receiving environments, defining mitigation technologies and consequence levels for each type of impact for each scenario. Each chapter provides spatially explicit risk maps which identify key issues that need to be addressed in terms of guidelines and regulations. The project team will use the risk assessment information to produce a risk surface for each type of impact, and subsequently a composite risk map will be created with reference to mitigation and another risk map without mitigation.
- Author teams are asked to consider what the implications are with respect to monitoring to end of activity, and in some cases beyond end of activity.

Questions:

- Rudi Dicks (DPME) questioned the inclusion of the "recent" report by the Academy of Science of South Africa (ASSAf) in the Scientific Assessment, and noted that the availability of the report for the Scientific Assessment is important.
    - Bob Scholes (Wits/CSIR) responded by reiterating that this Scientific Assessment did not conduct new research, and as such the ASSAf report is a key piece of information that the authors have not been able to access. Since all the strategic issues chapters raise concerns of legislative readiness for SGD, the ASSAf report would prove useful in the Assessment; should it become available prior to the due date for submission of the SODs. It may be problematic if the ASSAf report is presented as new material to stakeholders subsequent to the release of the SODs.
    - Greg Schreiner (CSIR) noted that the Project Team have been trying since mid-2015 to obtain the ASSAf report, and does not see it being resolved in next weeks.
    - Rudi Dicks (DPME) informed the PCG that it was agreed in cluster to make the ASSAf report available to the Project Team so that it may form part of the Scientific Assessment. Rudi suggested arranging the partial release of the report (limited sections) to the Project Team, as sections of the report are confidential.
- David Fig (Project 90x2030) queried whether Governance could be added as an independent strategic issue.
    - Bob Scholes (Wits/CSIR) responded by emphasising that each chapter is required to address the issue of governance, and therefore a standalone chapter focusing on

governance would be a duplication of what is already laid out in the other strategic issues chapters.

- Stefan Cramer (SAFCEI) questioned how new science and information can be incorporated into the process.
    - Bob Scholes (Wits/CSIR) responded by highlighting that this is a common concern among assessments of this nature. Similarly to the Intergovernmental Panel on Climate Change, an agreed date is decided upon (deadline) which is the limit to which new information can be incorporated into the assessment. If a sufficient set of new information is found to be significant and which brings the initial assessment into question, the Project Team will consider it incorporation into the assessment if it is presented within the Scientific Assessment timeframes.
- Sean O'Beirne (Chair/IAIAsa) posed the question as to how the DEA will address new findings once the SEA has been completed.
    - Dee Fischer (DEA) responded by stating that Government will utilise the Scientific Assessment, the 3rd phase of SEA and the ASSAf report. The findings of the ASSAf reports will not have a significant impact on the SEA up to this point, as the critical outcomes of the SEA e.g. baseline studies, guidelines for subsequent assessments etc., are what are important. The SEA will take on different forms in the future, but it is intended as a pre-fracking/ pre-shale gas assessment to determine how best to ask questions of policy and management. Using the SEA as a point of departure, different assessments can be done in future on a needs basis which will incorporate new science, evidence, technologies etc.
- Andrew Matjeke (EDD) stated concern as to the practical implementation of governance and policy, and the prolonged time it takes to inform municipalities when new policies are ready for implementation. Andrew noted that it would be beneficial for departments to actively participate in the process as to allow new information to be used/ synthesised as it is received, in an effort to reduce the time it takes to determine and implement new policies etc.
- Sean O'Beirne (Chair/IAIAsa) queried whether the PCG will advocate guide the Phase 3 process?
    - Bob Scholes (Wits/CSIR) confirmed that Phase 3 of the SEA will involve close relations with the project team (CSIR, SANBI and CGS) and Government to discuss/ suggest best practice, monitoring guidelines, etc. based on the phase 2 Scientific Assessment findings.
    - Greg Schreiner (CSIR) further noted that the PEC includes an interministerial group, and as such Government is built into the process to allow for this.
- Selaelo Matlhane (SKA) questioned the ability to quantify information exchange between the different strategic issues chapters.
    - Bob Scholes (Wits/ CSIR) responded by noting that this ability varies between chapters, for example the Electromagnetic Interference (EMI) chapter involves physics based quantifications while the Sense of Place chapter is subjective. The authors have quantified as much information as possible i.e. location and lengths of roads etc., but cognisance must be given to the fact that the SEA does not replace an EIA which will provide greater details.
- Selaelo Matlhane (SKA) queried whether an EIA will be required for every site under application.

  - Bob Scholes (Wits/CSIR) confirmed that legislation remains unchanged, and if there is a triggered activity, an EIA will have to be conducted.
  - Sean O'Beirne (Chair/IAIAsa) reaffirmed that the SEA will provide the grounding for future EIAs which would be required for the various applicants.
- Sean O'Beirne (Chair/IAIAsa) questioned whether the PCG will only have access to the Phase 3 Decision Making Framework along with general stakeholders e.g. through government gazette processes.
  - Greg Schreiner (CSIR) confirmed this and stated that the PCG provide input through to end of Phase 2 of the Scientific Assessment.

4. *Feedback to PEC from the PCG*

- Proposal for district municipalities to facilitate the dissemination of public briefing notices.
- Obtain partial access to the ASSAf report for inclusion in SODs.

5. *Key actions and way forward*

	Key Actions	Responsible party	Timeframe
1	Share presentations, meeting notes, attendance register with the PCG.	Project Team	End-May
2	Share a one page synopsis of registered stakeholder database to PCG	Project Team	End-May APPENDIX A
3	Receive SODs and responses to peer reviews from author teams	Project Team	End-May
4	Distribute notices of the public outreach session to Local and District Municipalities.	Project Team	End-June
5	Distribute final public outreach itinerary to the PCG	Project Team	Mid-June
7	Release SODs to stakeholders for comment (and Share consolidated comments spreadsheet for each strategic issue).	Project Team	14 June
8	Provide comments to the author teams on the SOD's (Project team will collate all public/ stakeholder comments (including the comments made by the general public, via website). Comments will not be responded to individually)	PCG and Project Team	15 July
9	Public Outreach, Round 2 (GFR, BW, VW & CT)	Project Team	18-22 July
10	Multi-Author Team Workshop #3	Project Team	25-27 July
11	Final draft of Scientific Assessment due	Project Team	22 Aug
13	PCG Meeting #4 following peer-review of the Second Order Drafts.		26 Sept
14	Phase 2: Final Scientific Assessment	Project Team	Mid-Oct

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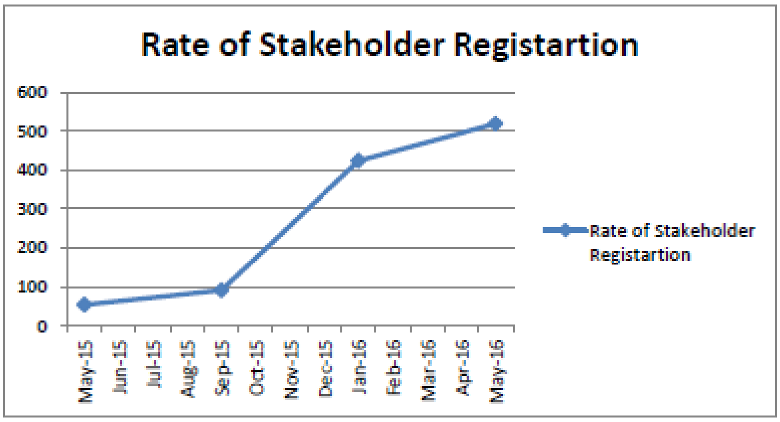
APPENDIX A: Demographics of registered stakeholders

Registered Stakeholders in numbers

The website of the Strategic Environmental Assessment was launched on 13 May 2015 after the parliamentary launch; from the date of the launch until end of June 2015 we received 53 online registrations. The period between 1 July and end 30 September a further 37 online registrations were received. During the period between 1 October -31 Jan 2016 there was a substantial increase in online registration, we received 333 registrations, this was mostly due to the first roadshows occurring during this time and a meeting registered stakeholders taking place in Cape Town. A total of 73 stakeholders have registered during the Public Briefings and they get notified via sms. The total number of the registered stakeholders on the database as of 27 May 2016 is 518.



Registered Stakeholders locality

The registered stakeholders are based in various provinces around the country, namely Free State, Kwa-Zulu Natal, Gauteng, Eastern Cape, North West and Western Cape, most of them being based in the Western Cape. A number of online registrations have not indicated their province and cities therefore they have not been accounted for in the diagram below. In the Eastern Cape most of the stakeholders are based in Graff-Reinett and Port Elizabeth, in the Free State the majority is in Bloemfontein, in Gauteng there is an equal share between Pretoria and Johannesburg, KwaZulu Natal has the majority of stakeholders based in Durban and a few in Pietermaritzburg. Victoria West has most of the stakeholders in Northern Cape, and Western Cape is shared between Beaufort West and Cape Town.

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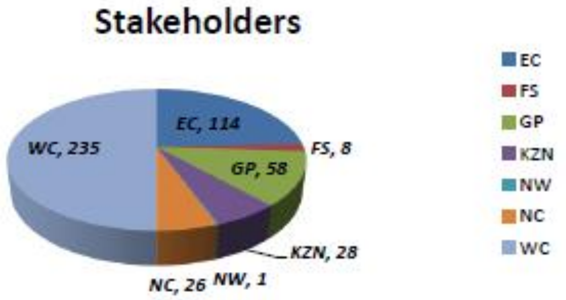
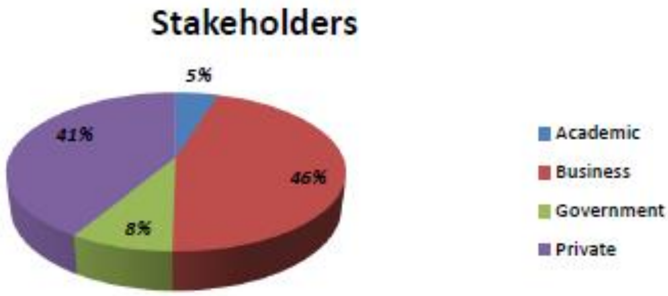


Interest Category of Stakeholders

The interest of stakeholders is divided into four categories; Business, Private/ Personal, Academic and Government. The percentage is of the stakeholders per category are shown in the graphic below.



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2.4 Process Custodians Group Meeting 4 Notes (26 September 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Strategic Environmental Assessment for Shale Gas Development in South Africa:

Process Custodians Group Meeting 4

Date:

26 September 2016.

Location:

CSIR Executive Boardroom, Building 3, CSIR Pretoria.

List of attendees:

Name	Organisation
Andrew Matjeke	Econ. Dev. Dept.
Bongani Sayidini	PetroSA
David Fig	Project 90x2030 & others
Dee Fischer	DEA
Demetre Labadarios	HSRC
Greg Schreiner	CSIR
Hendrik Kotze	Kerlipax
Henk Coetzee	CGS
Henri Fortuin	DEADP
Jeffrey Manuel	SANBI
Kristal Maze	SANBI
Luanita Snyman-Van der Walt	CSIR
Marius Diemont	BUSA
Megan de Jager	CSIR
Morné du Plessis	WWF-SA
Sean O'Beirne	IAIA-SA
Selaelo Matlhane	SKA-SA
Shafick Adams	WRC
Wayman Kritzinger	AgriSA

Apologies received:
- Bob Scholes (Wits)
- Jessica Courtoreille (PetroSA)
- Paul Lochner (CSIR)
- Peter Price (ONPASA)
- Rudi Dicks (DPME)
- Stefan Cramer (SAFCEI)
- Thato Kgari (CGS)
- Viswanath Vadapalli (CGS)

Absent:
- Angela Kariuki (SAHRC)
- Barry Morkel (AEON)
- Chantal Kissoon (SAHRC)
- Intelligent Chauke (SALGA)
- Janet Love (LRC)
- Julius Kleynhans (TKAG)
- Marlanie Moodley (DEA)
- Mukondi Masithi (CGS)
- Nada Kakaza (SAHRC)
- Nic Opperman (AgriSA)
- Selma Karuaihe (HSRC)

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Contents

List of acronyms

ASSAf	Academy of Science of South Africa
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DMR	Department of Mineral Resources
DPME	Department of Mineral and Energy
EDD	Economic Development Department
EIA	Environmental Impact Assessment
EMI	Electromagnetic Interference
FOD	First Order Draft
GFR	Graaff-Reinet
GTL	Gas-to-Liquid
IAIA-SA	International Association for Impact Assessment South Africa
NORM	Naturally Occurring Radioactive Material
PASA	Petroleum Agency of South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
SALGA	South African Local Government Agency
SANS	South African National Standards
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
SOD	Second Order Draft
SKA	Square Kilometre Array
USA	United States of America

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VW	Victoria West
Wits	University of the Witwatersrand
ZOD	Zero Order Draft

1. *Introduction and adoption of PCG Meeting #3 notes*

Actions from PCG Meeting #3 (27 May 2016)

Action	Status
1. Share presentations, meeting notes, attendance register with the PCG.	Completed.
2. Share a one page synopsis of registered stakeholder database to PCG.	Completed- Appendix A of PCG Meeting #3 notes.
3. Receive SODs and responses to peer reviews from author teams.	Completed.
4. Distribute notices of the public outreach session to Local and District Municipalities.	Completed.
5. Distribute final public outreach itinerary to the PCG.	Completed.
6. Release SODs to stakeholders for comment (and share consolidated comments spreadsheet for each strategic issue).	Completed 14 June – 22 July 2016.
7. Provide comments to the author teams on the SOD's (Project team will collate all public/ stakeholder comments (including the comments made by the general public, via website). Comments will be responded to individually*).	Completed 15 July 2016.
8. Public Outreach, Round 2 (GFR, BW, VW & CT)	Completed 18- 22 July 2016.
9. Multi-Author Team Workshop #3	Completed 25-27 July 2016.
10. Final draft of Scientific Assessment due	Completed.
11. PCG Meeting #4 following peer-review of the Second Order Drafts.	Peer review comments of SODs were shared with author teams prior to 3rd Multi-Author Workshop.
12. Phase 2: Final Scientific Assessment	Final scientific assessment report due to be electronically released by end October 2016 and hardcopies by end December 2016.

Corrections to PCG Meeting #3 notes:
*Corrected statement.
Apology for Jeffrey Manuel is noted.

Following corrections, the PCG members approved the meeting notes from PCG Meeting #3.

2. *Update on project status and progress*

Presentation by Greg Schreiner (CSIR)

Where are we now?

- With reference to the presented timeline for the entire SEA, it was indicated that the project is now almost at the conclusion of the Scientific Assessment Phase.

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- This conclusion will see the final Scientific Assessment Report, which will include all 18 strategic issues chapters, being electronically released November 2016, and hardcopies of the report are expected to be released by early 2017.

PCG Mandate

Throughout the scientific assessment process the PCG verified that the process was credible, legitimate and salient in that the process followed the prescribed guidelines; the author teams had the necessary expertise; the assessment covers the material issues; and the identified peer reviewers are independent, qualified and balanced. The final task of the PCG is to ensure that the review comments received from expert and stakeholder reviewers have been adequately addressed and documented.

Questions:

- David Fig (Project 90 x 2030): In what form is the PCG to check the comments and responses?
  - Greg Schreiner (CSIR): The comments and responses are available on the SEA website. PCG should consider comments and responses reports and cross check with chapters to see if the authors appropriately considered and responded to the peer reviewer and stakeholder comments. If the PCG feel the comments were not responded to adequately, they can indicate this directly to the project team.
- Morné du Plessis (WWF-SA): Is this final scientific assessment report not open for further comment?
  - Greg Schreiner (CSIR): The last round of peer reviewer and stakeholder comment was conducted in June- July and these were incorporated into the final report.

Scientific assessment timing

The scientific assessment process was conducted over a period of roughly one year, and involved multiple author meetings and review processes by the PCG, PEC, expert reviewers and stakeholders of the Zero Order Draft (ZOD, First Order Drafts (FODs) and Second Order Drafts (SODs). The scientific assessment process reaches completion at the end of October 2016, with the release of the final scientific assessment report.

Questions:

- Shafick Adams (WRC): Is there an opportunity for another outreach session to return to the study area to provide feedback on the final report? This will show buy-in by the Departments that commissioned the SEA and lessen the community's distrust. Inputs were received, and now an output is available- it's not about content; it's about goodwill. We need to let the public/ communities know that the process was achieved together, and so they can see how their inputs were incorporated.
  - Greg Schreiner (CSIR): This is a valid comment and good suggestion. It was encouraging to see how stakeholders reacted at outreach session 2 in response to the outreach sessions 1a and 1b. At outreach 2 there was a large degree of consensus which indicates the team has done will in reaching communities, receiving inputs and building trust. Essentially, outreach 2 achieved the purposes of a potential third outreach session.
  - Hendrik Kotze (Kerlipax): From a facilitator's perspective; outreach session 1a was to gather inputs, concerns and issues to be addressed. Additional issues/ concerns were received at outreach session 1b and confirmed the issues and concerns to be addressed

in the scientific assessment, which was then individually responded to. Outreach session 2 presented the SOD findings and showed how the authors addressed the concerns and comments. People are concerned about how the scientific assessment report links to the decision- making framework, and there may be value in reporting back to the community about the third phase of the assessment.

- Sean O'Beirne (IAIA-SA): Is it feasible, in terms of planning, budget, logistics etc. to conduct an additional/ final outreach session, with opportunity as the third phase of the SEA?
    - Greg Schreiner (CSIR): The suggestion will be taken on board and given significant consideration from a project management perspective and discussion will be undertaken with the PEC about this suggestion.
- Wayman Kritzinger (AgriSA): When will feedback be given to individual responses?
    - Greg Schreiner (CSIR): This will be released along with the final report.
- Sean O'Beirne (IAIA-SA): Are there additional public participation opportunities planned for phase 3, and who are the role players?
    - Greg Schreiner (CSIR): Public participation was planned largely around the scientific assessment process, and engagements from the scientific assessment phase feed into phase 3. The findings are taken to the (many) role players (DEA, DMR, PASA [Government] and PEC) in order to inform a decision-making framework.
- Morné du Plessis (WWF-SA): There may be a need for further public engagement in the decision-making process.
    - Greg Schreiner (CSIR): An opportunity may exist for another round of public participation, which would be focused around phase 3 (decision-making framework). This would be subject to agreement with the PEC.
- David Fig (Project 90 x 2030): Is there budget for launching the document? Can the Karoo be included in this planned release?
    - Greg Schreiner (CSIR): This is a good suggestion and there is a possibility to include the Karoo in the release and would allow the communities to see where their inputs have been implemented.
    - Shafick Adams (WRC): The document needs to be launched at a high profile level and it should create a sense of ownership.
- Kristal Maze (SANBI): What is the logic behind having the final PCG meeting prior to the launch of the final scientific assessment report?
    - Greg Schreiner (CSIR): 26 September was the date we had agreed to meet at the previous PCG meeting – there was no good reason not to honour this. There is no reason why the PCG mandate cannot be fulfilled remotely i.e. via email.
- Sean O'Beirne (IAIA-SA): With regards to the suggested additional outreach; it is unlikely that an additional outreach will occur as part of phase 2, but this may be considered as part of phase 3, as well as launching the report to create recognition around the community comments and as a means to acknowledge the role of stakeholders in the scientific assessment process.
- Hendrik Kotze (Kerlipax): As a facilitator of various processes, it is important to understand the change in atmosphere as this process progressed; from stress, anger and distrust during outreach 1a to outreach 1b

and 2, where people were thankful that the team had returned for further engagement and for the process, which they thought was effective and properly conducted, and that the outcome was useful.

- Bongani Sayidini (PetroSA): Is there any expectation for the PCG to endorse the final scientific assessment report?
    - Sean O'Beirne (IAIA-SA): There is no requirement to endorse the final technical content of the final report. The mandate was to oversee the process to ensure its legitimacy, as set-out within the process document.
    - Greg Schreiner (CSIR): The names or organisations of PCG members do not have to be affiliated with the content of the scientific assessment report. The mandate of the PCG is clearly defined in the Preface to the report. It is clear that it is a process, not content concerned group.

Public Outreach

A total of three rounds of public meetings were held during the scientific assessment phase, which took place in November 2015, and May and July 2016. Lessons learnt from the first public outreach included improving the distribution of the notice of the public meetings. Therefore, ministerial letters were sent to affected local municipalities requesting the local municipalities to distribute notice of the public briefings (dates and times) through the local government structures, namely through Ward Councillors to encourage and promote attendance at the briefings. Pre-meetings with municipalities also occurred, and in the last outreach of the scientific assessment phase, meetings were also held with the Laingsburg Farmers Association. A workshop was held in Cape Town for registered stakeholders as part of the first and last outreach session in May 2015 and July 2016, respectively.

The SODs were released for public comment on 14 June for a period of 38 days. Stakeholder registration increased progressively throughout the scientific assessment phase (May 2015- May 2016). The majority of stakeholders are from the Western Cape, with the Eastern Cape and Gauteng having the second and third largest stakeholder representation, respectively. Furthermore, the business sector represents the majority of registered stakeholders (46%), followed by the private sector (41%), while government represents 8% of registered stakeholders, and academia only 5%.

Questions:

- David Fig (Project 90 x 2030): Are notes on the public outreach sessions available?
    - Greg Schreiner (CSIR): The minutes are available for the first round, and will ensure the notes from the second round are made available from the project website.

Key dates going forward

The PCG mandate concludes at the end of Phase 2 (scientific assessment), with the final report due for electronic publication November 2016.

Phase 3 (decision-making framework) moves into the policy domain where the PEC operates (mandate), including a host of other institutions that need to make decisions in relation to shale gas development – this may or may not include further public engagement. Draft outputs for Phase 3 are expected end December 2016, and final outputs at the end of February 2017.

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Comments and Questions

- Morné du Plessis (WWF-SA): There was discomfort from the first PCG meeting that Phase 3 is disconnected from the PCG as it becomes a political process. It would be comforting if decisions in Phase 3 were made with the scientific assessment findings in mind, and some guidance (feedback) was given as to how the decisions are made and the outcomes of Phase 3.
    - Greg Schreiner (CSIR): The project team will inform the PEC of the PCG concerns and will discuss ways to ensure a transparent and credible process of decision-making at this phase.
    - Sean O'Beirne (IAIA-SA): Phase 3 is where the outcome of the SEA manifests, therefore it is essential to be able to determine whether due respect is given to the outcomes of the assessment.
- Shafick Adams (WRC): Concurs with Morné du Plessis' comment and questions as to how to convert science into policy, and the process to be followed to achieve this. The PCG should at least be kept in the loop, highlighting potential issues which may arise from Phase 3, especially since many PCG members risk brand image (e.g. WWF, WRC). Information should keep flowing between phase 2 and 3.
    - Greg Schreiner (CSIR): The PCG is not asked to endorse or tie their name to the scientific content of the final report have rather been custodians for the process used to derive information. Scientists function in the science domain which is then translated by policy makers to create policy.
- Sean O'Beirne (IAIA-SA): Poses a question to the PCG, given that this is the last meeting, as to how the PCG feel about their role in the process, how the process has been undertaken, and what can be taken forward and learnt to make it a constructive and positive process.
- Morné du Plessis (WWF-SA): Appreciates the outcome thus far and feels the process has fulfilled its role, but something that can be improved for future process is to provide more lead time for meetings. Advanced planning is required.
- Bongani Sayidini (PetroSA): A positive about the process is it created an environment whereby the PCG could contribute in terms of reviewing the content, but a shortcoming was that as a PCG member, he did not feel compelled to interact/ review the material, as there was no formal obligation/ expectation to review the material despite this being one of the governance groups responsibilities.
    - Sean O'Beirne (IAIA-SA): This was almost done by design to allow those persons sitting on the PCG to review the process and thus fulfil the role of the PCG, but not restrict them to interacting in another role as a stakeholder, where review of all material was a right as a stakeholder.
    - Greg Schreiner (CSIR): This provided the PCG members the opportunity to make content related comments, which is outside the ambit of the PCG.
- Wayman Kritzinger (AgriSA): The understanding from the beginning was that the PCG were to review the information provided during the process and provide recommendations to the PEC. How can the PCG accept a process that has not be concluded? How is this the final PCG meeting if the final report has not yet been released? It feels like there is no conclusion and no more time for inputs. In light of this, the PCG should have a summarised version of what the decision, since the PCG provided pertinent recommendations.
    - Greg Schreiner (CSIR): The PCG is not mandated to sign off or endorse the findings or content of the scientific assessment report, but to ensure the process was conducted effectively, as

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laid out in the process document; feedback of which is provided to the PEC. The scientific assessment report is a content report and does not need endorsement by the PCG. Should you have a content related issue with the way a comment has been addressed, or an issue has been captured, you have a right to take that up with the project team, authors of the chapters etc., but that is not a process related issue.

  - Sean O'Beirne (IAIA-SA): The understanding was that the PCG only review the process and provide recommendations for author teams and peer reviewers; and check that the running of that process was undertaken in a legitimate fashion.

- David Fig (Project 90 x 2030): Feels that there is a gap and he is uncomfortable about the content, but he is aware that the content concerns stray from the PCG mandate. Have the PCG missed the opportunity to ensure the content is sufficient? Where in the process has there been room for discussion on the governance issues? What would be expected to be good recommendations to government in terms of how SGD should be governed?
  - Greg Schreiner (CSIR): Governance as a topic has been addressed in each chapter where it was raised as an issue, and recommendations have been made in the report for effective monitoring for example. Recommendations have also been around the capacity of the decision-making and enforcing bodies/ institutions. These recommendations may be taken forward in Phase 3 if this is something Government requires. Whatever emerges from the political domain (Phase 3) will have to be in line with what has been recommended in the scientific assessment report (Phase 2), as it is available in the public domain. Having the report in the public domain is powerful in itself since government will have to prove how it considered the evidence base.
  - Sean O'Beirne (IAIA-SA): Confirms that the overarching concern is how the information will be implemented into policy-making recommendations.
- Shafick Adams (WRC): To protect the PCG constituencies a disclaimer must be added to protect brands and reputation, which stipulates for example that the PCG were only mandated to consider the process.
  - Sean O'Beirne (IAIA-SA): A particular concern and action to be taken is to review the process description and ensure it is very explicit regarding the role the PCG has played and what their mandate has been, including the five tasks (as described in the Preface of the scientific assessment report).
- Dee Fischer (DEA): Where would the PCG mandate best fit? It does not fit in the scientific assessment report, but rather in other SEA documentation. More discussion is needed around this issue.
  - Shafick Adams (WRC): The disclaimer needs to be in the report, and is of no use in the minutes for example.
- Henk Coetzee (CGS): The PCG forms part of the scientific assessment process and what happens after this phase is out of their control.
- Sean O'Beirne (IAIA-SA): Questions whether the authors/ scientists consented to packaging the science as it is and not be involved in Phase 3 of the SEA? Have they raised concern as to how Phase 2 will be considered in Phase 3?

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  - Greg Schreiner (CSIR): Overall the scientific community felt comfortable handing over the report, and approximately four of more than 70 authors indicated they would like to be kept close the Phase 3 process.
- Wayman Kritzinger (AgriSA): There is confusion regarding the function of the PCG. PCG are expected to look at the process and provide an opinion/ recommendation as to whether the process was conducted effectively, but they also considered the technical content. When the agricultural chapter was released, AgriSA felt that the chapter was badly written, despite the recommendations made to authors and reviewers. The flaws of not getting the right people to write the chapter were evident. Now this chapter must be signed off without knowing if the chapter has implemented the comments and has been improved.
  - Sean O'Beirne (IAIA-SA): This is outside the PCG mandate, and is something that needs to be taken up as a stakeholder (as AgriSA) with the project management.
  - Hendrik Kotze (Kerlipax): This falls under Task 5 (check review comments received have been adequately addressed and documented) of the PCG mandate and if it is unclear how chapters have been improved/ incorporated comments, then it will be difficult to make a statement on task 5 as the final report with comments and responses report.
  - Jeffrey Manuel (SANBI): Assumed that the PCG role is to check that the comments received have been addressed adequately, and not to check the content or validity. Also to check that the author teams have responded and/ or implemented the comments. Need to clarify separation between content and project oversight.
- Sean O'Beirne (IAIA-SA): What is the final expectation from the PCG?
  - Greg Schreiner (CSIR): The expectation is that once the draft final chapters are available, these will be circulated with the responses to stakeholder comments. The PCG will be notified to consider the final documents and provide a "no objection to process followed', but not a technical inquisition into the minutia of each comment/ response.
- Sean O'Beirne (IAIA-SA): Confirms that an expected action of the PCG is to consider the draft final report and comment and provide an opinion on whether comments were adequately addressed. Wayman Kritzinger's particular content related concern should be brought forward as a stakeholder (AgriSA), and not a PCG member.
- Morné du Plessis (WWF-SA): Does the PCG consider a draft and upon indicating no objection this becomes the final report?
  - Greg Schreiner (CSIR): The PCG will receive a draft final report and the comments and responses about a week prior to electronic publication. The final input from the PCG would not determine content, but only determines the validity of the process. Which would be decided by the group in consultation with the chair.
- Andrew Matjeke (EDD): Questions the use of the word "custodian" for this group and argues that it should have been Project Facilitator Group, because ownership is given to the process but not the outcome. To fulfil the role of checking comments, the PCG will need both the comments and the final document.
- Shafick Adams (WRC): What if issues are found after the final report has been published? What is the worst case scenario? For example, what if the PCG picks up a bias in responses to comments? The PCG

must have some responsibility, but it feels like simply ticking a box. The PCG should have sight of the document before it enters the public domain.

- Sean O'Beirne (IAIA-SA): The PCG needs to look at the comments and response report to see if it has been conducted in a credible, legitimate and transparent manner. If they find it has not, then the PCG need to decide how to take things further. What is the current availability of the spreadsheets?
  - Greg Schreiner (CSIR): An action will be taken to distribute the comments and responses to the PCG to consider as soon as possible. Approximately 95% of the spreadsheets are currently available.
- Henk Coetzee (CGS): The PCG need the relevant chapters to check whether comments have been addressed.
  - Greg Schreiner (CSIR): The project team still need to edit and consolidate the final chapters, so they are not available immediately; perhaps end-October.
- Sean O'Beirne (IAIA-SA): An action will be taken by the PCG Chair to run a process to capture whether the PCG members are satisfied that they have met each of the five PCG mandated tasks. The idea of a disclaimer is met with some discomfort, and it would be preferable to have a detailed description of the mandate.
- Dee Fischer (DEA): Thanked the PCG for their time. There will be opportunity to be involved in the next phase, perhaps not as a PCG member, but as individual organisations etc., to ensure the report is properly utilised.

3. *Feedback to PEC from the PCG*

- The Project Team will discuss PCG concerns regarding the manner in which the scientific assessment findings will be used during the decision-making process (Phase 3).

4. *Key actions and way forward*

	Key Actions	Responsible party	Timeframe
1	Share presentations, meeting notes, attendance register with the PCG.	Project Team	End Oct
2	Review the process description regarding the role the PCG and the PCG mandate, including the five tasks (as described in the Preface of the scientific assessment report).	PCG Chair and Project Team	Early-Nov
3	Distribute the comments and responses report to the PCG	Project Team	End Oct
4	Finalise Public Outreach meeting notes and make them available on the project website.	Project Team	End Oct
5	PCG to consider the draft final chapters and comments and provide an opinion on whether comments were adequately addressed	PCG	End Oct
6	Capture whether the PCG members are satisfied that they have met each of the five PCG mandated tasks	PCG Chair	End Oct
7	Final Scientific Assessment Report publication (electronic)	Project Team	Early-Nov
8	Final Scientific Assessment Report publication (hardcopy)	Project Team	End-Dec
9	Phase 3: Decision-Making Framework	Project Team	Nov 2016 - Feb 2017

3. ANNEX 3 STAKEHOLDER OUTREACH MEETING NOTES (INCL. ATTENDANCE)

3.1 Shale Gas SEA Public Outreach Round 1a Notes (09-13 November 2015)

Strategic Environmental Assessment for
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Shale Gas Strategic Environmental Assessment Public Outreach:
Key Issues Raised by Stakeholders

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List of acronyms

ACED	African Clean Energy Developments
AEON	Africa Earth Observatory Network
ANC	African National Congress
ANCWL	African National Congress Women's League
CER	Centre for Environmental Rights
CGS	Council for Geoscience
Cllr	Councillor
CSIR	Council for Scientific and Industrial Research
DA	Democratic Alliance
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
AQM	Air Quality Management
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DTK	Daan Toerien Konsultante
EIA	Environmental Impact Assessment
EMG	Environmental Monitoring Group
EMPr	Environmental Management Programme
I&AP	Interested & Affected Parties
IDP	Integrated Development Plan
IEC	Independent Electoral Commission
NEMA	National Environmental Management Act
NMMU	Nelson Mandela Metropolitan University
NORMS	Naturally Occurring Radioactive Materials
PASA	Petroleum Agency South Africa
PCG	Process Custodians Group
PEC	Project Executive Committee
PPP	Public Participation Process
SA	South Africa
SAAE	South African Academy of Engineering
SABC	South African Broadcasting Corporation
SAFCEI	Southern African Faith Communities' Environment Institute
SAHRC	South African Human Rights Commission
SAMWU	South African Municipal Workers' Union
SANBI	South African National Biodiversity Institute
SAOGA	South African Oil & Gas Alliance
SCLC	Southern Cape Land Committee
SDF	Spatial Development Framework
SEA	Strategic Environmental Assessment
Tcf	Trillion cubic feet
TKAG	Treasure Karoo Action Group
UCT	University of Cape Town
UFH	University of Fort Hare
WESSA	Wildlife and Environment Society of South Africa

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3.1.1 Graaff-Reinet Public Meeting Notes (09 November 2015)

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WITS University of the Witwatersrand

Graaff Reinet Public Meeting

Location	Venue	Date	Time	Attendance number
Graaff Reinet	Masizakhe Community Hall	09 November 2015	16:00- 19:00	~73

Attendance register

Name	Organisation
Andile Cetyiwe	-
Andile Dludla	CSIR
Angela Kariuki	SAHRC
B. van der Merwe	Ward 5 member
B.D. Kleinbooi	Ward 5 member
Barry Morkel	NMMU/ AEON
Bert Schade	Kriegershoek Nature Reserve
Bob Scholes	Wits/CSIR
Buhle Elie	-
C. Scheun	Die Burger Newspaper
Chris Julius	DEDEAT
Chris Marais	Karoo Space
Cynthia Kalipa-Mini	UFH Research
Dee Fischer	DEA
Denise Rews	Klipdrift
Derek Light	Attorney
Dorothy	Ward 5 member
Doug Stern	Agri East Cape
E. Buisman	Graaff Reinet Ratepayers
E. Rens	SCLC
Edmond Williams	Camdeboo Municipality
Elsie Williams	-
Ernest Mmonoa	SANBI
Fransie Fourie	Jansenville Agricultural Association
Gerry Pienaar	DEDEAT
Greg Schreiner	CSIR
Hauff-Cramer	SAFCEI
Hendrik Kotze	Peace Systems

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Henk Coetzee	CGS	
Ian Alleman	Nieu-Bethesda LTO	
Isaya Gxekwa	Coega Development Corporation	
Joley Jafitia	Ward 5/ Ward Committee	
Julienne du Toit	Karoo Space	
K. Rens	Southern Cape	
Khuthala Somdaka	Coega Development Corporation	
Krisjan Nomela	ANC	
L. Gqwetha	-	
L.M. Kuboni	-	
Leonie Fouche	Camdeboo Local Municipality	
Linda	Ward 5 member	
Luanita van der Walt	CSIR	
M. Bell	Ward 6 member	
M. Bell	ANC	
M. Loewe	Daily Dispatch	
M. Meishik	Camdeboo Municipality	
M. Ndoni	ANC	
Marika Rothenberger	Bread for the World (Germany)	
Martin	Ward 5 member	
Mavis Nqumashe	Ward Committee	
Mbuyi Nombembe	Shell SA Refining	
Megan de Jager	CSIR	
Morgan Griffiths	WESSA	
Mrs Laudheer	Kriegershoek Nature Reserve	
N. Grobler	Graaff Reinet Chamber of Commerce/ Graaff Reinet Tourism	
N.N. Ndudula	ANCWL Secretary	
P.T. Makhakhe	ANC	
P.W. Koeberg	ZR Trust	
Phakama Magadla	Coega Development Corporation	
Sandisiwe Ncemane	Coega Development Corporation	
Sivuyisile Solala	Coega Development Corporation	
Stefan Cramer	SAFCEI/ SEA PCG	
Stuart Giyose	-	
Sydney Tini	GRUSTA	
T. Eksteen	Cllr	

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environmental affairs · water & sanitation · science & technology · mineral resources · energy

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CSIR · SANBI · Council for Geoscience

T. Nkohla	SAMWU Chair	
Thema Jacobs	-	
Tom Mzivukile	ANC	
Vuyisile Booysen	Karoo Shale Gas Community Forum	
Xolani Jantjies	Communications	
Xolile Calado	ANC (Chairperson Ward 2)	
Yonela Kuboni	-	
Z.N. Hanabe	Eyethu Farmers Association	
Zenande Nombakuse	DEDEAT	
Ziphozakhe Williams	Coega Development Corporation	

Concerns Raised

Attendees raised the following concerns:

- Insufficient representation of the (potentially) affected communities at the meetings.
- Meetings were not properly or effectively advertised through the proper structures.
- Informing a few to communicate to the majority is not the correct path to follow.
- The voices of those employed elsewhere/ unable to attend the meeting for logistical reasons will be unheard.
- Suggestions/Recommendations for future meetings
- Increase the number of meetings to include other potentially affected areas.
- Follow proper communication routes and protocol prior to having the meetings, namely through local municipalities.
- Reconsider the time of meeting, with 16:00 ... ıking it later, ~17:30.
- Obtain assistance for future meetings if large a...
- Include Afrikaans and Xhosa for the informatio...
- Representatives should be present at future m... an be shared with those unable to attend the meeting.

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3.1.2 Victoria West Public Meeting Notes (10 November 2015)

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Meeting Notes

Victoria West Public Meeting

Location	Venue	Date	Time	Attendance number
Victoria West	Town Hall	10 November 2015	16:00- 19:00	~25

Attendance Register

Name	Organisation	Email	Telephone
Andile Dludla	CSIR		
Bob Scholes	Wits/CSIR		
Claude Vanqa	Shell SA		
Clive Kingwill	Farmer		
Contessa Kruger	USEOA		
Dee Fischer	DEA		
Ernest Mmonoa	SANBI		
Greg Schreiner	CSIR		
Hendrik Kotze	Peace Systems		
Henk Coetzee	CGS		
Herman Hugo	Farmer/ SKLU DLRC		
Ingrid Schofmann	Ubuntu socio-economic Forum		
J. Hamman	Farmer		
J. Olivier	Swalefontein Boerevereniging		
J.A. Bezuidenhoudt	Shell		
Jacques Scholtz	KVB Makelaars		
Lazarus Makwena	Socio Econ		
Lithan Biegst	-		
Louis Kruger	Socio Econ/ USEDA		
Luanita van der Walt	CSIR		
Megan de Jager	CSIR		
Mildred Mngeni	DMR		
Mpho Lepedi	Media		
Neliswa Chiloane	DMR		
Roger Conroy	DA Victoria West		
Schalk Nel	Moonlight Manor		
Sellwane Khakhau	SABC		
Spetho Eloff	Ubuntu Municipality		
Sven Anderson	Moonlight Manor		

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T. Olivier	Farmer	
Troumpie van Rensburg	Farmer	
Wilma Schutz	DA	
Xolani Malgas	Ubuntu Municipality	

Concerns Raised

Attendees raised the following concerns:

- Informing people of the meetings well in advance (>2 weeks).
- Queries on whether stakeholders would be able to aid in writing the chapters to improve relevance and whether municipalities could contact them in this regard.

Discussion on strategic issues

Governance

- Major concerns around the policing of regulations, and who will be responsible e.g. the government, science councils, exploration/production companies, interested stakeholders etc.
- Suggests a trust fund be established for policing and for rectification (where possible) of any problems that may arise in future (example given of Soekor well near Aberdeen where toxic substances created problems at some distance from the well only years later).
  - Dee Fischer responded in that independent environmental audits will be built into the Environmental Management Programmes (EMPrs), which will be available to the public, in addition to the government policing that will take place. Monitoring committees and stakeholders may therefore access the EMPrs though new Environmental Impact Assessment (EIA) regulations and can take legal action where they see necessary.
- Concerns were raised about the policing in the event of the company being liquidated during the process.
  - Dee Fischer responded in that new regulations provide for annual, life-cycle and latent effects, including matters of liquidation. There is an incentive for companies to do annual rehabilitation in order to lower their long term risk and to reduce insurance costs.
- Questions raised as to how farmers would be compensated if something transpires that renders the land unusable (e.g. water contamination), and whether this this will be included in the SEA.
  - Bob Scholes responded by assuring attendees that each chapter must look at the entirety of the issues through all phases of development, including post closure, as part of the risk assessment process.
- Attendees query the point at which the risk is too great for shale gas development to continue.

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   - Bob Scholes responded by referring to the scenarios and activities from which all chapters work from as a baseline, and states that this point may be determined using experience gained elsewhere in the world. Limits of acceptable change may also be used, which are set by national and international thresholds and expert opinion. The shale gas reserves are not concentrated over extensive distances, but occur in pockets, and if a pocket exists within close proximity to an important aquifer (for example), then recommendations would be made to avoid that portion of the gas reserve.
- Query as to whether the SEA will influence political decisions.
   - The project team is not responsible for political decisions by responded by saying that the SEA will influence how authorisations decisions are made on site specific EIA applications going forward for exploration and/or (in the future) production permits.

Water

- Attendees raised concern that no insurance company would insure borehole water against contamination from shale gas development.
- Attendees stressed the fact that the town of Victoria West is entirely dependent on borehole water.
- Issues concerning the migration of groundwater and linkages of surface and groundwater were raised.
   - Greg Schreiner responded by agreeing that surface and groundwater are linked, and therefore a single author team, consisting of experts in both ground- and surface water has been assembled and indicated that the best mechanisms for baseline and on-going water monitoring is an expected output from this assessment.
- Attendees suggest water analysis be undertaken before and after shale gas development, and urge that someone (company) should be responsible if contamination has occurred.

Spatial Planning and Infrastructure

- Concerns as to what extent people retain control over what happens underneath their property (underground resources). For example if a well pad is constructed on a neighbouring farm but is drilled horizontally under their own farm; who has jurisdiction?
- Further issues of land zoning and spatial planning and infrastructure were raised.
- Suggests that project team take cognizance of the fact that Integrated Development Plans (IDPs) are created by consultants who produce theoretical documents which are not representative of the community.
- Concerns regarding validity and credibility of available IDPs, since they are firstly not up to date and secondly, are not effectively implemented.
- Suggestion that authors of spatial planning chapter contact people in the respective towns to get IDPs.

- Greg Schreiner responded by informing attendees that the project involves the assessment of existing IDPs and Spatial Development Frameworks (SDFs) for existing information only, and for the spatial planning policy issues. New IDPs and SDFs will be not created during the assessment, but the assessment may be used to guide future IDP's and SDFs.

Human Health

- Concerns about chemicals used for fracking, and their carcinogenic properties.

Suggestions/Recommendations for future meetings

- Use of appropriate media should be considered to communicate meetings (e.g. local newspapers instead of regional/ provincial).

3.1.3 Beaufort West Public Meeting Notes (11 November 2015)

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Meeting Notes

Beaufort West Public Meeting

Location	Venue	Date	Time	Attendance number
Beaufort West	Rustdene Community Hall	11 November 2015	16:00- 19:00	~56

Attendance Register

Name	Organisation	Email	Telephone
A.M. Hendrickse	-		
Abongile Kata	-		
Andile Dludla	CSIR		
Andries le Roux	Laingsburg Landbouvereniging		
B.J. Tom	-		
Bathabile Dondolo	Beaufort West Provincial Traffic Department		
Bob Scholes	Wits/CSIR		
Bongiwe Ntebe	-		
Boy Hannies	-		
Buyani	-		
Charl Pienaar	Farmer		
Chorne Hermans	-		
Claude Vanqa	Shell SA		
Daan Toerien	DTK		
David Maans	Central Karoo District Municipality		
Debbie Anstey	Farmer		
Dee Fischer	DEA		
Dieter Van Der Merwe	Beaufort West Taxpayers Association		
Eluico Liniks	-		
Ernest Mmonoa	SANBI		
Francois van Niekerk	Die Courier (community newspaper)		
G. De Vos	Beaufort West Raad		
G.P Adolph	Beaufort West Municipality		
Gerrit Baily	-		
Greg Schreiner	CSIR		
Hendrik	SAMWU		
Hendrik Kotze	Peace Systems		
Henk Coetzee	CGS		
Henri Fortuin	DEADP		
J.A. Bezuidenhoudt	Shell		

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Jacob Lottering	-	
Kaylee	-	
Kenneth Ngqiqi	Cultural Forum	
Kenneth Pandle	-	
Khayalethu Madikizela	CGS	
L. Paulse	CLUEDA	
L. Tom	ANC	
Luanita van der Walt	CSIR	
Luncile Tom	ANC	
Luzuko Bana	-	
Luzuko Phillip	-	
M. Hangana	ANC	
M. Meyer	Radio Gamkaland	
Megan de Jager	CSIR	
Michael Anstey	Farmer	
Mike Verveen	-	
Mildred Mngeni	DMR	
Mongezi F. Pike	Central Karoo Development Forum	
Mzimandile Memziwe	-	
N. Mgubasi	-	
Ncebo Bango	-	
Neliswa Chiloane	DMR	
Oyama Mgesi	-	
Piet Van Wyk	Trakaskuilen (Pty) Ltd / Green Karoo	
Q. Louw	ANC	
Rozane Spogter	BADISA	
S. Kotela	ANC	
S.B. Jacobs	IEC/ Gateway	
Sias Reynolds	Agri Nelspoort	
Sivuyile	-	
T. Mangcoto	ANC	
Taronne Damon	BADISA	
Thato Kgari	CGS	
V.R.K. Vanapalli	CGS	
Wynand Vivier	Beaufort West District Landbou	

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Strategic Environmental Assessment for Shale Gas Development in South Africa
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Concerns Raised

Attendees raised the following concerns:

- Unsuitable meeting date due to prior commitments (meetings).
- Question on whether it is better for an association to register as a single entity or for each member of the association to register.
- Councillors responsible for engaging with community were absent and there was insufficient representation of the (potentially) affected communities at the meetings.
- Institutions comprising the project team should be responsible for communicating the meeting details, not the municipality.
- Representatives from local papers and radio, sport clubs/ associations and the education and health sector are not present at the meetings.

Suggestions/Recommendations for future meetings

- Liaise with farmers associations prior to setting meetings so it does not clash with other planned meetings.
- Use of appropriate media should be considered to communicate meetings, and advise not to rely heavily on social media and radio etc.
- Use district municipality as point of entry into the community.
- Wards should distribute flyers for future meetings.
- Meet with sectors first in order to identify the correct people to communicate with for distribution of meeting information.

3.1.4 Shale Gas SEA Workshop for Registered Stakeholders (13 November 2015)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Shale Gas SEA Workshop for Registered Stakeholders

Location	Venue	Date	Time	Attendance number
Cape Town	Iziko Museum	13 November 2015	10:30- 15:30	~57

Attendance Register

Amanda Hotata	DEADP	
Ambrose Carelse	DEADP: AQM	
Andile Dludla	CSIR	
Ann-Gail Watson	Friends of Iziko	
Aubrey Matsila	CSIR	
Bob Govender	Zwino Consulting	
Bob Scholes	Wits/CSIR	
Cheslin Elliott	DEADP	
Chris Dalgliesh	SRK Consulting	
Christine Reddell	CER	
Claude Vanqa	Shell SA	
Claudia Frazenburg	DEADP	
Cyril O'Connor	UCT	
Dee Fischer	DEA	
Derek Light	Attorney	
Eliya Madikane	CSIR Parliamentary Office	
Ernest Mmonoa	SANBI	
Ernst Baard	CapeNature	
Faseeg Salie	DEADP	
GhenEez Munian	Zwino Consulting	
Gladys Witle	-	
Goosain Isaacs	DEADP	
Greg Schreiner	CSIR	
Hassan Parker	DEADP	
Hendrik Kotze	Peace Systems	
Henk Coetzee	CGS	
Henri Fortuin	DEADP	
Janah Miller	Cullinan & Associates	
Jeanie le Roux	TKAG	
Jeff Jefferson	DEADP: Intelligence	
Jeff Manual	SANBI	

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John Wilson	DEADP	
Jolynn Minnaar	Unearthed	
Karam Singh	South African Human Rights Commission	
Karel Lewy-Phillips	Eco Environmental Services	
Karen de Bruyn	G7 Renewable Energies	
Karin Badenhorst	Footsteps Foundation	
Liza Petersen	DEADP	
Lize Jennings-Boom	Western Cape Government	
Luanita van der Walt	CSIR	
Marilyn Lilley	TKAG member	
Mary Waller	ACED	
Megan de Jager	CSIR	
Melanie Gosling	Cape Times	
Mike Davies	Kigoda Consulting	
Mike Shand	SAAE	
Nic Opperman	Agri SA	
Niell Fhrams	-	
Nigel Rossouw	Shell	
Paul de Ruyte	-	
Paul Hardcastle	DEADP	
Paul Lochner	CSIR	
Phillip Ravenscroft	Maluti GSM	
Richard Gordon	ACED	
Ronald Mukanya	DEADP	
S. Hrabak	SAOGA	
Saul Roux	CER	
Sibusiso Hlela	DEA	
Simon Botha	DEADP	
Stephen Law	EMG	
Vuyisile Zenani	Shell SA	
Waymann Kritzinger	Agri SA	
Wilbert L. Mathews	Mateus Petroleum LLC	
Zoë Palmer	Aurecon SA (Pty) Ltd	
Zolile Nqayi	DEA	

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Concerns Raised

Attendees raised the following concerns:

- Government decisions are being made regardless of the SEA process and potential outcome thereof.
- Confusion about the mandate of the CSIR in implementing the SEA process.
- What will be achieved at the end of the SEA?
- Communications with Petroleum Agency of South Africa (PASA) on the process and whether PASA is warranting licenses.
- Feedback on the public participation undertaken in study area.
- How does this SEA relate to other similar processes?
- Why was the meeting held in Cape Town and not Johannesburg since the study area map implies a national concern?
  - Greg Schreiner responded by noting that by far the majority of registered stakeholders at the time of organising the workshop were based in and around the Cape Town region.
  - Hendrik Kotze responded by noting that round two of the public participation process (PPP) will likely include a meeting in Johannesburg or Pretoria.
  - Bob Scholes responded by noting that the web based reviews implemented within the process allows for comment from everywhere. Furthermore, the web based registration of stakeholders and the first round of the PPP allows the project team to ascertain the regional extent of stakeholders.
- Query about whether the DEA published Terms of Reference and contract between DEA and CSIR were publically available documents.
  - Bob Scholes responded by informing the attendees that the SEA Process Document which outlines the nuts and bolts of the SEA process is available to all on the project website. This document best captures the SEA process which has been significantly refined and enhanced since the publication of the DEA Terms of Reference. .
- How are gaps in research dealt with during the SEA process?
  - Bob Scholes responded by stating that each chapter highlights where information is missing and whether is it considered imperative to the study. A key outcome of the process is to identify and recommend future research to close that information gap.
- Concerns as to how any overlaps in strategic issues are assessed.

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Discussion on strategic issues

Scenarios and Activities

- Concerns as to the fate of the coal industry and coal miners if, as indicated in the fourth scenario, 20tcf is discovered and shale gas development (and clean energy) replaces coal fired energy. Coal miners don't retro fit into shale gas development.
    - Bob Scholes responded by stating that coal resources are estimated to reach end of life between 2020-2030, and so shale gas development is not replacing new coal stations
- Attendees queried whether the cost of infrastructure is considered in the scenarios, for example the Gauteng Province have not invested properly for contaminated water.
    - Bob Scholes responded by indicating that it would be considered to an extent and perhaps it is best placed in each individual chapter, with particular reference to mitigation measures. Issue must be communicated to authors.

Terrestrial Biodiversity

- Will the risk assessment process consider population densities, particularly of people and (breeding) animals, as well as the relationship that exists between them?
    - Bob Scholes responded by stating that this consideration is subjective since such information does not currently exist in the literature. The assumptions made by the authors in their Chapters will be stated.
- Concerns as to the extent, in terms of time and space, to which the potential impacts will be investigated in the SEA.
    - Bob Scholes responded by assuring attendees that the impacts will be investigated as far as required from their point of origin e.g. greenhouse gas emissions is an international concern, energy pricing is a national concern, biodiversity for example might be more regional in its impacts .
- Best practices for restoration practices must be considered in the SEA?

Governance

- How will the SEA inform technical regulations of petroleum development?
    - Dee Fischer responds by emphasising that the development of regulations is an ongoing process which is under constant improvement. This process will augment those regulations if required.
- Concerns rose about extent of study area, and that marginalised areas are going unnoticed, particularly for those application areas in KwaZulu Natal.
    - Bob Scholes responded by explaining that the study area cannot be expanded at this point, but there is potential for this process to become the new norm and elude to the need for similar processes in such areas. The SEA findings will be able to inform other areas. The scope and the extent of the SEA is for dry gas from deep shale

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environmental affairs | water & sanitation | science & technology | mineral resources | energy

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CSIR SANBI Council for Geoscience

layers using hydraulic fracturing, this does not correspond with applications for exploration in the KZN Midlands which are for other minerals and exclude the proposal to undertake hydraulic fracturing.

- Why are certain areas excluded from the SEA?
    - Greg Schreiner responded by noting that the study area was delineated according to current exploration rights applications that have been submitted to PASA. Other technical cooperation areas were further back in the regulatory process and are not for dry gas from deep shale layers using hydraulic fracturing.
- Concern as to the identification of impacts specific to an area under consideration for fracking and how government will make decisions regarding such areas.
- Can a process be implemented through the SEA in which decisions are not made solely on political agendas?
    - Bob Scholes responded by noting that much work has been done to ensure the outcome of the SEA is not buried and cannot be embargoed by political agendas and that the outcomes are translated into gazetted regulations and best practise guidelines.
- Concerns about the effectiveness or credibility of current and future regulations, in terms of implementation and monitoring thereof.
- Concerns that the SEA does not include capacity analysis of the Departments of State, PASA and NEMA agencies.
- Would someone applying for an exploration permit be allowed to proceed?
    - Dee Fischer responded by informing the attendees that it would depend on where you are applying to do exploration, as the moratorium has been replaced in certain areas.
- Concerns as to the subjectivity of best practice according to different applicants.
    - Bob Scholes responded by assuring attendees that the benchmark of best practice will be set by the independent assessment, which would therefore prescribe best practices.
- Implementation of the SEA findings within decision making and whether new regulations would be devised to circumvent the potential findings and associated risks.
    - Bob Scholes responded by stating that the facts will be highlighted in the SEA and even if the assessment is disregarded in the decision making process, it should still be considered in order to understand the risks involved.

Water

- Potential negative impacts of fracking on water in particular and who will be responsible must be considered an important consideration.

Waste

- Does industry have an idea of what to do with the wastewater?
    - Bob Scholes responded by stating that the fracking fluid will most likely be sourced from outside the region, and South African regulations provide for disclosure of

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fracking additives. 70% of water used is returned to the surface and is re-used (depending on geological permeability). The water that returns to the surface may contains NORMS.

- Storage of radioactive waste, source pathways and parties responsible for its management is a key issue of concern.

Sense of Place

- Concerns as to the subjective nature of the sense of place issue.
- Would exclusion areas be determined by the SEA?
  - Bob Scholes responded by indicating that the strategic issues will list exclusion zones accordingly e.g. National parks, around towns etc. Further explains that this is why the risk assessment is spatially applied.

Economics

- Will a proper cost-benefit analysis be undertaken?
  - The project team responded by stating that the economic risks and opportunities associated with the 4 scenarios described in the SEA would be assessed. The SEA is set within a structured risk assessment approach so that all chapters and issues are consistent and comparable.
- Query as to whether fossil fuels would be subsidised.
- Attendees asked whether local people would benefit from job opportunities or if many of the jobs would be specialised?
  - Professor Cyril O'Connor (UCT) responded by noting that artisans would be required, but there are opportunities to develop these skills. However, it would be a challenge to get all government departments to work together to achieve this.

Social Fabric

- Human rights concerns in terms of lack of representation in SEA process.
- Queries pertaining to forced access to property without the landowner's permission, and whether land owners are informed enough in this regard.
  - Bob Scholes responded by ensuring the presence of a Human rights Commission representative on the PCG. Emphasises that landowners must be informed and that the SEA needs to be completed and distributed to landowners as soon as possible prior to development.
- Concerns regarding the consultation of stakeholders in rural communities who do not have internet access. How are they engaged in order to contribute to the credibility of the process?
  - Bob Scholes responded by indicating this to be a challenge, but many streams of media are used to improve the database.

  - Hendrik Kotze responded by stating that civil society plays a great role in information distribution, and civil society organisations should collaborate to ensure participation by all.

<u>National Energy Planning</u>

- Concerns about the replacement of potential for renewable energy by fracking outfits in South Africa.

Suggestions/Recommendations for future meetings

- Specialist communicators should be used to convey information to rural Karoo population and Interested and Affected Parties (I&APs).
- Every type of waste involved in shale gas development should be itemised and the amount stated in the SEA document.
- Include the type of facilities that are required for waste management in the relevant chapter.
- Include renewable energy as a standalone chapter in the SEA due to its importance in the Karoo.
- Consider the weight of renewable energy in South Africa and whether it should be subsidised.

3.2 Shale Gas SEA Public Outreach Round 1b Notes (16-17 May 2016)

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Shale Gas Strategic Environmental Assessment Public Outreach, Round 1b:

Key Issues Raised by Stakeholders

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List of acronyms

AEON	Africa Earth Observatory Network
ANC	African National Congress
ANCYL	African National Congress Youth League
ASSAf	Academy of Science of South Africa
CGS	Council for Geoscience
Cllr	Councillor
CSIR	Council for Scientific and Industrial Research
DA	Democratic Alliance
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DOE	Department of Energy
DWS	Department of Water and Sanitation
EC COGTA	Eastern Cape Department of Cooperative Governance and Traditional Affairs
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GCIS	Government Communication and Information System
GKDF	Great Karoo Development Forum
IDP	Integrated Development Plan
IPACED SA	Indigenous People's Association for Community Economic Development of South Africa
KEJM	Karoo Environmental Justice Movement
NEHAWU	National Education, Health and Allied Workers' Union
NMMU	Nelson Mandela Metropolitan University
NORMS	Naturally Occurring Radioactive Materials
PCG	Process Custodians Group
PEC	Project Executive Committee
PPP	Public Participation Process
SA	South Africa
SAFCEI	Southern African Faith Communities' Environment Institute
SAMWU	South African Municipal Workers' Union
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SEA	Strategic Environmental Assessment
SKDM	Central Karoo District Municipality
Tcf	Trillion cubic feet
WITS	University of the Witwatersrand

3.2.1 Graaff-Reinet Municipality Meeting Notes (16 May 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
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Graaff-Reinet Municipality Meeting

Location	Venue	Date	Time	Attendance number
Graaff-Reinet	Camdeboo Municipality, Robert Sobukwe Office	16 May 2016	12:00- 13:30	10

Attendance Register

Name	Organisation
De Jager, M.	CSIR
Hendriks, H.	Camdeboo Local Municipality
Kotze, H.	University of Stellenbosch
Mbete, M.G	DEDEAT (Chris Hani)
Mkhize, M.W.	DOE/DEA
Moganetsi, M.S	DEA
Bob Scholes	Wits/CSIR
Greg Schreiner	CSIR
V.R.K. Vanapalli	CGS
Luanita van der Walt	CSIR

Agenda for Public Briefing

- It was proposed that an agenda be drafted for the public briefing, which took the following structure:

Action	Responsible Party
1. Opening and welcome by Camdeboo Municipality	Member of Camdeboo Municipality
2. Introduction by National Government	Muzi Mkhize (DoE/ DEA)
3. Introduction by the Independent Facilitator	Hendrik Kotze
4. Overview of the Scientific Assessment Process	Bob Scholes
5. Questions from the Community on the Scientific Assessment	Project Team
6. Closure and way forward	Hendrik Kotze and Greg Schreiner
7. Vote of thanks	Member of Camdeboo Municipality

Facilitation of the public briefing

- It was suggested that a Municipal member should act as facilitator at the public briefing; however concern was raised as to the community's perception of the municipal member and whether they perceive him/ her positively or not. Furthermore, it was noted that the Municipality is regarded as a stakeholder and is therefore not entirely independent of the process. As such, the Municipality should refrain from facilitating the meeting. It was agreed

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that Hendrik Kotze remain independent facilitator and be introduced as such and not as a member of the Project Team.

Stakeholder engagement

- It was noted that the Municipality had engaged with stakeholders about the public briefing, and it would be announced over loudhailer in the area on the day of the meeting. Concern was raised as to the radio station(s) used to distribute notice of the meeting, and it was requested that the Mdantsane FM radio station be used for the next round of public briefings in July.

3.2.2 *Graaff-Reinet Public Meeting Notes (16 May 2016)*

Strategic Environmental Assessment for
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Graaff-Reinet Public Meeting

Location	Venue	Date	Time	Attendance number
Graaff-Reinet	Masizakhe Community Hall	16 May 2016	17:00- 20:00	~86

Attendance Register

Name	Organisation	Email	Telephone
B. Arends	Camdeboo Municipality		
B. Nomponiso	Resident		
B.T. Charles	Graaff-Reinet Ratepayers Association		
Barry Morkel	NMMU/ AEON		
Ben Nondlazi	Ward councillor		
Bob Scholes	Wits/CSIR		
Bomakele Speelman	Municipality		
Buhle Elie	Private		
Cara-Lee Dorfling	Die Burger Newspaper		
Charl Pienaar	-		
Claud Arnott	Graaff-Reinet Ratepayers Association		
Cobus Theron	EWT		
Derek Light	Derek Light Attorney		
Dr. Tony Williams	Spatial Planning EC COGTA		
Elizabeth Vorster	-		
Erika Hauff-Cramer	SAFCEI		
F.E. Sigonyela	Camdeboo Municipality Cllr		
G. Hitge	Private Resident		
G.J. Buisman	Graaff-Reinet Ratepayers Association		
Gerry Pienaar	DEDEAT		
Greg Schreiner	CSIR		
H. Hendriks	Camdeboo Local Municipality		
Haoani Chauke	DWS		
Hendrik Kotze	University of Stellenbosch		
Homsanqa	-		
Ilse Viljoen	DWS		
Jackson Madolo	-		
Jimmy	JBABC Trading Projects		
Kate Rowntree	Earth Bound Africa		
Khanyiso Desha	Private		
Khuthaza Lisa	-		
Khwize Xalisa	Mcikido 420 (Pty) Ltd		
Leolynn Smith	Camdeboo Local Municipality		
Leonie Fouché	Camdeboo Municipality		
Liz Buisman	Graaff-Reinet Ratepayers Association		
Luanita van der Walt	CSIR		
Lubabalo Xangati	-		
Luvuyo Malosi	Zikhali business solutions		
M. Mrwebi	DEDEAT		
M. Ndima	DWS		
M.K. Mati	Blue Crane Route Municipality		
Maria Meishik	Camdeboo Municipality		
Mbuyi Nombembe	Shell SA		
Megan de Jager	CSIR		
Michelle Duncan	-		
Mkhize, M.W	DOE/DEA		
Mkululeko	Private		
Moganetsi, M.S	DEA		
Mxolisi Booi	ANC		
Mziwandile	Sibabale Trading Enterprise (PTY) LTD		

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3.2.3 Beaufort West Municipality Meeting Notes (17 May 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
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Beaufort West Municipality Meeting

Location	Venue	Date	Time
Beaufort West	Beaufort West Local Municipality Offices, Donkin Street	17 May 2016	11:00- 13:00

- The Municipality informed the Ward Councillors of the meeting, which was placed on their agendas. Ward Councillors would be reminded of the meeting via sms that day. Notice of the meeting would be announced over loudhailer in the area on the day of the meeting in English and Afrikaans, and a slot was arranged with Gamka radio station in which to communicate the meeting details.
- Concerns were raised about the community's disappointment about shale gas opportunities that were presented to them previously, which may cause difficulty in attracting an audience for the meeting.

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3.2.4 Beaufort West Public Meeting Notes (17 May 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
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Beaufort West Public Meeting

Location	Venue	Date	Time	Attendance number
Beaufort West	Rustdene Community Hall	17 May 2016	17:00- 20:00	~93

Attendance Register

Name	Organisation
A.Pienaar	Juriesfontein Farm
Allan Januarie	Beaufort West Municipality
Annelie Rabie	SKDM
Ayanda Yekani	Community
B. Snyman	-
Bernard Dampies	Community
Billy Steenkamp	IPACEDSA
Bob Scholes	Wits/CSIR
Bonnie Schuwein	EWT
Brian Booyse	-
C. De Vos	Councillor
C.D. Pienaar	Juriesfontein Farm
Christo Booyst	-
Curtis Philland	ANCYL
Danie Swanepoel	DEADP
Delene Slabbert	Councillor
Djorge Maloy	DA
E. Biesios	-
E. Marlow	SKDM
Edward Appies	Community
Eril Lande	-
Esté Matthew	EWT
Freddie Lottering	Community
Frikkie Vaalyn	Community
Fundiswa Renene	GKDF
G. Disten	Private
G. Lottering	Prince Albert Municipality
Garth Aphte	Community
Gideon Genties	Community
Godfrey Adolph	RDL
Greg Schreiner	CSIR
Gwendoline Lousw	-
H. Maans	SAMWU
Hendrik Kotze	University of Stellenbosch
Ingrid Schofman	Ubuntu Forum
Isak Windvogel	Prince Albert Municipality
J. Booysen	Beaufort West Municipality
J.A. Jefferson	DEADP
J.N. Jadu	-
Jacobus De Wet	-
Jamiel Sias	DA
Joe Kalo	Afrimat
Johan Ceasar	Community/ Rustdene
Johan Strauss	-
Joseph Hartzenberg	Community
Josephine Brown	Private
K. Siwa	Farmer
Kenneth Ngqiqi	GKDF
Kim	Community
L. Lakay	Beaufort West Municipality
L. Lukas	-
Lazola Ngqandela	Tasman Pacific Mines

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Lee-André Peters	-	
Leon Kooiman	Community	
Lianda Dunke	Community	
Linki Lambert	-	
Lizzy Swartz	Community	
Luanita van der Walt	CSIR	
Lunga Mnqwazi	Afri Guard	
M. Baardman	Private	
M. Verveen	GKDF	
Madelein Sias	DA	
Megan de Jager	CSIR	
Michelle Duncan	-	
Mkhize, M.W	DOE/DEA	
N. Zalisile Oliphant	ANC	
Nkosinati Xuayimp	-	
Nqwabani Eric	Afri Guard	
P. Van Wyk	Agri Beaufort West	
P.J. Matthee	Riebeek Valley	
Pole Bruyn	-	
R.P. Baloyi	Security	
Rainy Hugo	Councillor	
Riaan van der Walt	Shell	
S. Moses	Private	
S.A. Monga	Farmer	
Sias Reynolds	Agri Nelspoort	
Simonette Strauss	South African Sp	
Siphiwe Piti	GKDF	
Siyabulela Syb	Car Wash	
Somila Xhosa	DST	
Stephanie Borchordt	-	
T. Lewies	SIMLAB	
T. Maritz	Private	
T. Mjoli	Farmer Tulplecute	
T.G. Mngubisa	Worker	
Thunzi Kalo	Afrimat	
Ulrich Steenkamp	KEJM	
V.R.K. Vanapalli	CGS	
Vuyisile Zenani	Shell	
W. Matunzi	Worker	
W. Moyeso	Private	
Zamaxolo	-	

Concerns Raised

Attendees raised the following concerns:

- Representation of the (potentially) affected communities at the meetings.
- Questions about the purpose of a dispute resolution specialist as a facilitator.
- Misconstrued link between DMR process and SEA.
- Questions around training of labour force for SGD.
- Concerns regarding the (lack of) inclusion of valuable shale gas information in Integrated Development Plans (IDPs).
- Misunderstanding of expected timeframes of SGD.
- The amount of time allocated to stakeholders to interact with the Scientific Assessment.

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Strategic Environmental Assessment for Shale Gas Development in South Africa
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Questions and Answers on Scientific Assessment Process

- Considering approximately 200 people are a part of this process as experts, who is representing the community's which will be directly affected?

A soccer referee analogy can be used to explain the structure that guides the process, whereby a set of rules and procedures are in place to do so. The structure to referee this process is by means of the Process Custodians Group (PCG) which is comprised various stakeholder groups. The PCG do not determine content, but they ensure that the questions being asked are addressed fairly and in a balanced way. Broader stakeholders can be involved by providing comments on the assessment.

- Is dust pollution being addressed in the Scientific Assessment?

Issues relating to dust and air quality are covered in the Air Quality and Greenhouse Gas Emissions chapter, as well as the Human Health Chapter.

- Is employment addressed, given that Beaufort West has a high unemployment rate?

Jobs are addressed in the Economics Chapter and include the types of jobs that would be available and who would be able to fill them.

- Last year DMR indicated that licenses were going to be issued while the SEA was still underway. What will happen in the event that a license is issued by DMR and the information is still being gathered, as this will be to the detriment of the community?

In the media there has been a commitment to issue exploration permits, however even if they are issued, the applicants would still have to go through a site specific EIA process. This process is likely be completed by the time any applications for Environmental Authorisation is lodged by gas companies.

- What body is involved by regulating boreholes being sunk? And does South Africa have the institutions and ability to enforce regulations to tidy up after processes (post decommissioning)?

Authors are investigating what measures need to be in place to ensure efficient regulation and enforcement thereof. A separate investigation of institutional capacity has been conducted by the ASSAf.

- Government must enforce renewable energies, considering South Africa has high wind potential; so there are alternatives. Why is shale gas still being considered?

The Energy Chapter considers the energy alternatives that are feasible in the Karoo and looks at how shale gas would change South Africa's energy mix, along with the potential risks and opportunities.

- These industries require high qualification jobs which would increase influx of people into the nearby towns, not to mention the farm workers on the farms that are bought, who would be forced into towns to wait for housing.

An influx of people from outside the region is typical in investment areas. This issue is extensively addressed in the Social Fabric Chapter, which looks at the potential strain that would be placed on local infrastructure, services etc.

- There are concerns regarding the balance of power in the decision making process and questions as to whether the big corporates/ industrial organisations would benefit the most from SGD?

By participating in this process stakeholders can hold the decision makers and organisations accountable for all the issues that were addressed, as this is a transparent process. This question is also thoroughly addressed in the Social Fabric chapter under new power dynamics.

- Young people should be taken into universities and trained with the skills that would be useful to the gas companies. What are the timelines for SGD?

The Scientific Assessment is described for three scenarios, of which the first is an exploration process which draws out over ~5 years. The next scenario assumes a discovery of ~5tcf, which would draw out over many more years and the reserve would last ~25 years. If a relatively large resource is discovered (~20 tcf) the development process would be ~20-30 years and the resource would last ~40-50 years. Therefore there are opportunities to educate the younger generation(s) on shale gas according to three potential futures that might play out; however there is lots of uncertainty. SGD will not happen overnight; there will be warning for government and communities to educate and capacitate, to take advantage and be responsible.

- IDPs do not speak clearly to the issue of shale gas and how it should be governed. Valuable information should get into the IDP and the 'referee' (the PCG) should play this role.

This is considered in the Impacts on Land, Infrastructure and Settlement Development Chapter (i.e. Planning), and it is recognized that currently IDPs are not equipped to address shale gas and the potential changes it might bring. SGD will bring about services and responsibilities that the municipalities and Government have never performed. This chapter takes this into account and assesses how they would have to adjust to these responsibilities etc.

- What measures are in place if the groundwater is contaminated with radioactive compounds from the uranium in the Karoo? Also, it is assumed many of the sites would be restored- how do we ensure our heritage is restored/ areas (e.g. Nelspoort, Fraserburg, Carnarvon, Baviaans) kept pristine for future generations?

Large parts of Karoo do have uranium deposits, which is a concern addressed in the Surface Water and Groundwater resources Chapter. Must keep in mind that deep water retrieved by flowback may be naturally saline and radioactive, and once it comes out it may be toxic, and this is being addressed in the chapter. South African legislation states that any of that kind of waste could not be disposed of in the Karoo, and would have to be exported from the Karoo to a registered disposal facility. The Heritage Resources Chapter looks extensively at palaeontological heritage, pre-colonial heritage, colonial heritage etc. and emphasises that the heritage council, SAHRA, must be involved in the regulation of these issues and where the council falls short (e.g. data gaps), there must be measures in place to "remediate" this. Also during an EIA all heritage resources must be identified and classified on site.

- Regarding timeframes, within the Municipalities shale gas is sold as happening tomorrow and this builds community expectations with regards to training opportunities and scholarships. Councillors are being inundated for requests to attend EIA meetings for all the integrated mining and development initiatives in the Karoo, but there is no integrated platform where all these developments are presented. It is important that truthful, realistic timeframes are communicated to the communities.

Timelines have been pushed back because currently, South Africa doesn't have the required infrastructure for this development and due to the current oil market etc. Government is there to make political decisions, and the government can make that decision, however this is not entirely a political decision; unless economics and environmental factors are favourable for applicants to actually develop, investment may not be realised and SGD may not be viable.

- How is the process being communicated to people in the area? If 2 hours before the meeting, a loudhailer was used to announce the meeting, how serious can we be? How many people did we expect at the meeting, and what type of audience is expected (e.g. level of education)?

It was realised the importance of stakeholders at the outset of the project (commissioned in 2015). There are dedicated persons in the Project Team who work with stakeholders on a daily basis. Every effort was made to engage with the communities throughout the process, including i.e. phone calls, sms's, emails, post. It is a constant ongoing process. Suggestions on how to improve stakeholder engagement are welcome. Letters were sent from the Minister of Environmental Affairs to the municipalities to mobilise structures and inform the community, emails were sent to registered stakeholders, newspaper advertisements were placed at local and provincial level, there were meetings with all provinces which distributed notices through their provincial structures, SALGA and district municipalities were notified and asked to distribute notice of the meetings.

- In a meeting by Shell in Victoria West, it was indicated that 20 million litres of water would be required per day per well, which was based on the Van Tonder 2010 report. Since then, the Karoo has experienced severe drought, hence we do not have the water. Should there not be a rule that states the reports they use must be updated regularly to ensure the most up to date data/ information is used?

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This Scientific Assessment estimates ~15 million litres of water per well, but remember that some of that water (~ 30-50%) is reused. Regardless, this is a lot of water and freshwater resources in Karoo cannot sustain this development. One option is to bring water in from outside the Karoo, or to intercept aquifers that are too saline for freshwater purposes. Water sources are designed against worst case scenarios.

- How far is the report from being finalised? Is it still subject to commentary, or is the content set? They are still busy with bioblitzes and there are many unknowns with regards to biodiversity. Do we have enough biodiversity information to inform a decision?

The report is about two-thirds complete and commentary may still change the content. Biodiversity experts are never satisfied, but relative to other parts of the world, we know a lot about biodiversity. There are data gaps but we have the helicopter view necessary for this SEA. The bioblitz will feed into the SEA due.

- Will the area not clash with areas proposed for uranium? What happens if we don't frack?

The Karoo is not a static environment, and shale gas is not the only activity proposed in the Karoo. Therefore, whether SGD occurs or not, the Karoo will change for various reasons e.g. uranium mining, renewable energies, changing agriculture etc. The baseline scenario in the Scientific Assessment takes into account the changing Karoo without shale gas development.

- How many job opportunities are expected from SGD?

Jobs covered in the report, but the numbers are not what might be expected. It might help address the employment problems, but will not solve it.

- Is the shale gas a distraction from uranium? No EIAs have been done for uranium? How will you reach people on the ground, more specifically; how can the Scientific Assessment be conveyed to people in a way that they can understand e.g. not in academic language?

The best way to do so is for people who understand the question and answer to convey this to other people and explain it to them in a way they will understand. A SEA is done when there are uncertainties around the proposed activity and where it will be done (has a "big picture" outlook), while an EIA is a decision making process for an activity that you are certain about what you want to do and where you want to do it. It is uncertain as to why an SEA was not conducted for uranium, but the process is catching on, with SEA's being done for renewable energy and electricity grid planning.

- How will communities and normal people benefit from shale gas (other than jobs)?

The Economics Chapter examines the issues of who will benefit and how to maximise benefits and recommends measures on how to reduce the effects of possible inequitable distribution of benefits.

- Would the matters of non-disclosure which are associated with negative (health) impacts in Canada, USA etc. happen in South Africa?

In South Africa, the law leans toward disclosure (i.e. fracking fluid composition), but alternatively one does not have to go through the courts to obtain information- there are alternative means to do so e.g. studies etc. People in the study area generally do not have good health because they are poor. SGD might cause health impacts, but it may also raise the economic status and therefore raise overall health status of people living in the area. Both sides are considered in the Scientific Assessment report.

Suggestions/Recommendations for future meetings

- It was suggested that a PowerPoint presentation be used as well as people speaking.
    - It was noted that a PowerPoint presentation was not used in a deliberate attempt to engage with the audience.
- Deliver the meeting in Afrikaans.

3.3 Shale Gas SEA Public Outreach Round 2 Notes (18- 22 July 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Shale Gas Strategic Environmental Assessment Public Outreach, Round 2:

Key Questions and Comments raised by Stakeholders

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Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

List of acronyms

ANC	African National Congress
ANCYL	African National Congress Youth League
ASSAF	Academy of Science of South Africa
CARA	Conservation of Agricultural Resources
CGT	Cycle Gas Turbines
CGS	Council for Geoscience
COGHSTA	Cooperative Governance, Human Settlement & Traditional Affairs
CSIR	Council for Scientific and Industrial Research
DA	Democratic Alliance
DEA	Department of Environmental Affairs
DEADP	Department of Environmental Affairs and Development Planning
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DOE	Department of Energy
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EWT	Endangered Wildlife Trust
IDP	Integrated Development Plan
LM	Local Municipality
NAMAQA	National Environment Management: Air Quality Act.
PPP	Public Participation Process
SADTU	South African Democratic Teachers Union
SALA	Subdivision of Agricultural Land Act
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SEA	Strategic Environmental Assessment
SGD	Shale Gas Development
UFH	University of Fort Hare
UFSED	Ubuntu Forum for Socio Economic Development
WITS	University of the Witwatersrand

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3.3.1 Graaff-Reinet Local Municipality Meeting Notes (18 July 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
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Camdeboo Local Municipality Meeting

Location	Venue	Date	Time	Attendance number
Graaff Reinet	Robert Sobukwe Building	18 July 2016	13:00- 14:30	10

Attendance Register

Name	Organisation
Andile Dludla	CSIR
Bob Scholes	Wits/ CSIR
Ernest Mmonoa	SANBI
Greg Schreiner	CSIR
Hans Hendriks	Camdeboo LM
Hendrik Kotze	University of Stellenbosch
Luanita Van der Walt	CSIR
Simon Moganetsi,	DEA
Stella Mamogale	DoE
Vadapalli, V.R.K.	CGS

Agenda for Public Briefing

- The proposed agenda for the stakeholder meeting was presented to the municipality and was accepted.

Stakeholder engagement

- The Municipality indicated that they have assisted in advertising the stakeholder meeting in the following ways:
  - Informed stakeholders from their database.
  - Distributed flyers in the wards.
  - Notified senior members of the municipality.
  - Identified a representative from the municipality will be present to chair the stakeholder meeting.

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3.3.2 Graaff-Reinet Public Meeting Notes (18 July 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Graaff-Reinet Public Meeting

Location	Venue	Date	Time	Attendance number
Graaff-Reinet	Masizakhe Community Hall	18 July 2016	17:00- 20:00	~43

Agenda for Public Stakeholder Meeting

Welcome	Municipal Official
Introduction	National Government Representative
Draft findings	Scientific Team
Questions and Discussion	Local Community & Scientific Team
Vote of Thanks	Municipal Official
Closing	National Government Representative

Attendance Register

Name	Organisation
Albert Jacobs	Tender Company
Andile Dludla	CSIR
Bernard Weyer	Architecht
Bob Scholes	WITS
Boy Bokwe	-
C. Arnott	Ratepayers Association
Dr. Geoffery Yalolo	Minister Fraternal
Derek Light	Stakeholder Attorney
Dini Sobukwe	Robert Mangaliso Sobukwe Trust
Ellen Jacobs	Homebased Worker
Ernest Mmonoa	SANBI
Esmari Borchardt	Stakeholder
Faith	ANC
G. Hitge	Resident
Greg Schreiner	CSIR
H. Hendricks	Cambdeboo LM
H. Makoba	Camdeboo Mun/ Mayor
Hendrik Kotze	University of Stellenbosch
Irene Mentjies	-
Kalipha Mini	UFH Student
Khwezi Xalisa	-
L. Smith	Camdeboo LM
Lindi Fula	Contractor
Luanita Van der Walt	CSIR
M.C	Comm Carwash
M.K. Maneli	DWS
Manelisi Ndima	DWS
Mbuyi Nombembe	Shell SA Energy
Monde Kaptem	ANC
Mziwelile	Community Member
S. Jantjies	Ordinary Citizen
Sizwe Grootboom	-
Simon Moganetsi	DEA
Skhumbuzo Pase	-
Stella Mamogale	DoE
Stephanie Borchardt	Stellenbosch University (Stakeholder)

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Terence Jantjies	-	
Thamsanqa Blouw	-	
Themba Bartman	-	
V. Jack	Ordinary Citizen	
V.R.K. Vadapalli	CGS	
Vuyisile Booysen	Karoo Shale Gas Community Forum	
Xolani Jantjies	Local Municipality	

Questions and Answers on Scientific Assessment Process

- 30 days opportunity for comments was not sufficient; however, the SEA has been a very meaningful exercise. Treatment of economic potential in this area hypes the issue and creates unrealistic expectations and polarize the community. Studies like this should be objective, so that decision-makers can make informed decisions and not emotional decisions. The SEA will be very useful if policy makers take the assessment into strong consideration.

Questions /Answers on the Draft Findings

Governance

- The report highlights potential risks to local authorities and therefore the community, not only should capacity be developed, but also the increased capacity needs to be funded, for instance, the municipality needs to employ more people. That national level feels the benefits, but the local communities carry the costs of the development. What about the Academy of Sciences South Africa (Assaf) report on technical readiness? Not available and is disappointing as it could add value to the SEA. Local authorities should be positioning them to be able to attach conditions to authorizations, or national government should think how they could have more positive feedback into local communities.
    - Bob Scholes explained that the Assaf report would not have changed the findings of this assessment; the experts also flagged potential capacity issues.
- Is there a process that allows young people to be equipped with skills to benefit from SGD?
    - Bob Scholes stated that one of the main this is how the country decides to develop shale gas and whether young people will be capacitated to benefit from this, there is a long time before SA has a gas industry and there is an opportunity to upskill people and generate local capacity. This is a decision that will get written into policy.

Tourism

- Are there precedence for cooperation between tourism and industry and departments? Would the tourism industry have enough muscle to stand up to DMR and SGD?
    - The stakeholder must relay this question to the tourism team, or we can do so on their behalf with their permission.
- Tourism industry experienced a phenomenon with the World Cup where opportunists invested in housings and flooded the market, and negatively impacted the local economy, pushing out tourists, especially post SGD.

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- Bob Scholes indicated that this was discussed more in the economics and social chapters not the above way that inequities may be increased.

Waste

- Can the waste from SGD be used to generate energy such as Biogas?
  - Bob Scholes explained that Biogas is generated from organic waste that decomposes and produces gas, but the waste from shale gas is mostly building material, rock and contaminated water.

Water

- What about cross contamination between deep and shallow aquifers? Mitigation?
  - Bob Scholes explained that cross contamination between deep and shallow is not likely, and the water would have to migrate upwards, which is very unlikely, leaks from the top will pose the main risk to surface water contamination. A big aspect of the mitigation is around capacity, enforcement, institutions. Legacy issues after SGD around who is responsible for problems arising from abandoned wells, SA legislation takes into account funds from developers for legacy issues.
- What about water requirements?
  - Bob mentioned the findings are that exploration doesn't need as much water, but each frack requires huge amounts of water, but the water can be re-used for subsequent fracks. There is not enough water in the Karoo, it cannot come from the same source as drinking and agricultural water.

Meeting Closure

- Greg Schreiner provided feedback on commenting period and way forward.
- Mr Hendricks (Camdeboo Municipal Manager) gave his final words and closure of the meeting.

3.3.3 Victory West Local Municipality Meeting Notes (19 July 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

Victoria West Local Municipality Meeting

- The proposed agenda for the stakeholder meeting was presented to the municipality and was accepted.
- Xolani Malgas (Municipal Manager) indicated that they have assisted in advertising the stakeholder meeting in the following ways:
    - Informed stakeholders from their database.
    - Distributed flyers in the wards.
    - Notified senior members of the municipality.
    - Announced Meeting details in town with a loudhailer

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3.3.4 Victory West Public Meeting Notes (19 July 2016)

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Victoria West Public Meeting

Location	Venue	Date	Time	Attendance number
Victoria West	Victoria West Town Hall	19 July 2016	17:00- 20:00	37

Agenda for Public Stakeholder Meeting

Welcome	Municipal Official
Introduction	National Government Representative
Draft findings	Scientific Team
Questions and Discussion	Local Community & Scientific Team
Vote of Thanks	Municipal Official
Closing	National Government Representative

Attendance Register

Name	Organisation
A. Schoevers	Boer
Andile Dludla	CSIR
Berney Bostander	Coghsta cdm
Bob Scholes	WITS
Clive Kingwill	Sentral Karoo Landbou unit
Contessa Kruger	UFSED
Dumisani Tuis	Dept of Justice
Ernest Mmonoa	SANBI
Esmari Borchardt	-
Greg Schreiner	CSIR
J.P Van Rensburg	Sentral Karoo Landbou Unit
Johan Bostander	UFSED
Johan Viljoen	Sentral Karoo Landbou unit
Hendrik Kotze	University of Stellenbosch
Klaas Meintjies	Ubuntu Municipality
Klaas Agterdam	CWP Ubuntu
Louis Kruger	Development Corporation
Luanita Van der Walt	CSIR
Lusanda Gqagqa	Youth
Martin Cedres	Ubuntu Municipality
Morney Ennes	Youth Movement
Mzukisi Moloi	Young chief/ANCYL
N.F Hamman	Sentraal Karoo Landbou Unit
Ntombi Gqagqa	COGHSTA
Paul Gcuku	Community Youth
Phumza May	Standard Bank
Riaan v.d. Walt	Shell
Simon Moganetsi	DEA
Stella Mamogale	DoE
Stephanie Borchardt	Stellenbosch University (Stakeholder)
Surika v/d Merwe	Sentraal Karoo Landbou Unit
Thobeka Gqagqa	John Rossuw Primary
V.R.K. Vadapalli	CGS
Wilma Schutz	DA
Xolani Malgas	Ubuntu Municipality
Yolisa Tsheke	Ubuntu Municipality

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Questions/Comments and Answers on Scientific Assessment

- Where is the gas present?
    - Bob Scholes stated that the gas is very deep and you can drill approx. 3 km horizontally, if you need to go further it would not be economically viable. Well pads are far apart. Since you can manoeuvre subsurface you have flexibility to miss very sensitive surface areas, areas like national parks will be avoided, and many very high sensitive areas may well be no-go.
- How many hectares will be affected by SGD?
    - Bob Scholes explained that the wellpad is about 2 ha and then the road networks will also contribute to the footprint. Overall less than 0.001 of the study area is anticipated to be occupied by physical infrastructure footprints, even at a large scale scenario of 20 Tcf.
- Is the next step in the SEA is to fine tune the report using the documents?
    - Bob Scholes concurred that is the direct next step, after the report is finalised we take the evidence in the report and help government decide what regulation should be in place.
- Does negative consequence outweigh the positive?
    - Bob Scholes explained that Shale gas isn't a yes-no thing, there is a range of possibilities. Decision that has been made is that it would be good for SA to know if it has shale gas, to actually develop shale gas is not a government decision, it is the decision of the public sector they will decide to explore/produce if the economics and technicalities are in order.
- Where will the money for SGD come from?
    - If you have an economically viable activity you have a tax stream, you have more money that is being consumed, then it is a government fiscus decision about how money is spent and how / who funds aspects of development.
- A comment was made that South Africa suffers from the lack of implementing and policing regulations.
- A comment was made that Informal settlements determine how towns develop, not really spatial planning.

Questions/Answers on the Draft Findings

<u>Agriculture</u>

- What about current legislation like Conservation of Agricultural Resources (CARA)?
    - Bob Scholes stated that the agriculture team has found that the current legislation is sufficient to protect the interests of farmers, but there are questions around the implementation capacity.

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<u>Economics</u>

- Property values in towns are expected to rise, but how does the Karoo compare to counties in America? And what are the differences in using local labour?
    - Property values around towns would in all likelihood rise if there was a functioning gas industry in the region, the international literature supports this. Cases reported from the rural parts of the U.S.A are not entirely different to the Central Karoo, although there is a much higher degree of both existing (and well-functioning infrastructure e.g. WWTW, roads, pipelines) and human skills capacity and local governance efficiency.

<u>Energy</u>

- Nuclear energy is not included? But coal has been considered, why?
    - Bob Scholes explained that it is not in the assessment because it was not part of the mandate of the study. The base load can come from nuclear and from coal, coal would be the main thing to be displaced by gas.

<u>Governance</u>

- How soon should the municipality be expected to plan for these types of developments?
    - Bob Scholes responded by saying that quite a lot of time and it needs to be done very thoroughly, it will take a few years.

<u>Human Health</u>

- American reports say that there are major health effects?
    - Bob Scholes stated that many of those reports are epidemiological, people are sick but a causal relationship showing that it is fracking, is not proven. He added that Health effects are not too well knows now, and it will take time (if SGD occurs) to prove.

<u>Terrestrial Biodiversity</u>

- Land rehabilitation post SGD and Land acquisition? E.g. SKA expanded.
    - Pipelines and new roads, for the pipe they will have the shortest possible routes, therefore it will be large areas that will be cleared, and these are difficult to rehabilitate.

<u>Social Fabric</u>

- A comment was made on increasing inequalities, the people who have will get more, the people who don't have, will have even less.
    - Bob Scholes highlighted that the social fabric chapter recognizes the risk of growing inequalities that may be created by SGD.
- How was spatial planning and social fabric affected by the World Cup?

- Bob Scholes stated that World Cup was boom and bust characteristics.

<u>Tourism</u>

- Victoria West may not be identified as a sensitive tourism town, but they want to invest in tourism for their livelihood.
  - Bob Scholes explained that the assessment looks at available information now, at an EIA stage there should be opportunity to consider emerging trends (that were not evident at the time of the assessment) that will be negatively impacted by SGD.
- A comment was made on the future of tourism in Victoria West may look different that than is captured in the report. Concerned that the levies in Vic west apart from agriculture is tourism. To look at tourism the community and the municipality must work together to develop tourism in line with the IDP.

<u>Waste</u>

- How do you store flow back?
  - Bob Scholes highlighted that SA legislation prescribes that it must be stored in closed containers, no open tanks or lagoons are allowed.
- Flowback get stored, but what if the gas is finished, does the tank stand there forever?
  - Bob indicated that waste disposal at proper facilities, however, hazardous waste needs to go to special facilities outside the Karoo (Cape Town or Port Elizabeth).

<u>Water</u>

- It is best practice and best technology for casing and drilling, but you are working "blind" and accidents happen.
  - Bob Scholes stressed that risk of failure is very small but it does exist, however contamination event are mainly contained. Fluids do not move easily laterally in aquifers.
- Is there radioactivity in flowback?
  - Bob Scholes indicated that there is radioactivity is present but current samples (soekor and hot springs) shows that it is present.

Meeting Closure

- Greg provided feedback on commenting period and way forward on behalf of the project team.
- Final word and closure was done by municipal manager, Mr. Malgas.

3.3.5 Beaufort West Local Municipality Meeting Notes (20 July 2016)

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Beaufort West Local Municipality Meeting

Location	Venue	Date	Time	Attendance number
Beaufort West	Beaufort West Municipality	20 July 2016	13:00- 14:00	10

Attendance register

Name	Organisation
Andile Dludla	CSIR
Bob Scholes	Wits/ CSIR
Ernest Mmonoa	SANBI
Greg Schreiner	CSIR
Hendrik Kotze	University of Stellenbosch
Lewellyn. Lakay	Beaufort West LM
Luanita Van der Walt	CSIR
Simon Moganetsi,	DEA
Stella Mamogale	DoE
Vadapalli, V.R.K.	CGS

Agenda for Public Briefing

The proposed agenda for the stakeholder meeting was presented to the municipality and was accepted.

Llewellyn Lakay (Municipal Representative) indicated that they have assisted in advertising the stakeholder meeting in the following ways:

- Informed stakeholders from their database.
- Distributed flyers to the community.
- Announced Meeting details in town with a loudhailer.

3.3.6 Beaufort West Public Meeting Notes (20 July 2016)

environmental affairs
water & sanitation
science & technology
mineral resources
energy

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CSIR
SANBI
Council for Geoscience

Beaufort West Public Meeting

Location	Venue	Date	Time	Attendance number
Beaufort West	Rustdene Community Hall	20 July 2016	17:00- 20:00	~ 84

Agenda for Public Stakeholder Meeting

Welcome	Municipal Official
Introduction	National Government Representative
Draft findings	Scientific Team
Questions and Discussion	Local Community & Scientific Team
Vote of Thanks	Municipal Official
Closing	National Government Representative

Attendance Register

Name	Organisation
Andile Dludla	CSIR
Andre Mcleod	WA
Andrew Solomons	-
Ashwill Sawall	Gemenskap
Aubrey v/d Lingen	Ward 2
Bob Scholes	Wits/CSIR
Bonnie Schumann	EWT
Bulelani Bilikwa	Jaw operator
C.W Adolph	ANC
Celby November	-
Carlos Lakay	Community
Cazola	Tasman Pacific Minerals
Charles Lakay	Community
Christo Booysen	Gemenskap
D. Stander	SADTU
Daniel Swanapoel	DEADP
Debbie & Michael Anstey	Farmer
Denny Byilikwa	Great Karoo Gospel
Edwin Samson	
Eifredo Jantjies	Ward 3
Eirione Kanpher	
Estner Booysen	Community
Este Matthew	EWT
Erika van der Linde	Ferret Mining & Environmental Services
Evelyn Lawrence	Community
Frank Fenbers	-
Freddie Martin	Pastors Fraternal
Freddie Lottering	Community
G. Gentles	Great Karoo
George van der Walt	Tasman
Gideon Sebabis	Community
Godfrey Adolph	-
Greg Schreiner	CSIR
Henri Fortuin	DEADP
Hendrik Kotze	University of Stellenbosch
Ingrid S	Ubuntu Forum
J. Booysen	Beaufort West Municipality

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J.D.M. Bosman	ANC
J. Slabbert	Resident MB
Jack Edwards	-
Kaylee Booysen	ANC
Klaas Telanie	Community
Llewellyn. Lakay	Beaufort West Municipality
Lindokuhle Jodwana	ANC
Lorenzo Johnson	Private
Luanita van der Walt	CSIR
Lungile Mendou	Sccd
M.V Madolo	-
Madoda Bokwe	Private
Malesia Gonyana	Community
Mark Olivier	-
Matthews Dikana	-
Melulawn K	-
Menziwa Mzwandile	Ward Committee
Moeti Zingxondo	-
Mongezi Pike	Greater Karoo Dev Forum
N.Z Oliphant	ANC
Nathi	ANC
Ntobeko	Resident
Peter van wyk	-
Randal Dumpie	
Riaan v/d Walt	SHELL
Roger Jacobs	Gemenskap
Ronaid	-
Skoki	-
Somila Xhosa	DST
Stephanie Borchordt	-
Steve Moseley	Private
Stuurman	-
T.N Jadu	ANC
Tefo Malobae	Penninsula Energy
Thanduxolo Kokwe	-
Tim van Stombrole	Ferret
W.Jonas	-
W. Moyeso	Private
V.R.K. Vanapalli	CGS
Victor Malowizz	-
Victor Olivier	-
Violet	ANC
Vuyisile Bartman	-
W. Bezadenhoudt	Private
W. Vivier	BW Landbou
Xoliswa	Womens League

Questions/Answers on Scientific Assessment Process

- If new information arises it would be included in the document how will that be regulated?
    - Bob Scholes stated that these assessments are not regularly re-done, smaller issues would not constitute an upgrade, if something substantially changes the assumptions of the assessment it will have to be considered in some way and perhaps at an EIA stage.
- The study is independent and is not to make a decision for or against shale gas, but it has been indicated that a decision will be made. At what point will communities have an

Strategic Environmental Assessment for Shale Gas Development in South Africa
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opportunity to make proper inputs into such a decision? The community should be given opportunity to influence decision on how, when and where.

- Bob Scholes pointed out that Knowledge empowers communities, this assessment provides that knowledge. In SA constitution is committed to a participatory style of governance. This is a strategic assessment looking at the big picture, as soon as there are specific details "I want to drill here" and this will require an EIA for which PPP must be done. There aware also opportunities to comment on policy and legislation.
- Henri Fortuin added that even though national department may approve an EIA, there are many other licenses that need to be required. A community must start a zoning committee/ local council to give planning permission (if they do not give planning permission fracking cannot go forward), land use planning, IDP, stakeholders have opportunity to interact on local, provincial and national level as well, a range of authorities must all say yes.

- A comment was made on Public participation at EIA phase can be quite technical and difficult to understand, there is a call for departments / provinces / councils to aid communities to understand issues and be able to sufficiently provide inputs.
- Further there is an understanding that reference scenario is not static and that it changes, have you considered the cumulative impacts of uranium?
  - Bob Scholes stated that this is not a uranium SEA, but we have pointed out that shale gas is not the only thing going on and that it would be in addition to other changes. These issues should attract an EIA, hopefully the SEA provides information to support some of the other things as well and that it sets a standard for assessments.

- How would you mobilize an assessment of cumulative impacts of multiple developments?
  - Bob Scholes stated that Provincial and other authorities should determine when an SEA is necessary and is in addition to and EIA.
  - It was added that decision on uranium is taken by national government, so provincial doesn't have a say even if they didn't want it. A large study like this would be welcomed, the Western Cape SDF does touch in issues like this, but do not have much control over mining.

- SEA Process in relation to the legislative process on to frack or not to frack, how many years?
  - Bob Scholes indicated that the SEA process goes on until March 2017 (the decision making framework), the process of policies will run as usual. Fortunately it seems there is a breathing space, with the low oil prices there is not a great rush for SGD, we may see exploration and will have a warning.

Questions/ Answers on Draft Findings

<u>Governance</u>

- Why was functionality of governance not assessed? The reports assume that mitigation will be applied, and that governance is effective.
    - Bob Scholes highlighted that almost every chapter asks about institutional readiness, many of them raised uncertainties and concerns. In many instances the legislations found to be sufficient.

<u>Sense of Place</u>

- It all boils down to the economy and to money, people who do not know the Karoo have totally different values, to start up a business in the Karoo for a short time and you steal the soul of the Karoo. Make money, pack up and leave and leave the mess behind in the Karoo. Rather go the other gas routes, from Mozambique and offshore, economically it would be a far better advantage for South Africa.
    - Bob Scholes response was that Sense of place is understood to some extent and these points are made in the report, however little evidence to base an assessment on. Many people think that the govt. decides whether to go ahead with fracking, but in the end it is up to the economics and technical viability that will be determined by the fracking companies. It is important to understand the opportunities and understand the risks and then make informed decisions, the pose decisions will be made by the govt. by the fracking companies and by civil society.

<u>Social Fabric</u>

- When it comes to a small town like Beaufort there are two different worlds, the rich, and the people who are struggling for food every day, and many people do not understand economics and oil prices etc.
    - Bob Scholes highlighted that Social fabric touches on growing inequalities, and the economy chapter looks at who could benefit from the income from SGD. Recommendation around mitigating these impacts are suggested in the reports and will be packaged in a way to help govt. make good decisions.

<u>Terrestrial Biodiversity</u>

- Grassland biome covers many ha but doesn't seem to be assessed, and only Karoo threatened species considered.
    - Bob Scholes stated that all biomes within the study area have been assessed.

<u>Tourism</u>

- A comment was made that dysfunctional municipality, in certain areas it is important to recognize that they may not have IDPs and they are definitely not being implemented. A community forum in Loxton has identified tourism as being the best patch way to create jobs and develop communities. Fracking will hinder sustainable tourism opportunities.

- It was added that it would be interesting to see what the investment opportunities will be for fracking vs tourism. Consider economic opportunities against other sectors.
    - Bob Scholes highlighted the fact that at a strategic level there is not enough info to do a full cost benefit analysis, until exploration for gas is done you cannot know what the value of it will be, these studies are surely to arise when better resource estimates are known.

<u>Waste</u>

- Will there be a lot of radioactive material in the waste stream generated from flowback?
    - Bob Scholes stated that this is considered in the water section, water that goes deep down will be contaminated with radioactivity. Current measures of radioactivity are known through soekor holes and hot springs, the levels of radioactivity is not very high, but higher levels may be encountered when drilling. He also added that Fracking companies would have to deal with the waste, they would not be allowed to be burdened with fracking waste. The SEA was commissioned is to gain information of what is happening in the South African context.

Meeting Closure

- Greg Schreiner provided feedback on commenting period and way forward.
- Mr. Booysen (Municipal Manager) shared his Final words and closure.

3.3.7 Shale Gas SEA Workshop for Registered Stakeholders (22 July 2016)

Strategic Environmental Assessment for
Shale Gas Development in South Africa
Meeting Notes

Shale Gas SEA Workshop for Registered Stakeholders

Location	Venue	Date	Time	Attendance number
Cape Town	Iziko Museum	22 July 2016	10:30- 15:30	~35

Attendance Register

Andile Dludla	CSIR	
Aubrey Matsila	CSIR	
B. Williams	SAOGA	
Bob Scholes	Wits/CSIR	
Derek Light	Attorney	
Fahiema Daniels	SANBI	
Francine Dieckman	-	
Greg Schreiner	CSIR	
Hendrik Kotze	Peace Systems	
Henri Fortuin	DEADP	
JA Bezuidehoudt	SHELL	
Jeanie le Roux	Parliament	
Jeff Jefferson	DEADP: Intelligence	
Jeff Manual	SANBI	
John Wilson	DEADP	
Kobus Jooste	Parliament	
Karel Lewy-Phillips	Eco Environmental Services	
Luanita van der Walt	CSIR	
Marilyn Lilley	TKAG member	
Niall Kramer	-	
Nic Opperman	Agri SA	
Ramatholo Sefako	SAAD	
Ruth-Mary Fischer	SanParks	
Simon Botha	DEADP	
Simon Moganetsi	DEA	
Somila Xosa	DST	
Stella Mamogale	DoE	
Stephanie Borchardt	Stellenbosch University	
T Mawonga	Gariep LM	
Vuyisile Zenani	Shell SA	
Waymann Kritzinger	Agri SA	

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Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

Wilbert L. Mathews	Mateus Petroleum LLC	
Willem Louw	SanParks	

Questions and Answers on Scientific Assessment Process

- What is the value of the full report?
  - Bob Scholes highlighted that the full report is in the public domain, and the information is available to other studies. The document will be published electronically. The Summary for Policy Makers will almost certainly come out as a hard copy as well. The client is government, but the specific report is a public domain report. Paid for by government, but for use by all. Government gets this entire report, and our support feeding this into a framework for decision making

- Potential alternatives is lacking in the report.
  - Development alternatives are required in an EIA level under law. The SEA deals with alternatives through the risks assessment, which looks at 4 different future alternatives, with and without mitigation. These all represents alternatives. There is also a "stopping" point. This is not an assessment of absolutely everything going on in South Africa.

- A comment was made on the importance of people to understand the fracking regulations and the permitting requirements and timeframes.
- What is the public participation going forward?
  - The public participation fort the scientific assessment section is done now, after this is the policy development process, which consists of the PPP normal to those processes.

- This study focuses on shale gas only, did you look at other activities, such as uranium and gypsum?
  - Bob Scholes stressed that this SEA doesn't replace the EIA but directs it and provides a framework. The dynamic baseline of the Karoo (Ch 1) tries to capture that, we do not have full insight on those issues, such as uranium is also sort of a rumor it has not yet happened and cannot be taken into cumulative account. Our mandate is to look at shale gas. If the assumptions of the assessment changed substantially it would not be valid anymore, it would have to be revisited. See point above.

- What about National parks and protected areas, buffer zones?
  - Bob Scholes stated that those are definitely taken into account, and they are protected by law, which provides for protected are and buffers.

- There seems to be a decision that SGD will occur.

Strategic Environmental Assessment for Shale Gas Development in South Africa
Meeting Notes

- SGD is not only a government decision, but the decisions also rely on the private sector (developers) and civil society also needs to provide input into the decisions which will happen in the future. Re acknowledging uncertainties - when we wrote the SPM we didn't draw on the preface, perhaps draw preface into the SPM. Question to ask yourself is: if you knew more about this, would it change you decision? Or do you know enough to make a decision?

Questions/Answers on Draft Findings

Scenarios and Activities

- How did you arrive at the impact drivers described in the Scenarios and Activities chapter (Ch1)? For instance 10 wells instead of 32 wells per wellpad, these differences are significant. Precautionary approach call for the worst case figure to be taken into account. The entire report is based on assumptions that may not be correct.
  - Bob Scholes responded by explaining that we worked closely with industry, and this was peer reviewed by international experts, and then chose the most reasonable assumption for a South African context. Strategic assessment taking the big picture in account, for permitting they need to be explicit. Proposed more wells at a well-pad could also be seen as proposing less impact i.e. fewer wellpads, fewer well bores and casing, fewer roads. It depends which way you look at it. But the international evidence is clear, in the region of 10 wellbores per wellpad is a very legitimate assumption.
- Is there a map indicating infrastructure?
  - Bob Scholes responded with No, because no development is proposed as of yet, it is all what-ifs. We have no idea where infrastructure would be placed. There are examples of infrastructure in chapter 1 as well as "imaginary" notional layouts.

Air Quality & GHG Emissions

- What about flaring? Downwind movement of gasses from flaring. And air quality re: compressor stations. Therefore air quality issues not only on wellpad but along all infrastructure. Venting of gas and fugitive leaking.
  - Bob Scholes stated that it is not anticipated that there will be extensive flaring, and will be well within NEMAQA standards. Fugitive leakage is very well understood, industry would want to avoid that.
- Shale gas is potentially cleaner source if fugitive emissions can be mitigated, a US study...assumptions based on conventional gas...abandoned wells and fugitive emissions, based on info like this life cycle of gas would not be as GHG efficient. Shale gas would be lower than coal - this statement is not correct. (Stakeholder has submitted this comment)
  - Bob Scholes emphasised that there is a lot of literature in this, additional literature is welcome but would not change the finding that this is a critical issue.
- A concern was raised on GHG that a number of the chapters correctly record a number of scientific unknowns that renders it difficult or impossible to do a risk assessment. Concerned

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that one is not making the point strongly enough that where there is a lack of knowledge they should be cautious about making decisions that could influence aspects that are clouded by uncertainties.

Agriculture

- Foliage damage to crops? Nitrogen deposition?
  - Bob Scholes highlighted that this should be covered in agriculture, related to dust pollution that could affect species within about 30 m of dirt roads. Nitrogen deposition is not really an issue in this area of the world.
- The Conservation of Agricultural Resources Act (CARA) and Subdivision of Agricultural Land Act (SALA) are old pieces of legislation. Agricultural legislation has been neglected and no legislation is available to support agriculture, especially with regards to mining. Mining fraternities have shorter routes in terms of EIA and that is a constraint for agriculture.
  - Bob Scholes stated that CARA is a good piece of legislation, but the implementation and policing capabilities of that is brought under question.
- A concern was raised that the Agricultural chapter is based on a 1994 study, and a lot has changed in the agricultural sector, it is now a much more successful sector. Furthermore, it creates many jobs and provides other services to their workforce. Do not underplay the significance of chapter 8.
- Radioactivity? Radioactivity can be found in the wool of sheep?
  - Bob Scholes indicated that this is dealt with in the groundwater chapter. Available levels from hot springs and soekor holes are low.
- Will farmers who lease or sell their land to developers return to the areas?
  - Bob Scholes stated that experience shows that people would likely not want to return; this will not only be because of SGD but also due to other factors such as climate change. Somila Xosa added that Colorado shows examples of a co-existence between SGD and agriculture; however, it might be possible to do some agriculture but not all agriculture.

Earthquake

- It is fine to say that fracking shouldn't happen close to towns, but would the legislation prevent that. Prevent creeping of SGD into towns and closer to sensitive areas.
  - This is around implementation and institutional capacity and available legislation and the shortcomings have been raised in all chapters.

Economics

- Economic benefits of economics equations, do they account for GHG and full SGD life cycle?
  - Bob Scholes responded by explaining that a cost benefit analysis was not undertaken, as there is not enough information, so have not done that level of analysis. Combine Cycle Gas Turbines (CGTs) are efficient.
- Economic benefits of renewables to shale gas?

Strategic Environmental Assessment for Shale Gas Development in South Africa Meeting Notes

- Bob Scholes explained a comparison can be made with the kW/h generations costs, wind is the cheapest, solar a bit more expensive, CCGT at is more expensive, new coal is very expensive, nuclear is most expensive. But you cannot from that say that we should only do wind, you cannot builds tire system just from the cost; you also need to look for reliability. This is analysed extensively in SA energy plans, looking at price, reliability energy independence etc.

Human Health

- CANSA came out very strongly about the link between cancer and fracking.
    - Bob Scholes explained that health impacts from fracking are not dismissed, they are present in the likely vicinity of the well pads, but are not so substantial that it would remove this as a potential activity.

Energy Planning

- Latest information contradicts statement that gas is relatively cheaper and can be used to compliment renewable energy.
    - Stakeholder must provide evidence of this

Governance

- The issue of institutional capacity has come up most times and the report also highlights that as a key issues. Will you recommend that institutional capacity be consistently monitored to see how it berg ores and whether it is successful?
    - Bob Scholes responded by stating that the chapters address what institutions exist, are they fit for purpose, and how should they be augmented. Authors do not make specific recommendations; they provide the facts, in phase three such issues will be dealt with.
- One of the mitigation processes in by monitoring, but the player cannot be the referee
    - Bob Scholes stated that the monitoring should be independent or at least a hybrid arrangement, an obligation on developer to install equipment and do monitoring, with an independent auditing that. Post closure monitoring is also an important aspect.

Social Fabric

- Social and labour plans routed as a good way for SED? National policy can't always be interpreted as being implemented.
    - Bob Scholes stated that the chapter draws extensively on examples from South Africa and around the world. Does draw on policy aspects such as how developers should invest money for local socio-economic development.

Strategic Environmental Assessment for Shale Gas Development in South Africa
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Terrestrial Biodiversity

- What about birdwatchers?
  - Bob Scholes responded by stating that Birds should be considered in the biodiversity chapter (IBA map) important bird areas should be considered.
- What about avoiding surface features, and going underneath?
  - There is precedence for a coking coal company wanting to burrow under the national park, but it went to court and lost. Many of the fine-scale siting issues are considered at the EIA level.

Visual

- Optical astronomy Sutherland and light and dust pollution?
  - Bob Scholes highlighted that light pollution and dust pollution is considered. Main source of dust would be from trucks on dirt roads. Potential light pollution effects on Optical astronomy are considered in the Visual chapter

Water

- If water is not available, what are the impacts associated with the other sources available?
  - Bob Scholes pointed out that it is clearly painted out in the chapters.

Waste

- What is hazardous waste generated by SGD?
  - Bob Scholes stated Brine, radioactivity, contaminated water. These cannot be treated in the study area, but must go to licensed area.

Meeting Closure

- Greg Schreiner provided feedback on commenting period and way forward.

Strategic Environmental Assessment of Shale Gas Development in the Central Karoo

Phase 3:
Decision Support Tools Report

APPENDIX 2

Bioblitz Closure Report:
Generating New Foundational Biodiversity Information for the Shale Gas SEA

SANBI
Biodiversity for Life
South African National Biodiversity Institute

Bioblitz Closure Report:

Generating New Foundational Biodiversity Information for the Shale Gas SEA

February 2017

Principal Investigators:

Domitilla Raimondo, Michelle Hamer & Ismail Ebrahim

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Figures

features and/or features that are important for achieving targets for representing biodiversity and/or maintaining ecological processes. Protected areas, EBIS-1 areas and EBIS-2 areas collectively meet targets for representation of biodiversity and maintenance of ecological processes in the study area. EBIS-3 areas (44% of the study area) are natural areas that do not contain currently known sensitive or important features. In EBIS-4 areas (1% of study area) there is no remaining natural habitat.

1. INTRODUCTION

The Department of Environmental Affairs (DEA) commissioned a Strategic Environmental Assessment (SEA) for Shale Gas Development (SGD) (Figure 1). DEA appointed a project team comprising the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI) and the Council for Geoscience (CGS). SANBI's role in the SEA was to provide inputs on the terrestrial and freshwater biodiversity within the study area, and identify the importance and sensitivities of the various species and ecosystems. Due to significant data gaps within the Karoo region, SANBI undertook bioblitzes (rapid biodiversity assessments) in addition to mobilising existing biodiversity data in order to improve the overall understanding of the biodiversity of the this region.

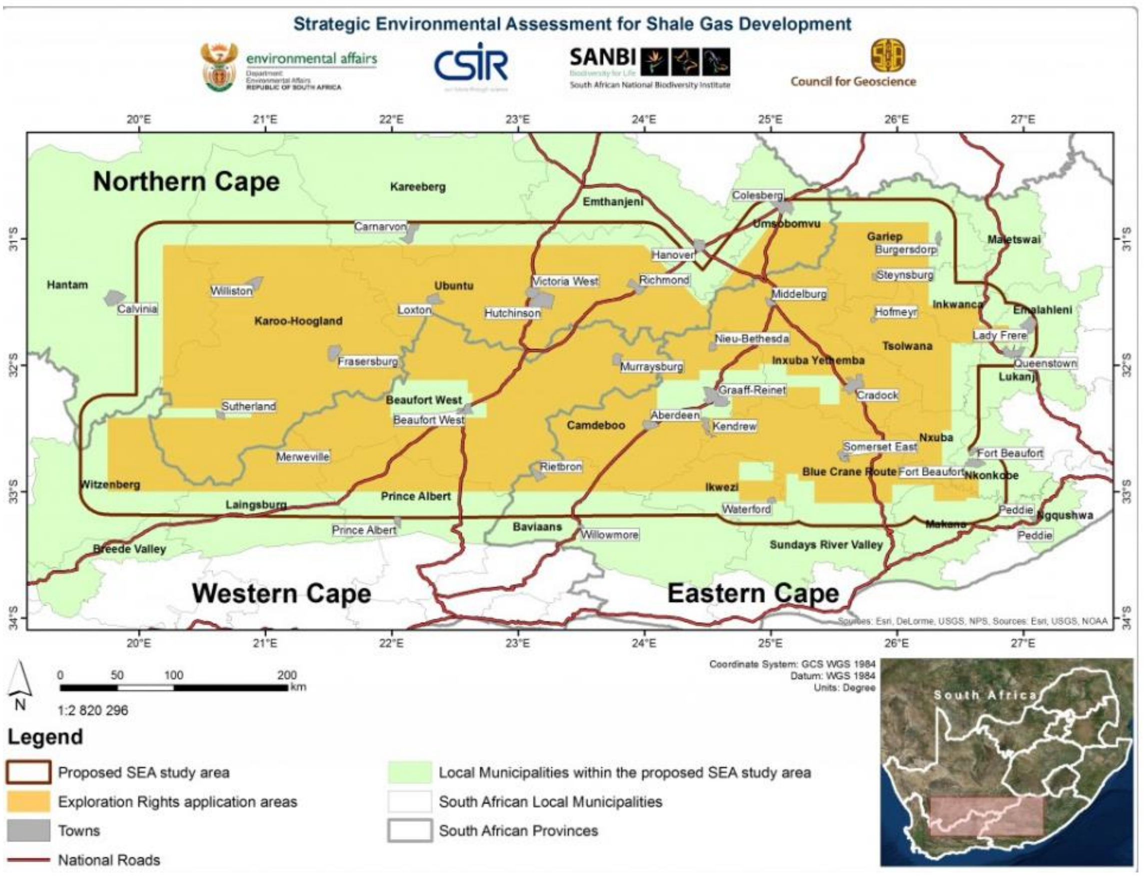

Figure 1: Study area for the Shale Gas Development SEA in the Karoo region

This report focuses firstly on the fieldwork undertaken during the SEA timeframe in the form of BioBlitzes. It also covers the mobilisation of existing collections data and explains how all species data was used in Chapter 7 Biodiversity and Ecological Impacts: Landscape Processes, Ecosystems and Species (Holness et al. in Scholes, R., et al. (eds.). 2016. Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks.

2. BIOBLITZES CONDUCTED FOR THE SHALE GAS DEVELOPMENT SEA

The Nama-Karoo biome is one of the most biologically underexplored areas of South Africa. For example, only 3% of plant records of the country come from this region, despite the fact that it occupies nearly 30% of the country's total area. Due to this, part of SANBI's deliverables was to conduct bioblitz exercises to collect data for ten different taxonomic groups within the study area.

THE BIOBLITZ PROCESS

A bioblitz is a process of conducting field surveys at a single site in a short time period (usually one day) with as many observers as possible. Bioblitzes are usually conducted by biologists who are specialists for specific taxonomic groups. Bioblitzes can also involve citizen scientists, and are an excellent opportunity to involve the public in biodiversity surveys.

A challenge about conducting field surveys within the Nama Karoo biome is that the whole ecology of the area is dependent on scarce and variable rainfall. Much of the biodiversity of this region is ephemeral, with many species of plants only flowering after rain. The plants in the Karoo region are only identifiable with flowers. In addition, invertebrate species (especially freshwater invertebrates that occur in ephemeral wetlands) and insect pollinators are not present as adults, but only in larval and egg life history stages, buried underground during dry periods. Sampling during dry spells misses at least 75% of species present in the Karoo.

It was thus imperative that bioblitzes were conducted at the correct time of the year after significant rainfall events. Although funding was received in January of 2015 fieldwork could not start before the SGD SEA was officially launched, this took place in May of 2015. At the start of this SEA, SANBI was given until May 2016 to obtain species data. Unfortunately, the times for submission of species data were brought forward to December 2015 during the first SEA Authors workshop that took place from 28 – 30 September 2015 so that the data could be included in the analysis for the first order draft of the biodiversity chapter. The best rainfall months in the Karoo are February to April. With the changes in timeframes of this project two field seasons were lost. In addition from May to December 2015 there was no rain at all in the Karoo as a result of the El Nino drought experienced across South

Africa. It was therefore not possible to conduct bioblitzes, with experts from all 10 different taxonomic groups. Two fieldtrips were however conducted in August 2015 and December 2015. During these fieldtrips it was clearly apparent that this was not the ideal time to survey for example many of the species present could not be identified.

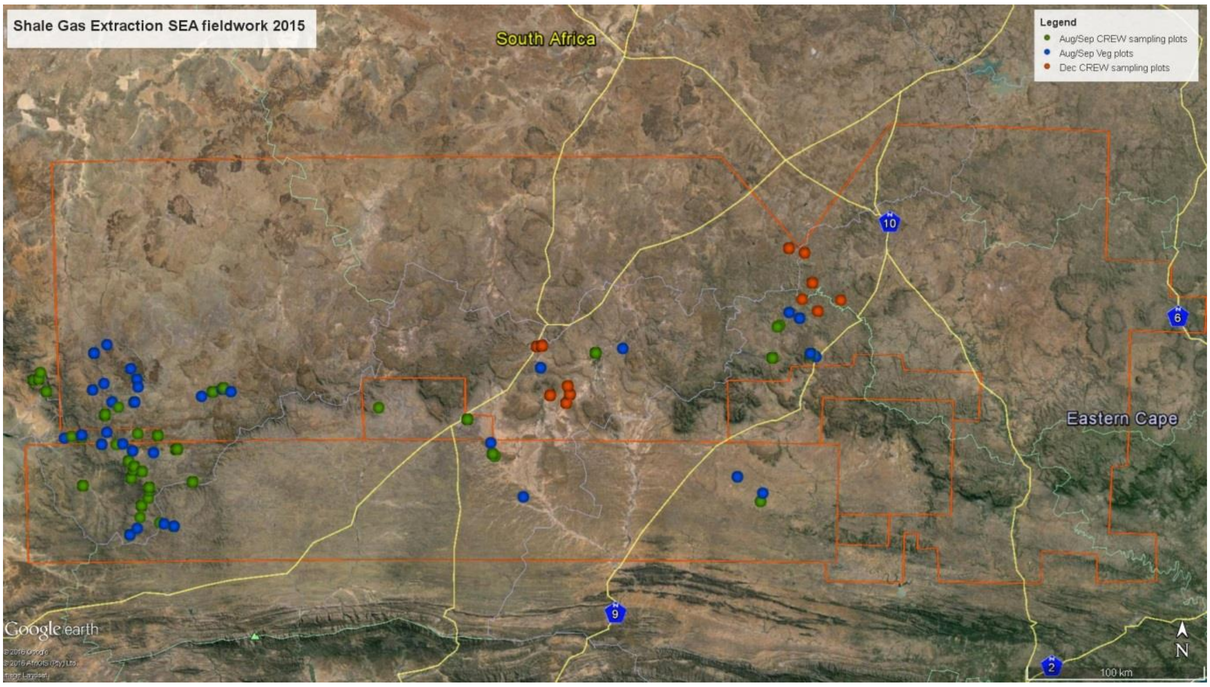

Figure 2: Bioblitzes conducted between August - December 2015 in the study area

A total of 16 days were spent in the field from 25 August – 9 September 2015. Nine days were spent surveying the western section of the SGD study area, in Sutherland, Fraserburg and Tanqua Karoo region, while seven days were spent in the central and western parts of the Karoo. 47 surveys for range restricted endemic and near endemic species were conducted. A total of 183 species was recorded and data was collected for 10 endemic species.

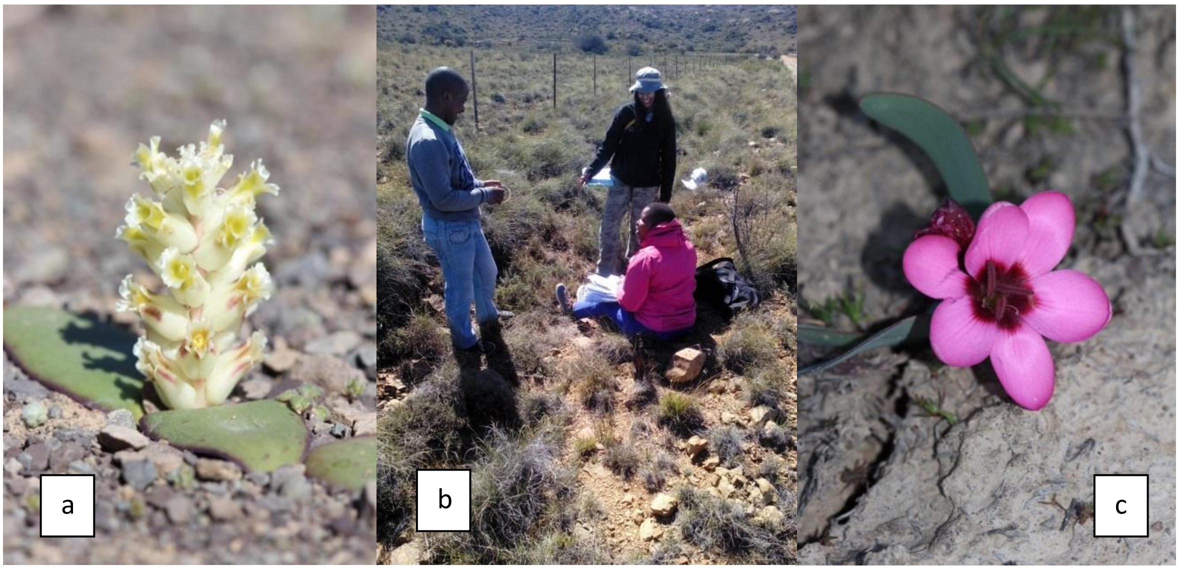

Figure 3a. *Lachenalia congesta*, a range restricted rare species endemic to the western section of the SGD study area, b. conducting bioblitzes in the field, c. *Heasperantha humilis*, a range restricted species from the Sutherland area

During December 2015, four days were spent in the field, despite the fact that no rain had been received. The focus of the field work was the eastern section of the study area stretching from Graaff-Reinet towards Beaufort West. Through mapping range restricted endemic and near endemics, it was apparent that the mountainous areas between the Roggeveld and Camdeboo regions are key hotspots for plants, however there are major information gaps for the lowlands. Efforts were taken in these lowlands areas as these areas might be the main focus should there be any shale gas development in the area. Due to the drought, many of the species were either not flowering (plants), or were dormant (animals). Despite this, 15 sites were surveyed and 45 species were recorded and data was collected on 4 endemic species.

Figure 4a. *Geranuim harveyi*, b. *Monsonia camdeboensis*, c. *Moraea crispa* three range restricted endemic species from the Eastern and Central section of the study area

In order to address the situation that all species data was to be submitted into the SEA process in December 2015, but that funding to conduct fieldwork from DEA stretched to May 2016, in March and April 2016 further surveys were done in the Karoo BioBlitz funding. Spiders, reptiles and plants were the focus of this fieldwork. The data collected were channelled into the larger Karoo BioGaps project detailed below.

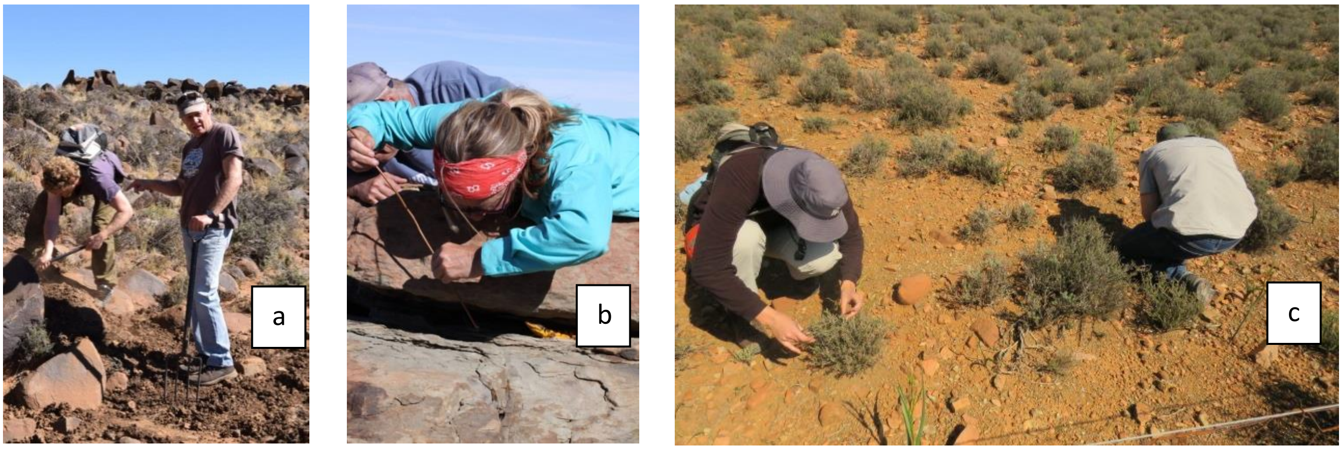

Figure 5: Fieldwork for Reptiles (a & b) and for plants and insects (c).

In addition, SANBI hosted a BioBlitz involving members of the public. The BioBlitz was held on Saturday 16 April 2016 near to Matjiesfontein in the Karoo. Over 70 people attended this BioBlitz and amongst others included community members from Beaufort West, individuals who had registered as interested and affected parties for the Karoo Shale Gas Strategic Environmental Assessment and government officials from the Department of Science and Technology, the Department of Minerals Resources, and the Northern Cape and Western Cape conservation agencies. Participants were guided by taxonomic experts on how to collect specimens of the different animal and plants groups that occur in the Karoo. Following a full day in the field, specimens were processed and an opportunity was provided to participants to learn how to process invertebrate and plant specimens.

Figure 6: The Karoo BioBlitz awareness day that took place in April 2016 involving members over 70 participants that ranges from community members to government officials (a& b). Participants were involved in surveying seven taxonomic groups shown here surveying for butterflies (c), collecting spiders (d) and identification of specimens (e).

Valuable observations of plants and animals were gained during the Karoo awareness BioBlitz and it started a citizen science engagement in the Karoo where citizens post their images of plants and animals onto the iSpot Citizen Science Portal, as part of the Karoo BioGaps project (detailed below) this project can be found at the following link http://www.ispotnature.org/projects/karoo-biogaps/observations/map. To date 4298 observations have been included on this portal. SANBI is in the process of engaging experts in identifying these postings so that citizen science observations can contribute to the overall datasets of animal and plant distributions feeding into decision making in the Karoo.

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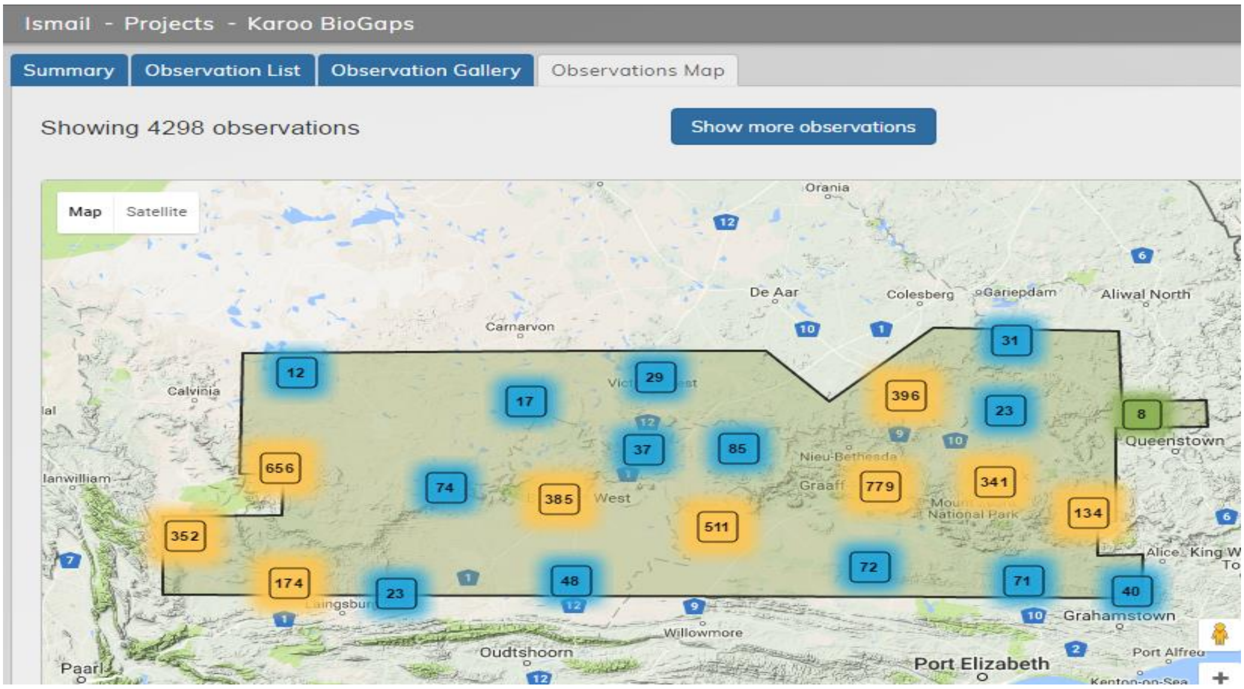

Figure 7: A screenshot image showing the number of citizen science observations posted for the Shale Gas Development Zone to date.

3. THE KAR00 BIOGAPS PROGRAMME AND FUTURE RESEARCH STIMULATED BY THE SHALE GAS SEA

During the process of conducting BioBlitzes and accumulating and assessing existing biodiversity data for the SGD SEA, a more nuanced understanding of the information gaps and biases was developed for Karoo plants and animals. The difficultly of thoroughly surveying the karoo in a one year period, due to the ephemeral nature of the species response to water availability was highlighted during the 2015 fieldwork. As a result, SANBI led a consortium of 18 collections and research institutions to secure funding from the National Research Foundation's (NRF) Foundational Biodiversity Information Programme (FBIP) for a three-year project entitled "BioGaps: Filling biodiversity information gaps to support development decision making in the Karoo" (referred to as "Karoo BioGaps Project").

The Karoo BioGaps Project aims to mobilise foundational biodiversity data to support the SEA for shale gas development and other potential infrastructure development projects in the Karoo basin. The current paucity of biodiversity data will be addressed through:

- integrating and upgrading existing species data located in museums and herbaria, and

- conducting detailed surveys for 12 representative taxonomic groups in areas targeted for shale gas exploration.

The 12 taxonomic groups are: plants, birds, mammals, fish, amphibians and reptiles; as well as six invertebrate groups: bees, dragonflies, grasshoppers, scorpions, butterflies and spiders. The BioBlitzes started during the SEA project will be continued until mid 2018.

50 Pentads that represent the climatic, edaphic, geographic and topographic variation of the Karoo have been selected by the by University of Cape Town's Centre for Statistics in Ecology, the Environment and Conservation (SEEC), to ensure that the sampling process is scientifically credible. After the first 6 months of field work it has become apparent that the BioGaps taxon leads will only be able to visit and sample the 30 pentads, leaving 20 peripheral pentads that require sampling. The power of statistical analyses to model the distribution and occupancy of species needed to feed into land-use decision making is significantly decreased if data from only 30 sites/pentads are utilised. Volunteer citizen scientists are thus being engaged to sample 20 pentads through conducting a further series of BioBlitz field trips. A minimum of 6 volunteers will carry out sampling in the focal pentads during each BioBltiz. BioBlitzes as part of the Karoo BioGaps project start in February of 2017.

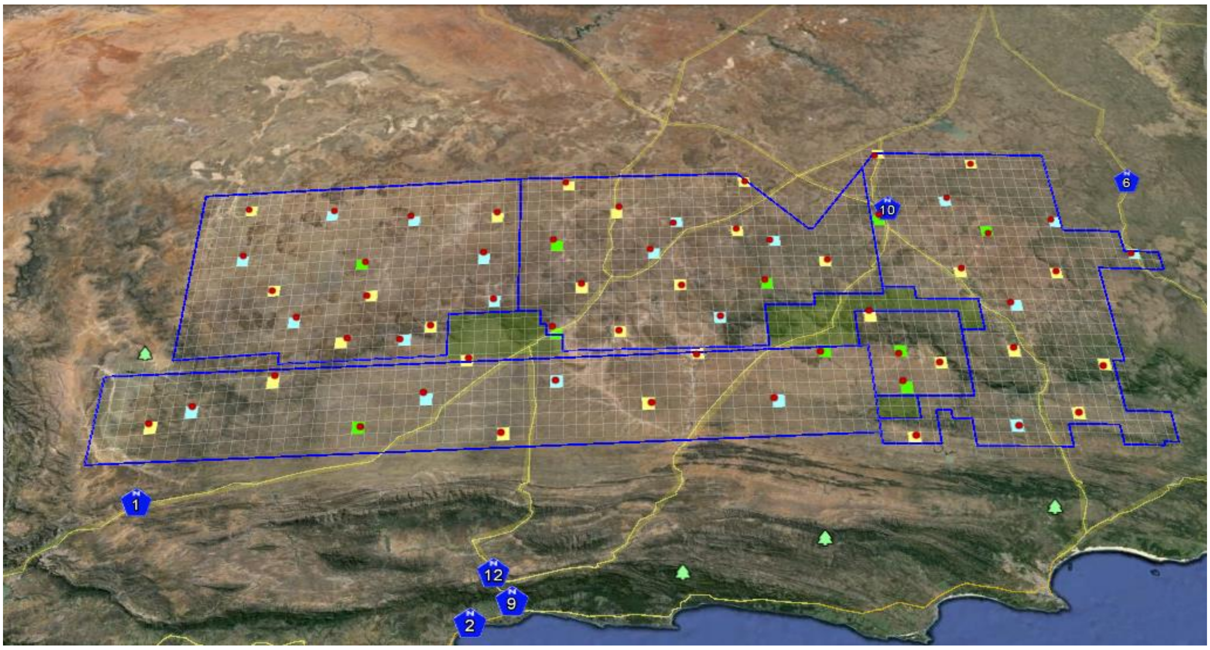

Figure 8: The randomly sampled statistically representative sample pentads for the Karoo BioGaps project. The yellow pentads represent the 30 pentads for where the taxon experts will sample, while the blue pentads will be sampled by citizen scientists. Green pentads are 10 additional sites that will be sampled for plant diversity only as part of SAEON's (South African Earth Observation Network), one of the project partner's, aims to effectively monitor the biodiversity of the Karoo.

4. MOBILISATION OF HISTORICALLY COLLECTED PLANT AND ANIMAL DISTRIBUTION DATA FOR USE IN THE SHALE GAS SEA

The first step to mobilising historic distribution data was to identify which plant and animal species of conservation concern occur in the Karoo. This exercise relied on extensive consultation of literature as well as bringing together various taxonomic experts of the Karoo region to assess historic data that could be used in the biodiversity assessment component.

4.1 Plants

There are over 7000 plant species occurring in the study area (Figure 1) for the shale gas development SEA. The approach was to first identify which plants are of conservation concern. Through discussions with the Karoo experts, plant species that have either 80% or their entire global range (near endemic) or that occur entirely (endemic) within the study area for the shale gas development SEA were selected as plant species of conservation concern. Endemic and near endemic plants were identified by checking all plants listed in the three regional flora's that cover the SGD study area (Snijnam, 2013, Maggee & Boatwright, in prep, Bredenkamp, in prep).

There are a total of 193 endemic and near endemic plants species that occur within the study area. Of these, 20 plants are too poorly known (no recent collections of these species exist) to be included in a spatial prioritisation plan. About 57 plants (Figure 9) are locally common and widespread within this area and are not likely to lose a significant proportion of their population to shale gas development, even under the large scale production scenarios. About 119 near endemic and endemic plants (Figure 10) have ranges and habitat requirements that are narrow and specific and likely to be threatened with extinction if there is large scale development. These species are of conservation concern and the area(s) of their concentration need to be avoided should there be shale gas development.

Occurrence records for each of these endemic and near endemic plants were gathered from SANBI's Botanical Research and Herbarium Management System (BRAHMS). All the records were not spatially geo-referenced. Four SANBI contract staff spent four months on geo-referencing about 2431 records obtained from herbarium specimens. Additional records were also obtained from the scientific literature (species descriptions and ecological studies). A spread sheet of all endemics and near endemics plants, along with their associated habitat preferences was produced and verified by experts during a workshop held on the 17-18 November 2015. All the occurrence records were fed into the spatial planning component of the Biodiversity chapter of the SEA.

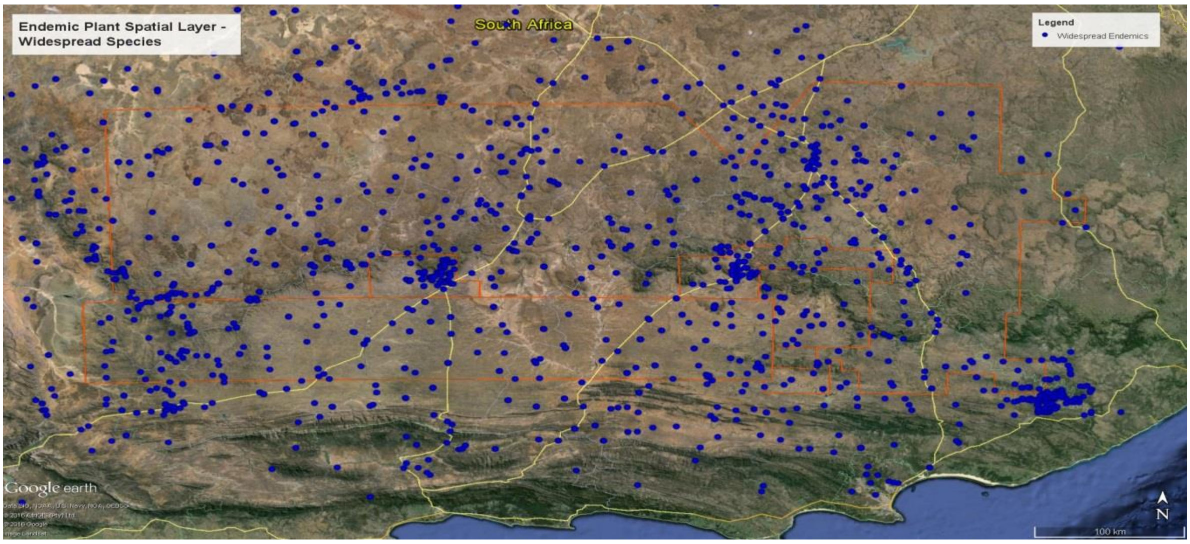

Figure 9: Distribution records of 57 plants species that are either endemic or near endemic that are common and widespread in the study area

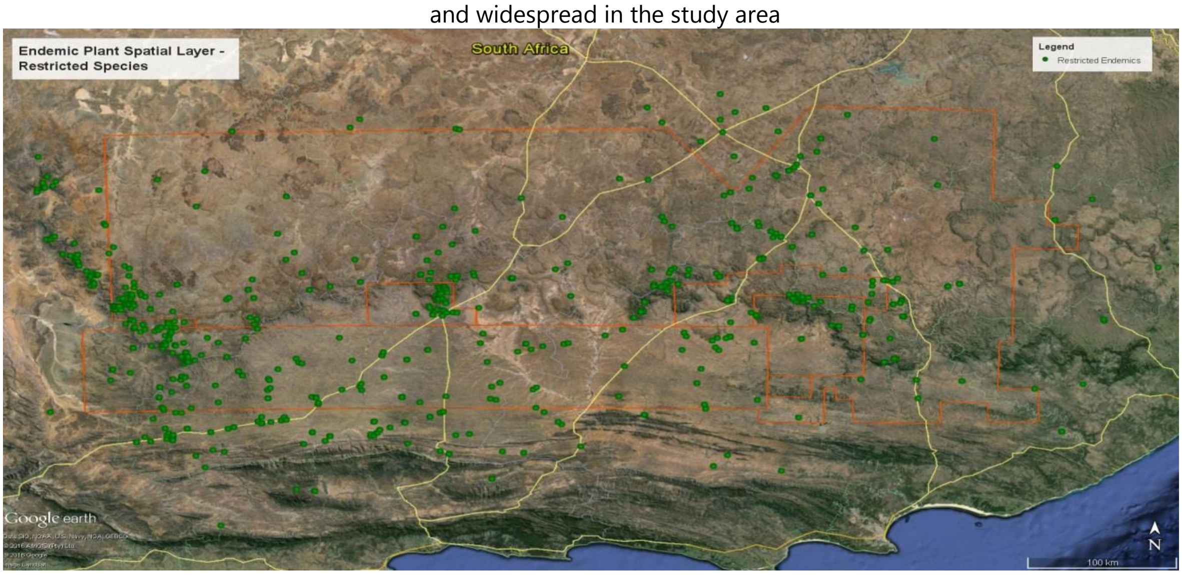

Figure 10: Restricted distribution range of 119 endemic and near endemic plant species in the Shale Gas Development study area

4.2 Animals

Two expert workshops were held, the first on the 5 June 2015 and the second one on the 17-18 November 2015 to identify animal species of conservation concern and to discuss which groups to include in the biodiversity assessment component. Species of conservation concern were considered as:

- Those that are endemic or largely endemic to the study area (>60% of distribution range in the study area)

- Those that are threatened and occur in the study area (threatened at a global level as per the IUCN). Only species that are relatively well known in terms of taxonomy and distribution were considered.

Below are the species of conservation concern that fed into the systematic biodiversity spatial plan of the SEA:

Mammals: Black-Footed Cat (Vulnerable) and Riverine Rabbit (Critically endangered); Sclater's Golden Mole (subspecies *Chlorotalpa sclateri shortridgei* (endemic to the study area)); *Elephantulus pilicaudus* (near endemic to the study area).

Birds: While there are no species endemic to the study area, and no threatened species occur in the focus area, species listed are endemic or near endemic to South Africa, and occurring in the focus area were included as priority birds. The following birds were included as priority species - Grey-wing falcon, Ground woodpecker, Blue korhaan, Karoo prinia, Namaqua warbler, Large-billed lark, Sickle-winged Chat, Southern double-collared sunbird, African rock pipit. In addition, a nesting colony of Cape Vultures in the study area has been flagged.

Reptiles:
Threatened species endemic to the focus area are Plains Mountain Adder (Endangered); and two species are near threatened: Karoo padloper and Braack's Pygmy gecko. An additional five species / subspecies are not threatened, but are endemic / near endemic to the focus area are also considered to be species of special concern (Cloete's Girdled Lizard, *Pseudocordylus microlepidotus namaquensis (*no common name) , Karoo Flat Gecko, Western Dwarf Girdled Lizard and Thin-skinned Gecko.
Amphibians: There are no threatened species in the study area; however there is one near endemic amphibian species of conservation concern, *Cacosternum karroicum*, in the study area.

Freshwater fish: There are five fish species that are endemic / near endemic, and that are threatened. These are the Eastern Cape redfin (*Pseudobarbus afer*), Amatola barb (*Barbus amatolicus*), Border barb (*Barbus trevelyani)* and the Cape rocky (*Sandelia bainsii*).

Invertebrates: There are two Anostraca species (fairly shrimp) that are known only from the Karoo region, seven terrestrial mollusc species (endemic or near endemic), one millipede species (endemic), 19 butterfly species (endemic or near endemic) of which one species is considered threatened and seven species are considered rare. There are six locust species thought to be endemic / near endemics, and two damselfly species that are endemic and threatened.

A total of 12, 000 records of animals occurring in the Karoo region were sourced from experts who took part in the data collection process. After the process of consultation, a total of 993 animal records (Figure 11) were fed into the systematic biodiversity spatial plan component of the biodiversity assessment.

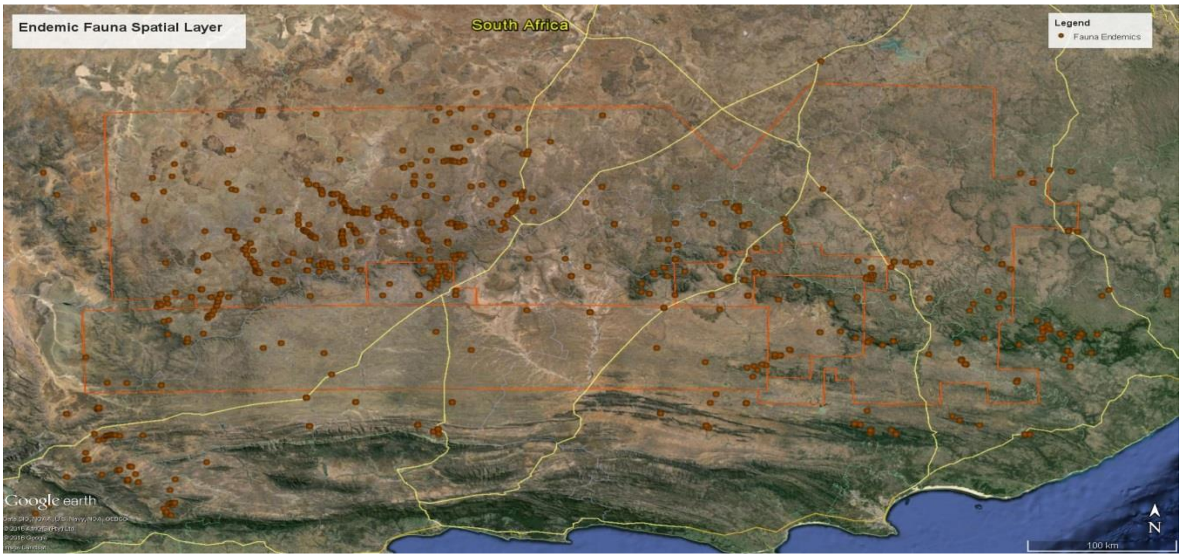

Figure 11: Distribution of animal species that are either endemic or near endemic in the study area

5. HOW THE DATA HAS BEEN USED TO UPDATE RELEVANT ENVIRONMENT SURFACES

5.1 Use of data for Shale Gas Development Strategic Environmental Assessment.

Accurate point distribution records for species of conservation concern identified and mobilised as described above were fed into the spatial prioritisation conducted as part of the Biodiversity component of the SGD SEA. 119 range-restricted plant species, and 12 globally threatened animal species have been recorded from the study area, with 2431 plant records (for the 119 range restricted species) and 993 animal records (for the 12 globally threatened animals) feeding into the spatial sensitivity analysis.

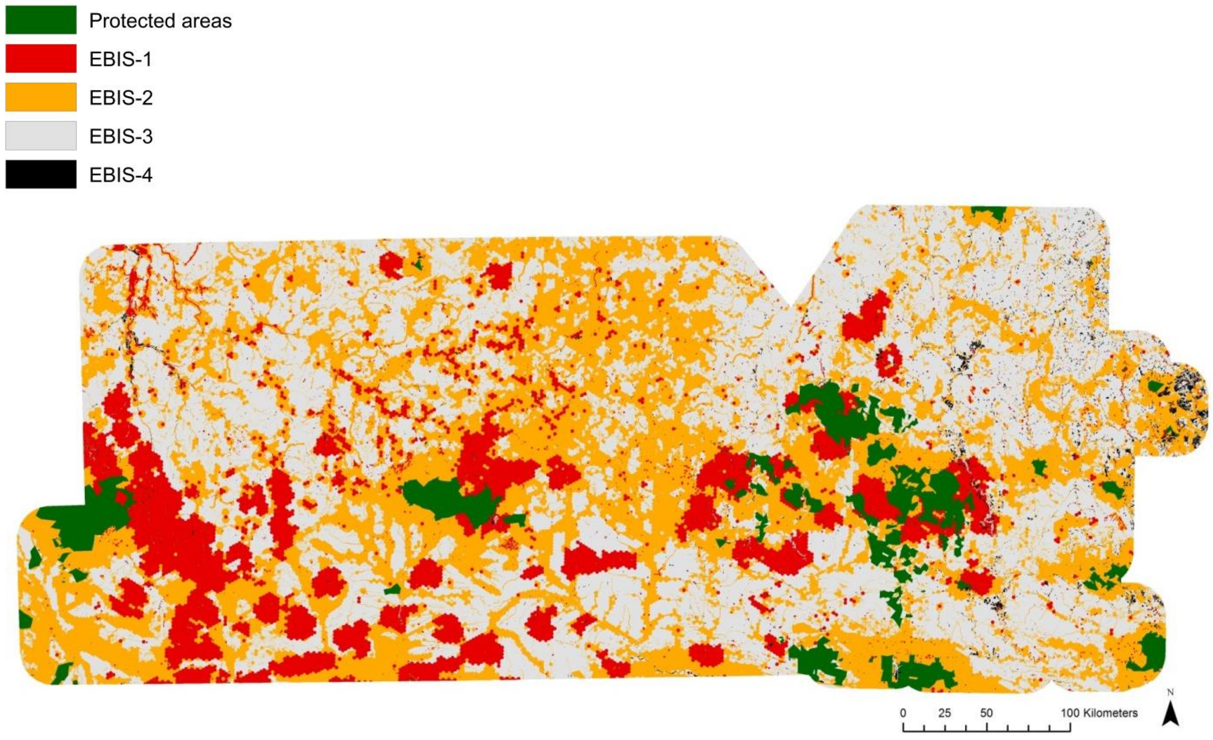

Figure 12: Map of Ecological and Biodiversity Importance and Sensitivity (EBIS) in the study area. Protected areas (5% of study area) are legally protected. EBIS-1 areas (13% of study area) contain extremely sensitive features and are irreplaceable. EBIS-2 areas (37% of study area) contain highly sensitive features and/or features that are important for achieving targets for representing biodiversity and/or maintaining ecological processes. Protected areas, EBIS-1 areas and EBIS-2 areas collectively meet targets for representation of biodiversity and maintenance of ecological processes in the study area. EBIS-3 areas (44% of the study area) are natural areas that do not contain currently known sensitive or important features. In EBIS-4 areas (1% of study area) there is no remaining natural habitat.

In the spatial sensitivity analysis for the SGD SEA four levels of Ecological and Biodiversity Importance and Sensitivity (EBIS) were identified. Species of conservation concern were used to identify the areas of highest ecological and biodiversity importance and sensitivity EBIS-1 (Figure 12).

EBIS-1 are defined in the analysis as areas that contain extremely sensitive features, such as key habitat for rare, endemic or threatened species, or features that perform critical ecological functions. These sites are irreplaceable (i.e. no ecologically equivalent sites exist and there is no exchangeability between sites). The land-use guideline recommendation for these areas are that SGD activities must be avoided, as impacts of SGD in these areas would undermine the ecological integrity of the Karoo. Ideally these areas should be secured through appropriate zoning, development controls, or protected area expansion through stewardship and other mechanisms.

5.2 Use of data for future land-use decision making for the Karoo Region.

All species distribution data collected during the Bioblitzes for the SGD SEA as well as the data currently being collected for 12 taxonomic groups working as part of the Karoo BioGaps project will be supplied to the University of Cape Town’s Centre for Statistics in Ecology, the Environment and Conservation (SEEC). Species occupancy modeling will be conducted by scientists working at SEEC. The Karoo BioGaps project team will develop a range of landuse guidelines linked to the likelihood of a species of conservation concern being predicted by the models to occur in different areas of the karoo. These data will feed into the land use decision support as part of DEAs screening tool for Shale Gas Development.

The data collected and georeferenced through the SGD bioblitzes as well as the data that is and will continue to be collected and georeferenced through the Biogaps project will be added to the existing data sets for the relevant taxonomic groups. Plot data collected also gets added to the veg map database, which helps in refining SANBIs vegetation boundaries in support of the updates to the National Vegetation Map. During the bioblitzes, wetland verification and ground- truthing for the SGD area was also done as one of SANBI’s wetlands team as well as desk top verification by the wetlands specialist on the Biodiversity Chapter of the SEA. This wetland data, as well as all the data digitised and improved on for Shale Gas SEA is being used to improve and inform the national wetland map, which will be relied on heavily in DEAs Screening Tool and forms part of the national wetland inventory for the National Biodiversity Assessment 2018.

Appendix 3

DRAFT FOR PEC COMMENT – 05 May 2017

Minimum Information Requirements in terms of the National Environmental Management Act (107 of 1998) as part of the application for an Environmental Impact Assessment (EIA) for Environmental Authorisation related to onshore shale gas exploration activities

Contents

1. Definitions

"**Exploration**", referring specifically to shale gas, means (1) the re-processing of existing seismic data, acquisition and processing of new seismic monitoring data and (2) the drilling of exploration wells or holes only for obtaining information pertaining to specific geological, structural and stratigraphic information that might lead towards the discovery of petroleum with no hydraulic fracturing.

“Appraisal”, referring specifically to shale gas, means further testing including horizontal drilling, pressure testing and hydraulic fracturing to assess the existence and commerciality of petroleum prior to the onset of production.

“Production” means any operation, activity or matter that relates to the development and production of petroleum.

"Seismic monitoring" means the monitoring of seismic activity using a network of calibrated seismological equipment in order to produce readings on magnitude, depth, location, error and time of each seismic event.

"Hydraulic fracturing" means injecting fracturing fluids into the target formation at a pressure exceeding the parting pressure of the rock to induce fractures through which petroleum can flow to the wellbore.

"Exploration well" means a vertical well drilled for the purpose of obtaining specific geological and geophysical information to prove, define and assess the existence and commerciality of petroleum.

"Horizontal well" means a well where the wellbore is drilled vertically to a kick-off depth beyond which the wellbore is deviated to run parallel to the target formation.

"**Exploration work programme**" means the approved exploration work programme indicating the petroleum operations to be conducted on the exploration area during the validity of the Exploration Right, including the details regarding the exploration activities, phases, equipment to be used and estimated expenditures for the different exploration activities and phases.

2. Context

(a) In terms of the National Environmental Management Act (Act 107 of 1998, as amended) ("NEMA") and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations promulgated in Government Gazette 38282 and Government Notice (GN) R984 on 8 December 2014, no one may commence with an activity identified in terms of Section 24(2)(a) of NEMA unless environmental authorisation in terms of NEMA has been obtained for the activity.

(b) An approval of an Environmental Management Programme ("EMPR") in terms of the Mineral and Petroleum Resources Amendment Act 2008 (Act No. 49 of 2008) ("MPRDA") does not constitute an environmental authorisation in terms of NEMA.

(c) The current applications submitted by shale gas development companies for Exploration Rights in terms of the MPRDA, prior to 8 December 2014, are pending and no application for environmental authorisation in terms of NEMA has been submitted to date. As such, applications for environmental authorisation are required prior to the commencement of any activities listed in the 2014 NEMA EIA Regulations (including Activity 20 of Listing Notice 1 and Activity 18 of Listing Notice 2).

(d) Regulation 10(b) of the Environmental Impact Assessment Regulations, 2014 (as amended) requires that an application for environmental authorisation comply with any protocol or Minimum Information Requirements ("MIRs") relevant to that application as identified by the Minister in a government notice.

(e) The MIRs provide the regulatory framework and process that will apply to applications for application for environmental authorisation for onshore shale gas exploration activities in order for the Competent Authority, to make decisions on the applications in a streamlined and responsible manner.

(f) The MIRs have been drafted in two parts to provide a step-wise regulatory process, accounting for the different phases of shale gas development operations so that baseline monitoring plans and baseline data can be submitted for approval as part of environmental authorisation applications to the Competent Authority. The MIRs provide a framework describing the nature and content of information which must be submitted prior to exploration and appraisal activities being approved as part of an environmental authorisation in terms of the NEMA. In this way, exploration is effectively detached from production via continuous Environmental Impact Assessments that account for the environmental and operational baseline data obtained during the preceding activities.

(g) The MIRs apply to shale gas exploration activities and must be read with Technical Regulations for Petroleum Exploration and Exploitation in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) and any other applicable Acts, regulations or guidelines. MIRs for shale gas appraisal activities will be developed separately.

3. Shale gas exploration activities

(a) **Exploration** activities are the first stage of the shale gas development cycle. They are typically concentrated in the initial 3-5 years, but are undertaken throughout the entire development cycle to inform the location of additional exploration and production activities if shale gas is found in suitable concentrations and flow rates. Exploration activities include 2-D seismics, 3-D seismics, vertical exploration wells, road development, trucks, water management and waste management.

4. Application for environmental authorisation for exploration

(1) Application

(a) Exploration activities for shale gas are subject to the requirements of the NEMA and any relevant Specific Environmental Management Acts.

(b) Before exploration activities related to shale gas may commence, the holder must be in possession of an Environmental Authorisation in terms of the Environmental Impact Assessment Regulations, 2014.

(c) The Competent Authority, with the Departments of Environmental Affairs, Science and Technology, Energy, Water & Sanitation, Agriculture Forestry and Fisheries; along with the relevant Provincial and Local Authorities, must be identified as interested and affected parties for the purposes of public participation to be undertaken as part of the Environmental Impact Assessment process.

(d) The South African National Biodiversity Institute, the Council of Geosciences and the Council for Scientific and Industrial Research must be identified as interested and affected parties for the purposes of public participation to be undertaken as part of the Environmental Impact Assessment process.

(e) An Proponent should, together with an application for environmental authorisation, also submit, for consideration to the Competent Authority, a –

i. Screening site-selection report;
ii. Shale gas exploration work programme; and
iii. Baseline monitoring programme for appraisal.

(2) **Screening site selection report**

(a) Potential exploration sites within an area where the Proponent holds an approved Exploration Right should be identified through a thorough screening site selection report which –

i. considers all environmental sensitivities based on existing and up-to-date spatial datasets. Datasets are obtainable from the Department of Environmental Affairs;
ii. considers the sensitivity of the Square Kilometre Array, the regulatory requirements of the Karoo Central Astronomy Advantage Area Astronomy in terms of the Geographic Advantage (AGA) Act, Act No.21 of 2007 and the Southern African Large Telescope in Sutherland, declared in terms of the AGA Act;
iii. considers the availability of existing services, infrastructure, and resources;
iv. identifies and confirms preferred sites, through a detailed site selection process, which includes an impact assessment process inclusive of cumulative impact and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment.

(b) The screening site selection report must contain information that is necessary for a proper understanding of the site selection process, informing all preferred alternatives. The scope of the screening site selection report must include –

i. documented public notification and consultation for the sites included in the screening site-selection report; and

ii. maps containing all considered environmental and social sensitivities, buffers, and existing services, infrastructure and resources.

(c) The Competent Authority must consider the screening site selection report and –

i. where needed request additional information or adaptive changes which consider local environmental and social sensitivities;

ii. decide to accept, or reject, all or some of the sites proposed in the screening site selection report to be assessed in the EIA phase; and

iii. decide to accept or reject the baseline monitoring programme for appraisal.

(3) Shale gas exploration work programme

(a) A shale gas exploration work programme must be produced which contains the information that is necessary for a proper understanding of the long-term plans of the exploration operations, and must include–

i. The proposed locations of seismic surveys, stratigraphic and exploration wells within the Exploration Right area;

ii. A description of the type of seismic survey to be used;

iii. The well design risk assessment which includes proposed control measures and an early warning monitoring and response system for failures, spills and contamination events.

(4) Baseline monitoring programme for appraisal

(a) A baseline monitoring programme for appraisal must be submitted to the Competent Authority and relevant departments. The baseline monitoring programme for appraisal must be submitted together with the exploration Environmental Impact Assessment application. The baseline monitoring programme for appraisal must detail the nature of the monitoring programme and the methods for data collection. The baseline monitoring programme for appraisal must immediately commence following approval of the application for environmental authorisation by the Competent Authority to run concurrently with the exploration Environmental Impact Assessment process.

(b) The baseline monitoring programme for appraisal, which must be approved by the Competent Authority with the exploration Environmental Impact Assessment application, must include –

i. Relevant geological information;
ii. a surface water baseline monitoring plan which will be considered by the Department of Water and Sanitation;
iii. a groundwater baseline monitoring plan which will be considered by the Department of Water and Sanitation and by the Council for Geoscience;
iv. a seismicity baseline monitoring plan which will be considered by the Council for Geoscience;
v. an air quality and greenhouse gas baseline monitoring plan which will be considered by the Department of Environmental Affairs: Air Quality Directorate;
vi. a biodiversity baseline monitoring plan which will be considered by the Department of Environmental Affairs: Biodiversity Directorate;
vii. a road infrastructure baseline monitoring plan,
viii. the siting of the various monitoring devices and stations;
ix. the sampling methodology for each plan;
x. the monitoring points for each plan;
xi. the monitoring parameters for each plan;
xii. the monitoring frequency for each plan; and
xiii. the reporting frequency for each plan.

(c) The designated Competent Authorities must consider the baseline monitoring programme for appraisal and –

i. where needed request additional information and adaptation of the baseline monitoring programme if required; and
ii. decide to accept or reject the baseline monitoring programme for appraisal as part of the Environmental Impact Assessment application for exploration.

5. Baseline monitoring programme implementation and reporting

(a) The approved baseline monitoring programme for appraisal must commence as part of the Environmental Impact Assessment for exploration activities –

i. on sites which have been accepted by the Competent Authority after consideration of the screening site selection report; and

ii. in accordance with the baseline monitoring programme for appraisal which was accepted by the Competent Authority with submission of the application for environmental authorisation.

(b) The baseline monitoring programme for appraisal must be overseen by a specialised inter-departmental monitoring unit to be established under the existing shale gas monitoring committee consisting of appointed panel members from those Departments governing the One Environmental System, namely: Water and Sanitation, Environmental Affairs and Mineral Resources.

(c) The draft baseline monitoring programme and data that it generates must be peer reviewed by a minimum of two independent and recognised experts.

(d) Analysis of baseline data collected during the baseline monitoring programme for appraisal must be executed using relevant nationally and internationally accredited facilities and according to relevant national norms and standards, or international norms and standards if relevant.

(e) Baseline data should be collected for a period of 12 months in the case of seismicity, air quality and greenhouse gas emissions, biodiversity, and road infrastructure. Baseline data should be collected for a period of time, no shorter than 36 months in the case of surface water and groundwater. All data must be collected, coordinated and logged by the project proponent under the guidance of the Environmental Assessment Practitioner and inter-departmental monitoring unit.

(a) Baseline monitoring reports for appraisal must be submitted prior to decision-making on the appraisal Environmental Impact Assessment process where the data will be publically disclosed. There must be disclosure of information on water use, volumes and characteristics of wastewater and air emissions, and fracking fluid additives and volumes, which must be displayed, on an ongoing basis, on a public disclosure register for all phases of the project life-cycle.

(f) The results must, at a minimum, include a detailed description of the sampling and testing conducted, including duplicate samples, the chain of custody of the samples and quality control of the testing.

(5) **Geological information and groundwater baseline monitoring**

(a) As part of the baseline monitoring report for appraisal, submitted to the Competent Authority during the Environmental Impact Assessment process for appraisal, a Proponent must describe geological information and assess the current quality and quantity of groundwater and other geohydrological features of the approved sites prior to appraisal activities and submit a groundwater baseline monitoring report to the designated agency for approval.

(b) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. geological map of the area (that can encompass several hydraulic fracturing sites for appraisal) at the appropriate scale and with details that will allow understanding of the potential structural aspects;
ii. analysis of all available geological information such as published and unpublished map sheets, satellite imagery and published and unpublished scientific papers;
iii. data from stratigraphic exploration boreholes to understand the regional stratigraphy and possible structural complexity. Proposed depth(s) to the top and the bottom of the formation into which well fracturing fluids are proposed to be injected;
iv. borehole analysis: core logging, downhole geophysics, camera, water strikes, hydrogeochemical character, injection tests in fractures or formations;
v. physical and chemical properties of the stratigraphic formations such as porosity, permeability, naturally occurring fissures and fractures, total organic carbon, clay and mineralogy;
vi. cross sections of the study area based on surface geology, exploration borehole and geophysical profiling showing the stratigraphy, including the presence and morphology of dolerite and kimberlite and tectonic structures;
vii. groundwater and deep groundwater assessment;
viii. a hydrocensus fulfilling the standard requirements of the Department responsible for water indicating all potentially affected water resources, at least 3 kilometres radius from the furthest point of horizontal drilling, as well as identify priority water

source areas and domestic groundwater supplies indicated on relevant geohydrological maps; and

ix. models of fluid migration within the target geological formation.

(6) **Surface water baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. water quality monitoring data of resources within the appraisal work programme;

ii. water quantity monitoring data of resources within the appraisal work programme;

iii. habitat integrity monitoring data of resources within the appraisal work programme; and

iv. weather data such as daily precipitation and evaporation, regionally, and within the appraisal work programme.

(b) Surface water baseline monitoring should cover all four seasons, for a period not less than 36 months, including at least a wet and a dry year, at representative sites.

(7) **Seismicity baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. all available background seismicity data;

ii. building typologies in the region;

iii. structural integrity of buildings and structures;

iv. desktop studies of existing geological maps;

v. identified stressed faults which must be avoided in the fracturing process;

vi. identified fracture behaviour of targeted formations;

vii. seismic reflection and refraction data where available;

viii. stress data from proximal boreholes where available; and
ix. other relevant available geophysical data such as gravity.

(8) **Air quality and greenhouse gases baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information, as it regards environmental and human health –

i. NOx baseline concentrations;
ii. SO_2 baseline concentrations;
iii. PM baseline concentrations;
iv. VOCs baseline concentrations;
v. CO_2 baseline concentrations; and
vi. N_2O baseline concentrations.

(9) **Biodiversity baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. species diversity and abundance;
ii. habitats;
iii. terrestrial ecosystems;
iv. aquatic ecosystems; and
v. Broad-scale processes.

(10) **Road infrastructure baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for appraisal. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. condition of roads and bridges within affected by appraisal;
ii. current traffic volumes;
iii. remaining life of roads and bridges; and
iv. pavement condition data.

6. Environmental Impact Assessment Process

(a) The Environmental Impact Assessment phase for exploration may commence after the dedicated competent authorities have accepted and approved the baseline monitoring programme for appraisal.

(b) The Environmental Impact Assessment must –

    i. be executed in adherence to Appendix 3 of the Environmental Impact Assessment Regulations of 2014.

7. Specialist studies

(a) Specialist studies must be executed by relevant nationally accredited and independent specialists, and should be undertaken in adherence to Appendix 6 of the Environmental Impact Assessment Regulations of 2014.

(b) The following specialist studies may be considered, depending on the scope of work outlined in the exploration work programme:

    i. Biodiversity impact assessment consistent with applicable protocols (Appendix C);
    ii. Agriculture impact assessment consistent with applicable protocols (Appendix D);
    iii. Heritage resources impact assessment consistent with applicable protocols (Appendix E);
    iv. Electromagnetic interference with applicable protocols (Appendix F);
    v. Surface water and groundwater impact assessment;
    vi. Noise impact assessment;
    vii. Socio-economic impact assessment; and
    viii. Waste management impact assessment.

8. Public Participation

(a) Public participation should be undertaken during the Environmental Impact Assessment Phase in adherence to Chapter 6 of the Environmental Impact Assessment Regulations of 2014.

9. Environmental Management Programme

(a) The Environmental Management Programme (EMPr) must adhere to the regulations as set out in Appendix 4 of the Environmental Impact Assessment Regulations of 2014 and contain at a minimum –

i. information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address identified environmental impacts in respect of the following key phases of the project lifecycle –

   - planning and design;
   - pre-construction and construction activities;
   - the operation or undertaking of the activity in question;
   - the rehabilitation of the environment; and
   - closure and post closure monitoring for legacy impacts.

ii. details of the person who prepared the EMPr; and the expertise of that person to prepare an EMPr;

iii. a detailed description of the aspects of the activity that are covered by the EMPr;

iv. information identifying the persons who will be responsible for the implementation of the measures;

v. information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance;

vi. as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and

vii. a description of the manner in which it intends to-

   - modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
   - remedy the cause of pollution or degradation and migration of pollutants; and
   - comply with any prescribed environmental management standards or practices.

(b) The EMPr must, where appropriate, contain -

i. time periods within which the measures contemplated in the EMPr must be implemented;

ii. measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of exploration activities which may occur inside and outside the boundaries of the Exploration Right area; and

iii. an environmental awareness plan describing the manner in which-

- the Proponent intends to inform his or her employees of any environmental risk which may result from their work; and
- risks must be dealt with in order to avoid pollution or the degradation of the environment.

(c) The Proponent and any person issued with an environmental authorisation-

i. must at all times give effect to the general objectives of integrated environmental management laid down in Section 23 of the NEMA;

ii. must consider, investigate, assess and communicate the impact of his or her exploration activities on the environment;

iii. must manage all environmental impacts-

- in accordance with his or her approved EMPr, where appropriate; and
- as an integral part of the reconnaissance, prospecting or mining, exploration or production operation, unless the Minister of Minerals and Energy directs otherwise

(d) must monitor and audit compliance with the requirements of the EMPr;

10. Subsequent environmental authorisations

(1) Environmental authorisation for appraisal activities

(a) The Proponent may apply for Environmental Authorisation for additional exploration or appraisal activities if –

i. The application for Environmental Authorisation, screening site selection report, exploration work programme and baseline monitoring programme for appraisal are accepted by the Competent Authority; and

ii. Following the Environmental Impact Assessment process for exploration, the application for Environmental Authorisation for exploration receives a positive decision and exploration activities are undertaken in a manner consistent with the associated EMPr.

(b) Each Environmental Authorisation for exploration, based on the scope of work as outlined in the exploration work programme requires a separate Environmental Authorisation, which may be obtained by –

i. Specifying and assessing additional and cumulative impacts and actions based on continuous monitoring; and

ii. Updating the EMPr based on the continuous monitoring data and availability of new information.

11. Financial Penalties

(a) Strict enforcement and penalties will be applied in the event of non-compliance of the Environmental Authorisation. Over and above the usual remedies such as suspension or revocation of the Environmental Authorisation, the Environmental Authorisation should provide for significant administrative penalties in the case of violations of conditions in the Environmental Authorisation and/or other legislative provisions.

12. Financial Provisioning for closure

(a) An Proponent must provide details for financial provisioning for closure, contamination events and on-going life-cycle monitoring post well decommissioning as provided for in the National Environmental Management Act: Regulations: Financial provision for rehabilitation, closure and post closure of prospecting, exploration, mining or production operations (GN1147) No. 39425.

Appendix A: Pre-production phases of shale gas development activities showing the activities, timeframes and regulatory check that will be implemented as part of the MIRs for exploration and appraisal

<table>
<tr><th colspan="6">Pre-production phases of shale gas development</th></tr>
<tr><td>Phase</td><td>Exploration</td><td rowspan="4">Competent authority accept or rejects checks 1-4</td><td>Appraisal</td><td rowspan="4">Competent authority accept or rejects checks 1-6</td><td rowspan="4">Commencement of appraisal activities</td></tr>
<tr><td>Activities</td><td>2-D seismics, 3-D seismics, vertical exploration wells, roads, trucks, water and waste management.</td><td>2-D seismics, 3-D seismics, vertical exploration wells, horizontal exploration wells, hydraulic fracturing, trucks, water management, waste management, flaring</td></tr>
<tr><td>Typical timeframe</td><td>3 years</td><td>5 years</td></tr>
<tr><td>Regulatory checks – approval required</td><td>1. Screening site-selection report
2. Shale gas exploration work programme
3. Baseline monitoring programme for appraisal
4. Environmental authorisation required for exploration activities</td><td>1. Screening site-selection report
2. Shale gas appraisal work programme
3. Quantitative risk assessment report
4. Baseline monitoring programme for production
5. Ongoing monitoring programme
6. Environmental authorisation required for exploration activities</td></tr>
<tr><td></td><td colspan="5">Three to five years baseline monitoring prior to hydraulic fracturing activities →</td></tr>
</table>

Appendix B: Decision-making mandates and permit requirements

Decision	Competent Authority	Legislation	Regulatory process
Exploration and Production Rights	DMR and PASA	MPRDA	EMPr initial submissions made to PASA in 2010 and 2011. DMR requested EMPrs to be updated in November 2014. DMR has not yet decided on any of the existing Exploration Right applications.
Environmental Authorisation	DMR and PASA	NEMA	No applications for Environmental Authorisation in terms of the NEMA have been submitted to date. Applications would be guided by the NEMA Minimum Information Requirements (MIRs) amongst other

Decision	Competent Authority	Legislation	Regulatory process
			legislation. DMR is the competent authority with DEA providing decision on appeals.
Atmospheric Emission Licence	DEA	NEM:AQA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DEA remain the competent authority.
Waste License	DMR	NEM:WA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DMR are the competent authority.
Water Use License	DWS	NWA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DWS are the competent authority. The Catchment Management Agencies will process all applications but the final authority to issue the license will be National Office – currently the Director General possibly later the Deputy-Director General of Water Sector Regulation.
Municipal Planning Decision	Relevant local authority	SPLUMA, LUPA and By-laws	For non-invasive 3-D seismic surveys rezoning will not be required. For the development of well pads, regional services, infrastructure servitudes, wastewater treatment works, housing developments, camps, gravel pits, landfill sites, roads, the subdivision of farmland etc., these will require rezoning. A Municipal Application must be submitted to the Municipality or in some cases (if the general welfare of the inhabitants of the region are affected) the land development applications could require provincial approval and in other instances when the activity is considered a national interest, the national Minister responsible for SPLUMA then has decision-making oversight.
Provincial Planning Decision	Provincial competent authority	SPLUMA and LUPA	

Appendix C: Protocol for biodiversity assessments

Colour	Sensitivity	Interpretation of Sensitivity	Further Assessment Requirements
Dark Red	Very High	No loss or degradation of Very High sensitivity areas is acceptable. These areas are irreplaceable and no ecologically equivalent areas exist for securing the features they contain.	Full biodiversity impact assessment conducted by competent terrestrial ecologist is required (Level 1 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Red	High	In High sensitivity areas, loss or degradation is acceptable only if ecologically equivalent sites are identified and secured through biodiversity offsets or equivalent mechanisms. An ecologically equivalent site means a site that contains equivalent ecological processes, ecosystems and species, and that compensates for the full ecological impact of the activity as identified through a detailed study.	Full biodiversity impact assessment conducted by competent terrestrial ecologist, plus an ecological offset study is required. (Level 1 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Yellow	Medium	Other natural or semi-natural areas that do not contain currently known sensitive or important features, and are not required for meeting targets for representing biodiversity or maintaining ecological processes. Provided that Very High and High areas are secured, loss of habitat in Medium sensitivity areas should not compromise the ability to achieve biodiversity targets in the Karoo, as long as the impacts in the Medium sensitivity areas do not extend into adjacent areas of higher importance or sensitivity.	Biodiversity impact assessment conducted by competent terrestrial ecologist (Level 3 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Green	Low	Areas in which there is no remaining natural habitat, e.g. urban areas, larger scale highly degraded areas, large arable intensively farmed lands. Shale gas development activities in these sites should result in minimal biodiversity loss, as long as the impacts do not extend to adjacent Very High and High sensitivity areas.	Biodiversity impact assessment conducted by competent terrestrial ecologist (Level 3 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).

Appendix D: Protocol for agricultural assessments

Sensitivity Class	Interpretation of Sensitivity	Further assessment requirements for electricity grid infrastructure developments
Very High	Very High and High agricultural sensitivity	Should the development envelope be required to be located on areas identified as Very High or High sensitivity as determined through the sensitivity mapping process, a comprehensive Agricultural Impact Assessment shall be undertaken for such areas. The Agricultural Impact Assessment shall be undertaken by a competent agricultural scientist undertaken in accordance with the NEMA regulations pertaining to specialist reports and impact assessment. The assessment of agricultural impacts and application for agricultural authorisation should be by way of a report compiled and signed off by a SACNASP-registered agricultural scientist.
High		
Medium	Medium agricultural sensitivity	Should the development envelope be required to be located on areas identified as Medium sensitivity as determined through the sensitivity mapping process, a compliance statement by a competent agricultural scientist is required.
Low	Low agricultural sensitivity.	Should the development envelope be required to be located on areas identified as Low sensitivity as determined through the sensitivity mapping process, a compliance statement by a competent agricultural scientist is required.

Appendix E: Protocol for Heritage (including palaeontology) Impact Assessments

Sensitivity Class	Interpretation	Assessments at project level	Motivating for exemption from an HIA	Permit requirements
Very High	Very High sensitivity includes all known heritage and palaeontological sites.	Proposed shale gas development infrastructure should avoid these areas. If avoidance cannot be achieved, a Heritage Impact Assessment (HIA) would almost certainly be required.	A HIA may not be required if such motivation was included in the initial notification prepared by a competent heritage specialist. In order to motivate for a HIA not to be required the inputs from an archaeology specialist is required as part of the notification. Site visits to inform the notification may also be necessary to motivate for an HIA not to be required, and are up to the discretion of the specialist providing input to the notification. In most cases, it will be sufficient for only the heritage specialist preparing the notification to visit the site before an exemption from further assessment can be motivated. If exemption from further	A permit under Section 27 of the NHRA will be required
High	High sensitivity includes all areas which are, or have the potential to be, highly sensitive in terms of heritage and palaeontological resources because either: Previous assessments have identified heritage resources which are classified as being of high significance, or there is a high probability of encountering a significant heritage resource.	These areas include or have the potential to include heritage and palaeontological resources of conservation status or have the potential to include cultural heritage resources which will require conservation or lengthy mitigation. A HIA would almost certainly be required to investigate the potential presence of these resources and, where applicable, the potential impact to such resources in the context of the proposed development.		If the development impacts on heritage and palaeontological resources of medium or high significance a permit under Section 35 of the NHRA would normally[1] be required before impact and/or mitigation may occur.
Medium	Medium sensitivity represents areas	These areas include resources which		

[1] Note that Heritage Western Cape currently does not require 'permits' for generally protected heritage resources under the NHRA when developments trigger Section 38 of the NHRA. Instead, a work plan is required which is very similar to a permitting process.

(orange)	inside of the shale gas development region which are or have the potential to be sensitive to development in terms of heritage resources because either: Previous assessment of the area have identified heritage resources which are considered to be of medium significance, or there is a medium probability of encountering significant heritage resources	may require mitigation or have the potential to include cultural heritage resources which will require mitigation. A HIA is likely to be required to investigate the potential presence of these resources and, where applicable, the potential impact to such resources in the context of the proposed development.	assessment is motivated, the notification must contain proposed mitigation measures for inclusion in the Environmental Management Programme (EMPr).	
Low (green)	Low sensitivity represents areas not likely to be sensitive to development in terms of heritage resources because previous assessment has revealed the area to contain no resources or resources of low significance.	No further assessment is necessary for proposed development in these areas.	A HIA is not required in Low sensitivity areas therefore applications for exemption do not apply.	No permit is required for development to proceed in these areas.

Appendix F: Protocol for electromagnetic interference assessment

<table>
<tr><th>Sensitivity Class</th><th>Interpretation</th><th>Assessments at project level</th></tr>
<tr><td>Very High</td><td>In Very High sensitive areas there is a high likelihood of significant negative impacts that cannot be mitigated. In-depth assessment of the potential impacts, and proof of efficacy of proposed mitigation measures, will be required before development can be considered in these areas. Following construction, proof of compliance with mitigation requirements will be required should the proposed development be considered favourably.</td><td rowspan="3">Proponents intending to undertake shale gas development that triggers an environmental assessment process in Very High to Medium sensitivity areas must prove to the relevant Competent Authority that the proposed development will not have an unacceptable negative impact on the SKA project. In order to do so, the proponent must request a comment from SKA South Africa confirming no unacceptable impact on components of the array.

SKA South Africa will conduct a high level risk assessment on the proposed development, and will consider the following:
• The potential Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) emitted;
• The footprint of the proposed shale gas development activities;
• The distance of the footprint of activities from the radio site;
• The elevation drill rigs relevant to the radio site; and
• Whether the shale gas development activities will be in line of sight of the receptors, or whether topographical shielding exists.

Should SKA South Africa determine that an in-depth assessment is required, the proponent will be required to undertake, at own cost, the relevant assessments. These can be sub-contracted to relevant experts in the field, and will include:
• Radio frequency measurements of operational facilities of equivalent electrical and structural design, to determine the RFI and EMI characteristic emissions profile;
• Radio frequency propagation modelling between the proposed facility and the nearest SKA stations at risk; and
• Any other studies that may be required and will be determined in consultation</td></tr>
<tr><td>High</td><td>In High sensitivity areas there is potential for negative impacts that can potentially be mitigated. In-depth assessment of the potential impacts and proven mitigation measures will be required before development can be considered in these areas. Following construction, proof of compliance with mitigation requirements will be required, should the proposed development be considered favourably.</td></tr>
<tr><td>Medium</td><td>In Medium sensitivity areas there is a low potential for negative impacts, and if there are impacts there is a high likelihood of mitigation. Further high level risk assessment of the potential impacts is required.</td></tr>
</table>

	An in-depth assessment may be required, if found necessary through the high level risk assessment.	between the SKA project and the relevant proponent. The results of such an in-depth assessment shall be provided to the SKA South African for consideration. Based on the results of high level risk assessment and in-depth assessment (where required), SKA South African shall issue a comment in the form of a 'letter of objection' or 'letter of no objection' on whether the proposed development can proceed and whether any specific mitigation is required. Proponents must receive a 'letter of no objection' from SKA South Africa before submitting an application for environmental authorisation in terms of NEMA. The 'letter of no objection' shall be submitted together with the application for environmental authorisation. Any mitigation requirements stipulated by SKA South Africa in its comment will be included as a condition on the Environmental Authorisation. Any mitigation measures recommended will be tested by SKA South Africa to ensure compliance following implementation, and the Environmental Authority responsible for the EA will be notified of the results of these tests.
Low	No expected impacts.	No assessment or authorisation for electricity grid infrastructure development in terms of the SKA project is required if the proposed development is not within the sensitive distances from radio sites. SKA South Africa must, however, be notified as an Interest and Affected Party if the development is located within the Northern Cape Province.

Appendix 4

DRAFT FOR PEC COMMENT – 05 May 2017

Minimum Information Requirements in terms of the National Environmental Management Act (107 of 1998) as part of the application for an Environmental Impact Assessment (EIA) for Environmental Authorisation related to onshore shale gas appraisal activities

Contents

1. Definitions

"**Exploration**", referring specifically to shale gas, means (1) the re-processing of existing seismic data, acquisition and processing of new seismic monitoring data and (2) the drilling of exploration wells or holes only for obtaining information pertaining to specific geological, structural and stratigraphic information that might lead towards the discovery of petroleum with no hydraulic fracturing.

"Appraisal", referring specifically to shale gas, means further testing including horizontal drilling, pressure testing and hydraulic fracturing to assess the existence and commerciality of petroleum prior to the onset of production.

"Production" means any operation, activity or matter that relates to the development and production of petroleum.

"Seismic monitoring" means the monitoring of seismic activity using a network of calibrated seismological equipment in order to produce readings on magnitude, depth, location, error and time of each seismic event.

"Hydraulic fracturing" means injecting fracturing fluids into the target formation at a pressure exceeding the parting pressure of the rock to induce fractures through which petroleum can flow to the wellbore.

"Hydraulic fracturing additive" means a chemical substance or combination of substances, including, but not limited to a chemical and proppant that is added to a base fluid for the purposes of preparing hydraulic fracturing fluid;

"Hydraulic fracturing fluid" means the mixture of the base fluid and the hydraulic fracturing additives used to perform hydraulic fracturing;

"Hydraulic fracturing flowback" means hydraulic fracturing fluid and other fluids that return to the surface after hydraulic fracturing has been completed and prior to the well being placed in production;

"Exploration well" means a vertical well drilled for the purpose of obtaining specific geological and geophysical information to prove, define and assess the existence and commerciality of petroleum.

"Horizontal well" means a well where the wellbore is drilled vertically to a kick-off depth beyond which the wellbore is deviated to run parallel to the target formation.

"**Appraisal work programme**" means the approved appraisal work programme indicating the petroleum operations to be conducted on the exploration area during the validity of the Exploration Right, including the details regarding the exploration activities, phases, equipment to be used and estimated expenditures for the different exploration activities and phases.

2. Context

(a) In terms of the National Environmental Management Act (Act 107 of 1998, as amended) ("NEMA") and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations promulgated in Government Gazette 38282 and Government Notice (GN) R984 on 8 December 2014, no one may commence with an activity identified in terms of Section 24(2)(a) of NEMA unless environmental authorisation in terms of NEMA has been obtained for the activity.

(b) An approval of an Environmental Management Programme ("EMPR") in terms of the Mineral and Petroleum Resources Amendment Act 2008 (Act No. 49 of 2008) ("MPRDA") does not constitute an environmental authorisation in terms of NEMA.

(c) The current applications submitted by shale gas development companies for Exploration Rights in terms of the MPRDA, prior to 8 December 2014, are pending and no application for environmental authorisation in terms of NEMA has been submitted to date. As such, applications for environmental authorisation are required prior to the commencement of any activities listed in the 2014 NEMA EIA Regulations (including Activity 20 of Listing Notice 1 and Activity 18 of Listing Notice 2).

(d) Regulation 10(b) of the Environmental Impact Assessment Regulations, 2014 (as amended) requires that an application for environmental authorisation comply with any protocol or Minimum Information Requirements ("MIRs") relevant to that application as identified by the Minister in a government notice.

(e) The MIRs provide the regulatory framework and process that will apply to applications for environmental authorisation for onshore shale gas appraisal activities in order for the

Competent Authority, to make decisions on the applications in a streamlined and responsible manner.

(f) The MIRs have been drafted in two parts to provide a step-wise regulatory process, accounting for the different phases of shale gas development operations so that baseline monitoring plans and baseline data can be submitted for approval as part of environmental authorisation applications to the Competent Authority. The MIRs provide a framework describing the nature and content of information which must be submitted prior to exploration and appraisal activities being approved as part of an environmental authorisation in terms of the NEMA. In this way, exploration and appraisal are effectively detached from production via continuous Environmental Impact Assessments that account for the environmental and operational baseline data obtained during the preceding activities.

(g) The MIRs apply to shale gas appraisal activities and must be read with Technical Regulations for Petroleum Exploration and Exploitation in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) and any other applicable Acts, regulations or guidelines. MIRs for shale gas appraisal activities will be developed separately.

3. Shale gas appraisal activities

(a) **Exploration** activities are the second stage of the shale gas development cycle. They are typically concentrated 5 years, but are undertaken throughout the entire development cycle to inform the location of additional appraisal and production activities if shale gas is found in suitable concentrations and flow rates. Appraisal activities include 2-D seismics, 3-D seismics, vertical exploration wells, horizontal appraisal wells, hydraulic fracturing, road development, trucks, water management, waste management and potentially flaring.

4. Application for environmental authorisation for exploration

(1) Application

(a) Appraisal activities for shale gas are subject to the requirements of the NEMA and any relevant Specific Environmental Management Acts.

(b) Before appraisal activities related to shale gas may commence, the holder must be in possession of an Environmental Authorisation in terms of the Environmental Impact Assessment Regulations, 2014.

(c) The Competent Authority, with the Departments of Environmental Affairs, Science and Technology, Energy, Water & Sanitation, Agriculture Forestry and Fisheries; along with the relevant Provincial and Local Authorities, must be identified as interested and affected parties for the purposes of public participation to be undertaken as part of the Environmental Impact Assessment process.

(d) The South African National Biodiversity Institute, the Council of Geosciences and the Council for Scientific and Industrial Research must be identified as interested and affected parties for the purposes of public participation to be undertaken as part of the Environmental Impact Assessment process.

(e) An Proponent should, together with an application for environmental authorisation, also submit, for consideration to the Competent Authority, a –

i. Screening site-selection report;
ii. Shale gas appraisal work programme;
iii. Quantitative risk assessment report;
iv. Baseline monitoring programme for production; and
v. Ongoing monitoring programme for appraisal.

(2) **Screening site selection report**

(a) Potential appraisal sites within an area where the Proponent holds an approved Exploration Right should be identified through a thorough screening site selection report which –

i. considers all environmental sensitivities based on existing and up-to-date spatial datasets. Datasets are obtainable from the Department of Environmental Affairs;
ii. considers the sensitivity of the Square Kilometre Array, the regulatory requirements of the Karoo Central Astronomy Advantage Area Astronomy in terms of the Geographic Advantage (AGA) Act, Act No.21 of 2007 and the Southern African Large Telescope in Sutherland, declared in terms of the AGA Act;
iii. considers the availability of existing services, infrastructure, and resources;
iv. identifies and confirms preferred sites, through a detailed site selection process, which includes an impact assessment process inclusive of cumulative impact and a ranking process of all the identified alternatives

focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment.

(b) The screening site selection report must contain information that is necessary for a proper understanding of the site selection process, informing all preferred alternatives. The scope of the screening site selection report must include –

i. documented public notification and consultation for the sites included in the screening site-selection report; and

ii. maps containing all considered environmental and social sensitivities, buffers, and existing services, infrastructure and resources.

(c) The Competent Authority must consider the screening site selection report and –

i. where needed request additional information or adaptive changes which consider local environmental and social sensitivities;

ii. decide to accept, or reject, all or some of the sites proposed in the screening site selection report to be assessed in the EIA phase;

iii. decide to accept or reject the baseline monitoring programme for production; and

iv. decide to accept or reject the ongoing monitoring programme for appraisal.

(3) **Shale gas appraisal work programme**

(a) A shale gas appraisal work programme must be produced which contains the information that is necessary for a proper understanding of the long-term plans of the appraisal operations, and must include–

i. The proposed locations of seismic surveys, stratigraphic, exploration wells and appraisal wells within the Exploration Right area;

ii. A description of the type of seismic survey to be used;

iii. The well design risk assessment which includes proposed control measures and an early warning monitoring and response system for failures, spills and contamination events;

iv. Precise information on the hydraulic fracturing fluids to be used during the process in terms of volumes, composition and toxicity;

v. Information on the proposed shale gas production scenario over a 10 year period and a preliminary shale gas production site layout including associated infrastructure such as roads, waste and water treatment facilities and transport routes;

vi. well engineering design which must include, but not be limited to the following-

vii. type of rig to be used;

viii. method of drilling;

ix. type and estimated amount of drilling fluids;

x. different stages of drilling and the size of drill bits;

xi. casing programme;

xii. cementation programme; and

xiii. perforation design.

xiv. hydraulic fracturing programme and procedures, which must include-

xv. pre-fracturing simulation and modelling;

xvi. the proposed depth(s) to the top and the bottom of the formation into which well fracturing fluids are to be injected;

xvii. authorised source and volume of water to be used

xviii. re-use and disposal of flowback;

xix. fracturing fluid compositions, concentrations and estimated total volume to be used;

xx. anticipated surface and downhole treating pressure range;

xxi. maximum injection treatment pressure;

xxii. annuli and offset well pressure monitoring programme to be performed;

xxiii. testing and flowback plan;

xxiv. equipment rig up and testing, including testing of all high pressure equipment;

xxv. a design of the fracture geometry including fracturing target zones, sealing mechanisms and aquifers;

xxvi. micro-seismic monitoring programme;

xxvii. monitoring of pressure on the production string and well annuli during rig up and testing; and

xxviii. monitoring of any adjacent or offset wells for pressure on the production string and other well annuli as required.

(4) **Quantitative Risk Assessment Report**

(a) A Proponent must assess potential risks within a structured quantitative Risk Assessment Report and develop a Risk Management Plan for each well to be drilled and hydraulically fractured addressing the following aspects-

i. The risks during normal operations and including occupational and health and safety risks;

ii. The risks associated with accidents or unplanned events in terms of probability of incidents and the associated consequences of the surface and sub-surface activities;

iii. identification of chemical ingredients and characteristics of each additive in terms of their risk to the social and ecological environment;

iv. assessment of potential environmental and health risks of fracturing fluids and additives in both diluted and concentrated form;

v. assessment of buildings, via building surveys, in proximity of hydraulic fracturing operations which may be affected due to increased seismic activity; and

vi. definition of operational practices and controls for the identified risk in the Risk Management Plan.

(b) A Risk Management Plan must be submitted to the competent authority as part of the application for Environmental Authorisation for appraisal and must be submitted to the designated agency before commencing with hydraulic fracturing Production operations.

(5) **Baseline monitoring programme for production**

(a) A baseline monitoring programme for production must be submitted to the Competent Authority and relevant departments. The baseline monitoring programme for production must be submitted together with the appraisal Environmental Impact Assessment application. The baseline monitoring programme for production must detail the nature of the monitoring programme and the methods for data collection. The baseline monitoring programme for production must immediately commence following approval of the application for environmental authorisation by the Competent Authority to run concurrently with the appraisal Environmental Impact Assessment process.

(b) The baseline monitoring programme for production, which must be approved by the Competent Authority with the appraisal Environmental Impact Assessment application, must include –

i. Relevant geological information;
ii. a surface water baseline monitoring plan which will be considered by the Department of Water and Sanitation;
iii. a groundwater baseline monitoring plan which will be considered by the Department of Water and Sanitation and by the Council for Geoscience;
iv. a seismicity baseline monitoring plan which will be considered by the Council for Geoscience;
v. an air quality and greenhouse gas baseline monitoring plan which will be considered by the Department of Environmental Affairs: Air Quality Directorate;
vi. a biodiversity baseline monitoring plan which will be considered by the Department of Environmental Affairs: Biodiversity Directorate;
vii. a road infrastructure baseline monitoring plan,
viii. the siting of the various monitoring devices and stations;
ix. the sampling methodology for each plan;
x. the monitoring points for each plan;
xi. the monitoring parameters for each plan;
xii. the monitoring frequency for each plan; and
xiii. the reporting frequency for each plan.

(c) The draft baseline monitoring programme and data that it generates must be peer reviewed by a minimum of two independent and recognised experts.

(d) The designated Competent Authorities must consider the baseline monitoring programme for production and –

i. where needed request additional information and adaptation of the baseline monitoring programme if required; and
ii. decide to accept or reject the baseline monitoring programme for production as part of the Environmental Impact Assessment application for appraisal.

(6) **Ongoing Monitoring**

(a) After the Baseline Monitoring Programme is conducted, a holder must continue ongoing with monitoring in accordance with an approved Ongoing Monitoring Plan as part of appraisal operations and -

i. have all water resources subjected to sampling, analysis and interpretation of water quality and changes in water levels by an independent specialist approved by the designated agency in accordance with the approved plan;

ii. submit the results of the analysis and interpretation to the designated agency and the Department responsible for water within 7 days of the receipt of the analysis and interpretation; and
iii. submit monitoring assessment reports in accordance with the approved monitoring plan.

(b) The Ongoing Monitoring Plan should contain monitoring procedures to address all environmental issues and aspects identified during the EIA, concerning operational, closure and post-closure impacts.

(c) The Ongoing Monitoring Plan gives effect to continuous monitoring of all environmental issues and aspects throughout and after the construction, operation and decommissioning phases of the activity, including the monitoring of legacy impacts following closure of operations.

(d) Monitoring reporting should include the disclosure and discussion of monitoring data with stakeholders and the independent Monitoring Inter-departmental Unit.

(e) Monitoring records must be maintained by the holder and submitted to the Monitoring Inter-departmental Unit at any time during the period up to and including 30 years after the well is permanently plugged or decommissioned.

(f) Monitoring results must also be included in the Environmental Management Program Report required in terms of the Environmental Impact Assessment Regulations.

5. Baseline monitoring programme implementation and reporting

(a) The approved baseline monitoring programme for appraisal must commence as part of the Environmental Impact Assessment for appraisal activities –
i. on sites which have been accepted by the Competent Authority after consideration of the screening site selection report; and
ii. in accordance with the baseline monitoring programme for production which was accepted by the Competent Authority with submission of the application for environmental authorisation.

(b) The baseline monitoring programme for production must be overseen by a specialised inter-departmental monitoring unit to be established under the existing shale gas monitoring committee consisting of appointed panel members from those Departments governing the

One Environmental System, namely: Water and Sanitation, Environmental Affairs and Mineral Resources.

(c) Analysis of baseline data collected during the baseline monitoring programme for production must be executed using relevant nationally and internationally accredited facilities and according to relevant national norms and standards, or international norms and standards if relevant.

(d) Baseline data should be collected for a period of 12 months in the case of seismicity, air quality and greenhouse gas emissions, biodiversity, and road infrastructure. Baseline data should be collected for a period of time, no shorter than 36 months in the case of surface water and groundwater. All data must be collected, coordinated and logged by the project proponent under the guidance of the Environmental Assessment Practitioner and inter-departmental monitoring unit.

(g) Baseline monitoring reports for production must be submitted prior to decision-making on the appraisal Environmental Impact Assessment process where the data will be publically disclosed. There must be disclosure of information on water use, volumes and characteristics of wastewater and air emissions, and fracking fluid additives and volumes, which must be displayed, on an ongoing basis, on a public disclosure register for all phases of the project life-cycle.

(e) The results must, at a minimum, include a detailed description of the sampling and testing conducted, including duplicate samples, the chain of custody of the samples and quality control of the testing.

(7) **Geological information and groundwater baseline monitoring**

(a) As part of the baseline monitoring report for production, submitted to the Competent Authority during the Environmental Impact Assessment process for production, a Proponent must describe geological information and assess the current quality and quantity of groundwater and other geohydrological features of the approved sites prior to production activities and submit a groundwater baseline monitoring report to the designated agency for approval.

(b) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the

Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. geological map of the area (that can encompass several hydraulic fracturing sites for appraisal) at the appropriate scale and with details that will allow understanding of the potential structural aspects;
ii. analysis of all available geological information such as published and unpublished map sheets, satellite imagery and published and unpublished scientific papers;
iii. data from stratigraphic exploration boreholes to understand the regional stratigraphy and possible structural complexity. Proposed depth(s) to the top and the bottom of the formation into which well fracturing fluids are proposed to be injected;
iv. borehole analysis: core logging, downhole geophysics, camera, water strikes, hydrogeochemical character, injection tests in fractures or formations;
v. physical and chemical properties of the stratigraphic formations such as porosity, permeability, naturally occurring fissures and fractures, total organic carbon, clay and mineralogy;
vi. cross sections of the study area based on surface geology, exploration borehole and geophysical profiling showing the stratigraphy, including the presence and morphology of dolerite and kimberlite and tectonic structures;
vii. groundwater and deep groundwater assessment;
viii. a hydrocensus fulfilling the standard requirements of the Department responsible for water indicating all potentially affected water resources, at least 3 kilometres radius from the furthest point of horizontal drilling, as well as identify priority water source areas and domestic groundwater supplies indicated on relevant geohydrological maps; and
ix. models of fluid migration within the target geological formation.

(8) **Surface water baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. water quality monitoring data of resources within the appraisal work programme;
ii. water quantity monitoring data of resources within the appraisal work programme;
iii. habitat integrity monitoring data of resources within the appraisal work programme; and
iv. weather data such as daily precipitation and evaporation, regionally, and within the appraisal work programme.

(b) Surface water baseline monitoring should cover all four seasons, for a period not less than 36 months, including at least a wet and a dry year, at representative sites.

(9) **Seismicity baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. all available background seismicity data;
ii. building typologies in the region;
iii. structural integrity of buildings and structures;
iv. desktop studies of existing geological maps;
v. identified stressed faults which must be avoided in the fracturing process;
vi. identified fracture behaviour of targeted formations;
vii. seismic reflection and refraction data where available;
viii. stress data from proximal boreholes where available; and
ix. other relevant available geophysical data such as gravity.

(10) **Air quality and greenhouse gases baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information, as it regards environmental and human health –
i. NOx baseline concentrations;
ii. SO_2 baseline concentrations;

iii. PM baseline concentrations;

iv. VOCs baseline concentrations;

v. CO_2 baseline concentrations; and

vi. N_2O baseline concentrations.

(11) **Biodiversity baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. species diversity and abundance;

ii. habitats;

iii. terrestrial ecosystems;

iv. aquatic ecosystems; and

v. Broad-scale processes.

(12) **Road infrastructure baseline monitoring**

(a) The report must be submitted to the Competent Authority as part of the Environmental Impact Assessment for production. The report must be compiled in partnership with the Environmental Assessment Practitioner and inter-departmental monitoring unit, and as a minimum include the following information –

i. condition of roads and bridges within affected by appraisal;
ii. current traffic volumes;
iii. remaining life of roads and bridges; and
iv. pavement condition data.

6. Environmental Impact Assessment Process

(a) The Environmental Impact Assessment phase for appraisal may commence after the dedicated competent authorities have accepted and approved the baseline monitoring programme for production.

(b) The Environmental Impact Assessment must –

i. be executed in adherence to Appendix 3 of the Environmental Impact Assessment Regulations of 2014.

7. Specialist studies

(a) Specialist studies must be executed by relevant nationally accredited and independent specialists, and should be undertaken in adherence to Appendix 6 of the Environmental Impact Assessment Regulations of 2014.

(b) The following specialist studies may be considered, depending on the scope of work outlined in the exploration work programme:

i. Biodiversity impact assessment consistent with applicable protocols (Appendix C);
ii. Agriculture impact assessment consistent with applicable protocols (Appendix D);
iii. Heritage resources impact assessment consistent with applicable protocols (Appendix E);
iv. Electromagnetic interference assessment with applicable protocols (Appendix F);
v. Air quality and greenhouse gas emissions impact assessment;
vi. Surface water and groundwater impact assessment;
vii. Noise impact assessment;
viii. Socio-economic impact assessment;
ix. Traffic impact assessment; and
x. Waste management impact assessment.

8. Public Participation

(a) Public participation should be undertaken during the Environmental Impact Assessment Phase in adherence to Chapter 6 of the Environmental Impact Assessment Regulations of 2014.

9. Environmental Management Programme

(a) The Environmental Management Programme (EMPr) must adhere to the regulations as set out in Appendix 4 of the Environmental Impact Assessment Regulations of 2014 and contain at a minimum –

i. information on any proposed management, mitigation, protection or remedial measures that will be undertaken to address identified environmental impacts in respect of the following key phases of the project lifecycle –

- planning and design;
- pre-construction and construction activities;
- the operation or undertaking of the activity in question;
- the rehabilitation of the environment; and
- closure and post closure monitoring of legacy impacts.

ii. details of the person who prepared the EMPr; and the expertise of that person to prepare an EMPr;

iii. a detailed description of the aspects of the activity that are covered by the EMPr;

iv. information identifying the persons who will be responsible for the implementation of the measures;

v. information in respect of the mechanisms proposed for monitoring compliance with the environmental management programme and for reporting on the compliance;

vi. as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and

vii. a description of the manner in which it intends to-

- modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- remedy the cause of pollution or degradation and migration of pollutants; and
- comply with any prescribed environmental management standards or practices.

(b) The EMPr must, where appropriate, contain -

i. time periods within which the measures contemplated in the EMPr must be implemented;

ii. measures regulating responsibilities for any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of exploration activities which may occur inside and outside the boundaries of the Exploration Right area; and

iii. an environmental awareness plan describing the manner in which-

- the Proponent intends to inform his or her employees of any environmental risk which may result from their work; and
- risks must be dealt with in order to avoid pollution or the degradation of the environment.

(c) The Proponent and any person issued with an environmental authorisation-

i. must at all times give effect to the general objectives of integrated environmental management laid down in Section 23 of the NEMA;

ii. must consider, investigate, assess and communicate the impact of his or her exploration activities on the environment;

iii. must manage all environmental impacts-

- in accordance with his or her approved EMPr, where appropriate; and
- as an integral part of the reconnaissance, prospecting or mining, exploration or production operation, unless the Minister of Minerals and Energy directs otherwise

(d) must monitor and audit compliance with the requirements of the EMPr;

10. Subsequent environmental authorisations

(1) Environmental authorisation for production activities

(a) The Proponent may apply for Environmental Authorisation for additional shale gas development activities if –

i. The application for Environmental Authorisation, screening site selection report, appraisal work programme, quantitative risk assessment, baseline and ongoing monitoring programmes for production are accepted by the Competent Authority; and

ii. Following the Environmental Impact Assessment process for appraisal, the application for Environmental Authorisation for appraisal receives a positive decision and appraisal activities are undertaken in a manner consistent with the associated EMPr.

(b) Each Environmental Authorisation for production, based on the scope of work as outlined in the production work programme requires a separate Environmental Authorisation, which may be obtained by –

i. Specifying and assessing additional and cumulative impacts and actions based on continuous monitoring; and
ii. Updating the EMPr based on the continuous monitoring data and availability of new information.

11. Financial Penalties

(a) Strict enforcement and penalties will be applied in the event of non-compliance of the Environmental Authorisation. Over and above the usual remedies such as suspension or revocation of the Environmental Authorisation, the Environmental Authorisation should provide for significant administrative penalties in the case of violations of conditions in the Environmental Authorisation and/or other legislative provisions.

12. Financial Provisioning for closure

(a) An Proponent must provide details for financial provisioning for closure, contamination events and on-going life-cycle monitoring post well decommissioning as provided for in the National Environmental Management Act: Regulations: Financial provision for rehabilitation, closure and post closure of prospecting, exploration, mining or production operations (GN1147) No. 39425.

Appendix A: Pre-production phases of shale gas development activities showing the activities, timeframes and regulatory check that will be implemented as part of the MIRs for exploration and appraisal.

<table>
<tr><th colspan="6">Pre-production phases of shale gas development</th></tr>
<tr><td>Phase</td><td>Exploration</td><td rowspan="4">Competent authority accept or rejects checks 1-4</td><td>Appraisal</td><td rowspan="4">Competent authority accept or rejects checks 1-6</td><td rowspan="4">Commencement of appraisal activities</td></tr>
<tr><td>Activities</td><td>2-D seismics, 3-D seismics, vertical exploration wells, roads, trucks, water and waste management.</td><td>2-D seismics, 3-D seismics, vertical exploration wells, horizontal exploration wells, hydraulic fracturing, trucks, water management, waste management, flaring</td></tr>
<tr><td>Typical timeframe</td><td>3 years</td><td>5 years</td></tr>
<tr><td>Regulatory checks – approval required</td><td>1. Screening site-selection report
2. Shale gas exploration work programme
3. Baseline monitoring programme for appraisal
4. Environmental authorisation required for exploration activities</td><td>1. Screening site-selection report
2. Shale gas appraisal work programme
3. Quantitative risk assessment report
4. Baseline monitoring programme for production
5. Ongoing monitoring programme
6. Environmental authorisation required for exploration activities</td></tr>
<tr><td></td><td colspan="5">Three to five years baseline monitoring prior to hydraulic fracturing activities →</td></tr>
</table>

Appendix B: Decision-making mandates and permit requirements

Decision	Competent Authority	Legislation	Regulatory process
Exploration and Production Rights	DMR and PASA	MPRDA	EMPr initial submissions made to PASA in 2010 and 2011. DMR requested EMPrs to be updated in November 2014. DMR has not yet decided on any of the existing Exploration Right applications.
Environmental Authorisation	DMR and PASA	NEMA	No applications for Environmental Authorisation in terms of the NEMA have been submitted to date. Applications would be guided by the NEMA Minimum Information Requirements (MIRs) amongst other

Decision	Competent Authority	Legislation	Regulatory process
			legislation. DMR is the competent authority with DEA providing decision on appeals.
Atmospheric Emission Licence	DEA	NEM:AQA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DEA remain the competent authority.
Waste License	DMR	NEM:WA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DMR are the competent authority.
Water Use License	DWS	NWA	Integrated into the Environmental Authorisation process with the establishment of the One Environmental System. DWS are the competent authority. The Catchment Management Agencies will process all applications but the final authority to issue the license will be National Office – currently the Director General possibly later the Deputy-Director General of Water Sector Regulation.
Municipal Planning Decision	Relevant local authority	SPLUMA, LUPA and By-laws	For non-invasive 3-D seismic surveys rezoning will not be required. For the development of well pads, regional services, infrastructure servitudes, wastewater treatment works, housing developments, camps, gravel pits, landfill sites, roads, the subdivision of farmland etc., these will require rezoning. A Municipal Application must be submitted to the Municipality or in some cases (if the general welfare of the inhabitants of the region are affected) the land development applications could require provincial approval and in other instances when the activity is considered a national interest, the national Minister responsible for SPLUMA then has decision-making oversight.
Provincial Planning Decision	Provincial competent authority	SPLUMA and LUPA	

Appendix C: Protocol for biodiversity assessments

Colour	Sensitivity	Interpretation of Sensitivity	Further Assessment Requirements
Dark Red	Very High	No loss or degradation of Very High sensitivity areas is acceptable. These areas are irreplaceable and no ecologically equivalent areas exist for securing the features they contain.	Full biodiversity impact assessment conducted by competent terrestrial ecologist is required (Level 1 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Red	High	In High sensitivity areas, loss or degradation is acceptable only if ecologically equivalent sites are identified and secured through biodiversity offsets or equivalent mechanisms. An ecologically equivalent site means a site that contains equivalent ecological processes, ecosystems and species, and that compensates for the full ecological impact of the activity as identified through a detailed study.	Full biodiversity impact assessment conducted by competent terrestrial ecologist, plus an ecological offset study is required. (Level 1 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Yellow	Medium	Other natural or semi-natural areas that do not contain currently known sensitive or important features, and are not required for meeting targets for representing biodiversity or maintaining ecological processes. Provided that Very High and High areas are secured, loss of habitat in Medium sensitivity areas should not compromise the ability to achieve biodiversity targets in the Karoo, as long as the impacts in the Medium sensitivity areas do not extend into adjacent areas of higher importance or sensitivity.	Biodiversity impact assessment conducted by competent terrestrial ecologist (Level 3 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).
Green	Low	Areas in which there is no remaining natural habitat, e.g. urban areas, larger scale highly degraded areas, large arable intensively farmed lands. Shale gas development activities in these sites should result in minimal biodiversity loss, as long as the impacts do not extend to adjacent Very High and High sensitivity areas.	Biodiversity impact assessment conducted by competent terrestrial ecologist (Level 3 assessment as contemplated in Part 3 Chapter 4 of the Strategic Environmental Assessment for Electricity Grid Infrastructure (2016)).

Appendix D: Protocol for agricultural assessments

Sensitivity Class	Interpretation of Sensitivity	Further assessment requirements for electricity grid infrastructure developments
Very High	Very High and High agricultural sensitivity	Should the development envelope be required to be located on areas identified as Very High or High sensitivity as determined through the sensitivity mapping process, a comprehensive Agricultural Impact Assessment shall be undertaken for such areas. The Agricultural Impact Assessment shall be undertaken by a competent agricultural scientist undertaken in accordance with the NEMA regulations pertaining to specialist reports and impact assessment. The assessment of agricultural impacts and application for agricultural authorisation should be by way of a report compiled and signed off by a SACNASP-registered agricultural scientist.
High		
Medium	Medium agricultural sensitivity	Should the development envelope be required to be located on areas identified as Medium sensitivity as determined through the sensitivity mapping process, a compliance statement by a competent agricultural scientist is required.
Low	Low agricultural sensitivity.	Should the development envelope be required to be located on areas identified as Low sensitivity as determined through the sensitivity mapping process, a compliance statement by a competent agricultural scientist is required.

Appendix E: Protocol for Heritage (including palaeontology) Impact Assessments

Sensitivity Class	Interpretation	Assessments at project level	Motivating for exemption from an HIA	Permit requirements
Very High	Very High sensitivity includes all known heritage and palaeontological sites.	Proposed shale gas development infrastructure should avoid these areas. If avoidance cannot be achieved, a Heritage Impact Assessment (HIA) would almost certainly be required.	A HIA may not be required if such motivation was included in the initial notification prepared by a competent heritage specialist. In order to motivate for a HIA not to be required the inputs from an archaeology specialist is required as part of the notification. Site visits to inform the notification may also be necessary to motivate for an HIA not to be required, and are up to the discretion of the specialist providing input to the notification. In most cases, it will be sufficient for only the heritage specialist preparing the notification to visit the site before an exemption from further assessment can be motivated. If exemption from further	A permit under Section 27 of the NHRA will be required
High	High sensitivity includes all areas which are, or have the potential to be, highly sensitive in terms of heritage and palaeontological resources because either: Previous assessments have identified heritage resources which are classified as being of high significance, or there is a high probability of encountering a significant heritage resource.	These areas include or have the potential to include heritage and palaeontological resources of conservation status or have the potential to include cultural heritage resources which will require conservation or lengthy mitigation. A HIA would almost certainly be required to investigate the potential presence of these resources and, where applicable, the potential impact to such resources in the context of the proposed development.		If the development impacts on heritage and palaeontological resources of medium or high significance a permit under Section 35 of the NHRA would normally[1] be required before impact and/or mitigation may occur.
Medium	Medium sensitivity represents areas	These areas include resources which		

[1] Note that Heritage Western Cape currently does not require 'permits' for generally protected heritage resources under the NHRA when developments trigger Section 38 of the NHRA. Instead, a work plan is required which is very similar to a permitting process.

(orange)	inside of the shale gas development region which are or have the potential to be sensitive to development in terms of heritage resources because either: Previous assessment of the area have identified heritage resources which are considered to be of medium significance, or there is a medium probability of encountering significant heritage resources	may require mitigation or have the potential to include cultural heritage resources which will require mitigation. A HIA is likely to be required to investigate the potential presence of these resources and, where applicable, the potential impact to such resources in the context of the proposed development.	assessment is motivated, the notification must contain proposed mitigation measures for inclusion in the Environmental Management Programme (EMPr).	
Low (green)	Low sensitivity represents areas not likely to be sensitive to development in terms of heritage resources because previous assessment has revealed the area to contain no resources or resources of low significance.	No further assessment is necessary for proposed development in these areas.	A HIA is not required in Low sensitivity areas therefore applications for exemption do not apply.	No permit is required for development to proceed in these areas.

Appendix F: Protocol for electromagnetic interference assessment

<table>
<tr><th>Sensitivity Class</th><th>Interpretation</th><th>Assessments at project level</th></tr>
<tr><td>Very High</td><td>In Very High sensitive areas there is a high likelihood of significant negative impacts that cannot be mitigated. In-depth assessment of the potential impacts, and proof of efficacy of proposed mitigation measures, will be required before development can be considered in these areas. Following construction, proof of compliance with mitigation requirements will be required should the proposed development be considered favourably.</td><td rowspan="3">Proponents intending to undertake shale gas development that triggers an environmental assessment process in Very High to Medium sensitivity areas must prove to the relevant Competent Authority that the proposed development will not have an unacceptable negative impact on the SKA project. In order to do so, the proponent must request a comment from SKA South Africa confirming no unacceptable impact on components of the array.

SKA South Africa will conduct a high level risk assessment on the proposed development, and will consider the following:
The potential Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) emitted;
The footprint of the proposed shale gas development activities;
The distance of the footprint of activities from the radio site;
The elevation drill rigs relevant to the radio site; and
Whether the shale gas development activities will be in line of sight of the receptors, or whether topographical shielding exists.

Should SKA South Africa determine that an in-depth assessment is required, the proponent will be required to undertake, at own cost, the relevant assessments. These can be sub-contracted to relevant experts in the field, and will include:
Radio frequency measurements of operational facilities of equivalent electrical and structural design, to determine the RFI and EMI characteristic emissions profile;
Radio frequency propagation modelling between the proposed facility and the nearest SKA stations at risk; and
Any other studies that may be required and will be determined in consultation</td></tr>
<tr><td>High</td><td>In High sensitivity areas there is potential for negative impacts that can potentially be mitigated. In-depth assessment of the potential impacts and proven mitigation measures will be required before development can be considered in these areas. Following construction, proof of compliance with mitigation requirements will be required, should the proposed development be considered favourably.</td></tr>
<tr><td>Medium</td><td>In Medium sensitivity areas there is a low potential for negative impacts, and if there are impacts there is a high likelihood of mitigation. Further high level risk assessment of the potential impacts is required.</td></tr>
</table>

	An in-depth assessment may be required, if found necessary through the high level risk assessment.	between the SKA project and the relevant proponent. The results of such an in-depth assessment shall be provided to the SKA South African for consideration. Based on the results of high level risk assessment and in-depth assessment (where required), SKA South African shall issue a comment in the form of a 'letter of objection' or 'letter of no objection' on whether the proposed development can proceed and whether any specific mitigation is required. Proponents must receive a 'letter of no objection' from SKA South Africa before submitting an application for environmental authorisation in terms of NEMA. The 'letter of no objection' shall be submitted together with the application for environmental authorisation. Any mitigation requirements stipulated by SKA South Africa in its comment will be included as a condition on the Environmental Authorisation. Any mitigation measures recommended will be tested by SKA South Africa to ensure compliance following implementation, and the Environmental Authority responsible for the EA will be notified of the results of these tests.
Low	No expected impacts.	No assessment or authorisation for electricity grid infrastructure development in terms of the SKA project is required if the proposed development is not within the sensitive distances from radio sites. SKA South Africa must, however, be notified as an Interest and Affected Party if the development is located within the Northern Cape Province.