Strategic Environmental Assessment for the central Namib

Uranium Rush

Main Report

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1 INTRODUCTION

The necessity for an SEA for the “Uranium Rush” was realised by the Chamber of Mines in 2007. The Geological Survey of Namibia within Namibia’s Ministry of Mines and Energy took over the responsibility for commissioning the SEA after discussion with the Chamber. The SEA was made possible through the generous financial support provided by the German Government, through the cooperation project between the German Federal Institute for Geosciences and Natural Resources and the Namibian Geological Survey. Consequently, the Geological Survey of Namibia and the German expert responsible for the cooperation project provided management oversight for the SEA.

In 2009, the Southern African Institute for Environmental Assessment (SAIEA) was contracted by the Government of the Republic of Namibia (GRN), with funding provided by the German Government through the German-Namibian Technical Cooperation Project of the Geological Surveys of Germany (BGR) and Namibia (GSN), to undertake a Strategic Environmental Assessment (SEA) for the so-called ‘central Namib “Uranium Rush”.

Mining for various minerals has been ongoing in the central Namib since 1901, and the first uranium mine was commissioned in 1976. Over the past 30 years, prospecting for uranium was at a relatively low intensity, but this changed recently when it was estimated that the supplies of both primary and secondary uranium would be unlikely to meet projected nuclear reactor requirements in the short or medium term. This lead to concerns about the security of uranium supplies, which in turn, could see uranium prices rising. This has triggered renewed interest in uranium exploration; the sudden scramble for prospecting rights in the central Namib resulted in the MME/GRN placing a moratorium in 2007 on further uranium prospecting licences to ensure that the authorities and other stakeholders could consider how best to manage the “Uranium Rush”. However, by that date, 36 exploration licences for nuclear fuels had already been granted in the central Namib (and a further 30 elsewhere in Namibia). Of these, 33 Exclusive Prospecting Licence (EPLs) were current and three were pending renewal (as of December 2009). As the moratorium does not prevent the GRN from upgrading an existing prospecting licence to a mining licence, the moratorium is not likely to significantly slow the ‘rush’ to develop new mines. At the time that the SEA was conducted, four mining licences had been granted: two mines were operational, the third was undertaking trial mining, and the fourth was beginning construction. Prospecting at three of the most promising new deposits was at an advanced stage. Thus, the “Uranium Rush” was, for practical purposes, already underway when the SEA was commissioned.

Nevertheless, the SEA was expected to provide strategic direction to the uranium industry, government and other stakeholders in the central Namib. This SEA differs from most others conducted elsewhere because the development in question is neither a policy, plan nor programme, but rather a collection of projects, each being conducted by individual companies that are not related to each other, and in many cases, undertaken in isolation of each other.

However, they collectively combine to produce cumulative impacts, with the public citing areas of concern as: loss of ‘sense of place’, over-abstraction and pollution of groundwater, short and long term radiation exposure of workers and the public, stress on physical and social infrastructure, opportunity costs on other, more sustainable industries (e.g. tourism) and reduced public access to the central Namib.

The flip side of the coin is that the “Uranium Rush” offers substantial opportunities for synergies, and the industry could stimulate critically needed development, which in turn enables growth in many other sectors. Examples include the construction of desalination plants, upgrading power supply, and investing in housing, schools and health facilities.

Recognising the opportunities and constraints presented by the "Uranium Rush", the Chamber of Mines established the Uranium Stewardship Council (USC) to be the 'spokesperson' for the Namibian uranium industry both national and internationally (Chamber of Mines, 2009). In 2008, a significant milestone was achieved when the Namibian Stock Exchange (NSX) agreed that uranium exploration and mining companies could not be listed on the NSX unless they were members of good standing on the USC. All USC members are bound by the Chamber's Constitution that commits them to upholding the Namibian uranium 'brand' and ensuring the highest standards of environmental and radiation safety management (Chamber of Mines, 2009).

Until legally binding Namibian regulations are introduced, the USC has adopted the World Nuclear Association's document entitled "Sustaining Global Best Practices in Uranium Mining and Processing" as its official guideline document and Environmental Code of Practice. In March 2009 a Management Working Group was established to monitor compliance of all member companies to these standards. It is in this context, that the SEA was expected to provide a roadmap for improved practice and meaningful corporate social responsibility initiatives. In return, the mines would be well placed to compete in a market that is sensitive to environmental issues. By being part of a broader sustainability initiative they could perhaps negotiate better contract prices and possibly have an advantage over suppliers from other parts of the globe.

The Erongo Region has no coherent development vision and the Namibian government readily embraces a wide range of development proposals without necessarily assessing their implications at a strategic level. The SEA provides a big picture overview and advice on how to avoid antagonistic and cumulative impacts (see Glossary of Terms), as well as how to enhance synergies within the uranium sector and between mining and other industries. It provides practical, outcomes-based tools for achieving good practice. It also proposes ways that the operators in the industry can collaborate to achieve a common approach towards long term management and monitoring – in some cases well beyond the life of individual mines (e.g. aquifer monitoring, tailings dam maintenance, etc.). This is useful even for existing mines, but even more valuable for those mining companies that have not yet started their operation.

The overall objectives of the SEA were as follows:

- Develop and assess ***viable scenarios*** of mining and associated developments as a basis for subsequent decision-making and formal planning.
- Provide ***recommendations*** on accepted overall strategic approaches for sustainable mining development in the Erongo Region.
- Provide ***guidance for overall solutions*** on crucial (cumulative) impacts and challenges stemming from the mining operations.
- Outline a ***Strategic Environmental Management Plan*** (SEMP).

The SEA was supervised by a broad-based Steering Committee consisting of approximately 30 members from Government, parastatals, NGOs, the Chamber of Mines of Namibia, the tourism industry, local and regional authorities, the Mineworkers Union and the Atomic Energy Board (see list of members in the Acknowledgements). The primary task of the Steering Committee was to guide the SEA process and SEA team by integrating and streamlining the SEA with other existing strategic initiatives (policies, plans and programmes). The existence of some technical experts on the committee enabled systematic peer review of the products emanating from the SEA process. To assist it in this task, the Steering Committee appointed Dr Barry Dalal-Clayton (IIED UK) as an independent external reviewer with the objective of ensuring a process and product that meets international standards. The Steering Committee met eight times during the 20-month period required for completing the SEA, so they were able to maintain close involvement with the SEA team, the entire process and its key outputs.

The SEA report provides the reader with background information on the method employed (Chapter 2), an analysis of the forces and dynamics of the "Uranium Rush" (Chapter 3), an overview of the current and predicted exploration and mining activities as well as associated industries[1] in the central Namib (Chapter 4), a brief regional description of the affected environment (Chapter 5) and a summary of the legal, policy and institutional framework pertaining to the "Uranium Rush" (Chapter 6).

Chapter 7 presents the main analysis of the cumulative impacts of the "Uranium Rush" on various components of the central Namib environment. This analysis has been presented thematically because the impacts and solutions will, to a large extent, be addressed sectorally by the responsible line ministry or local government department. It must be remembered that the SEA is not an EIA and that standard impact assessment methodologies do not apply. The SEA aims to provide proactive guidance for a speculative set of activities at some unknown time in the future, rather than being reactive to a specific project as in an EIA. The cumulative effects analysis in Chapter 7 therefore strives to present the potential benefits and synergies of the "Uranium Rush" as 'opportunities' and the negative cumulative effects as potential 'threats' which need to be managed. Where possible the quantum of change is provided. The exact impact of the "Uranium Rush" will only emerge once the SEMP is being implemented and the relevant data are being collected and presented in an annual report.

Although the cumulative effects analysis (CEA) has been presented thematically, there are numerous cross-cutting inter-linkages, creating a complex series of causes and effects. The linkages between the impacts identified in the CEA are thus examined and discussed in section 7.15.

The Strategic Environmental Management Plan is set out in Chapter 8. This provides a set of environmental quality objectives (EQOs), expressed as a set of desired future environmental conditions elicited through the stakeholder consultation process. The SEMP sets targets and indicators on how to achieve the desired objectives and lists the parties responsible for implementation. This is the most critical part of the SEA and the extent to which it is implemented will determine the ultimate success of the SEA process in guiding the "Uranium Rush" towards a sustainable future.

The conclusions of the SEA, including an analysis of its sustainability, are presented in Chapter 9 and the recommendations arising from the study are set out in Chapter 10.

[1] An associated industry in the context of this "Uranium Rush" is one which would not have come about except for the existing and future uranium mines.

2 APPROACH AND METHODOLOGY

2.1 Background

The Mining, Minerals and Sustainable Development Project (MMSD) was initiated by the mining industry in 2002 to advise on how best the sector could contribute to sustainable development. In response, the mining industry is under pressure to improve its social, developmental, and environmental performance in order to ensure it has a 'social licence to operate' (IIED, 2002). Increasingly, mines are expected by society to do much more than meet basic legal requirements and earn profits for shareholders.

A core principle of sustainable development is to improve human well-being and to sustain those improvements over time. The goal is for children to have as good a life as their parents did, or better. This requires passing the means of survival on to future generations unimpaired and building, or at least not diminishing, the total stock of capital. It also requires the integration of social, economic, environmental, and governance goals in decision-making (IIED, 2002). Implicit in this definition is that sustainable development is not possible without equitable development (improving the distribution of wealth, more universal rights, access to resources and government services etc.). The extent of inequality in Namibia, as measured by the Gini Coefficient, highlights the importance for equitable and hence sustainable, development in Namibia.

The idea of 'capital' lies at the heart of sustainable development and has thus been thoroughly examined as part of this SEA. Capital has the following five main forms (IIED, 2002):

- Natural capital, which provides a continuing income of ecosystem benefits, such as biological diversity, mineral resources, and clean air and water;
- Manufactured capital, such as machinery, buildings, and infrastructure;
- Human capital, in the form of knowledge, skills, health, and cultural endowment;
- Social capital, i.e. the institutions and structures that allow individuals and groups to develop collaboratively; and
- Financial capital, the value of which is simply representative of the other forms of capital.

The IIED (2002 Report), on the MMSD Project argues that equivalent or increased amounts of capital must be passed to future generations, so they can develop as required. Nevertheless, it is inevitable that some resources will be consumed, even exhausted, and that they will therefore not be available to future generations. However, this can be justified if their exploitation is balanced by investments in other areas (e.g. human capital and sustainable industries) so that people have the foundations and skills to respond to, or create, new opportunities. IIED (2002) suggest that one way of understanding how to use the idea of 'capital' is to divide decisions into three groups:

- 'Win-win-win' decisions – some decisions advance all the goals identified by sustainable development simultaneously; they improve material well-being for this generation, spread that well-being more equitably, enhance the environment, strengthen our ability to manage problems, and pass on enhanced stocks of capital to future generations. These are obvious 'wins' and should be acted upon.

- ‘Trade-off’ decisions – other decisions will result in both gains and losses. If the gains are great enough and the losers can be compensated, the decision should be to proceed. This is the zone of trade-offs and requires an agreed mechanism for reaching a decision.

- ‘No-go’ decisions – a final group of decisions may go past some widely accepted limit, such as destroying critical natural capital or transgressing fundamental human rights. If these conditions hold, the decision should be not to proceed.

The SEA has identified the key cumulative impacts of the “Uranium Rush” so that decision makers understand the synergies (win-wins), the antagonistic effects (trade-offs) between uranium prospecting and mining on the one hand and actual or potential economic activities on the other, as well as the potential fatal flaws of uranium mining in the central Namib.

While it is critical to enhance the opportunities afforded by the “Uranium Rush”, inevitably there will need to be compromises or trade-offs: between different objectives and dimensions; between different groups of stakeholders; and between different generations. Long-term needs will need to be balanced against short-, or medium-term imperatives.

2.2 Strategic Environmental Assessment

Traditionally, a Strategic Environmental Assessment (SEA) is the application of impact assessment to policies, plans, and programmes. There are many different approaches to a SEA: one is the ‘EIA’ model where the impact assessment is carried out on a policy, plan or programme once it has already been developed (i.e. reactive). Another is an integrated and/or ‘sustainability led’ approach that strives to meet sustainable development objectives. This is more proactive and can be integrated into policy and planning processes. Importantly, SEA encourages an ‘opportunities and constraints’ type approach to development, where such things as natural resources and ecosystem services at landscape scale define the ‘framework’ within which development can take place and the types of development that could be sustained. Since two mines are already in operation, but several more may be developed at some point in the future, this SEA has had to combine reactive and proactive approaches.

However, the broad scope and low level of detail of the SEA must be complemented by the narrow scope and relatively high level of detail of the individual mine EIAs. Thus in order to ensure that projects meet the objectives of sustainable development, it is important that the impact assessment of a project is ‘nested’ within the SEA, thus ensuring that it is contextually sound and consistent with broader development objectives.

Where a particular geographic area (e.g. Erongo Region) is experiencing rapid development and/or additive impacts (as is the case with the “Uranium Rush”) the SEA provides a framework within which to evaluate the cumulative impacts of future development. Cumulative impacts are best addressed at a landscape, regional or sectoral scale through SEA, with project level EIAs providing greater focus and detail.

Impact assessment and decision making are influenced by international conventions, national policies and laws, and a host of socio-economic imperatives. However, it must be informed by both scientific and local knowledge gathered during the impact assessment process (Figure 2.1).

Figure 2.1: Science, values and regulatory frameworks (source: Brownlie *et al* 2009)

Theoretically, society's values are reflected by policies and laws, but value systems change in response to new information and evolving cultures. As noted by Brownlie *et al* (2009) and illustrated above, impact assessment and decision making must consider both science and value systems.

2.3 Limitations and constraints

The TORs for this SEA were very specific in that the focus should be on uranium prospecting and mining in the central Namib, despite the fact that many other non-mining developments exist or are being planned and built in the central Namib, such as chemical plants, tourism, airport and harbour expansions, seawater desalination, fishing, aquaculture, irrigated agriculture and urban expansion. Some of these are linked directly or indirectly to the "Uranium Rush", but others are not. Those that are directly linked[1], such as the desalination plants and chemical plants, have been taken into consideration in the assessment of the cumulative impacts in this SEA. Other indirect and non-mining developments, while important in contributing to the overall positive and negative impacts in the region, have not been assessed in this "Uranium Rush" SEA.

Even beyond the Erongo Region, there are many development activities throughout Namibia and elsewhere in SADC countries that impact on the central Namib, such as power generation and distribution projects, mining, import and export of bulk goods, farming and irrigation, and many others. However, extending the scope of the SEA to encompass the cumulative effects of the "Uranium Rush" on the broader Namibian economy, or even at SADC level, becomes speculative at best. Thus there is a practical need to stay focussed as articulated in the Terms of Reference (Appendix A).

Originally, it was thought that the many EIAs[2] conducted in the central Namib would contain sufficient information to enable the completion of the SEA. However, it soon became apparent that regional-scale data for air quality, human health, radiation levels and subterranean water quality and quantity, were inadequate, necessitating further investigations. Thus, the Steering Committee overseeing the SEA commissioned (through the BGR/GSN project) additional studies on the above subjects[3].

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[1] That is industries that would not have occurred if it had not been for the "Uranium Rush".
[2] For various uranium and other mines, seawater desalination plants, power generation projects and powerlines, harbour expansion, township development.
[3] Regional scale studies on quality and quantity of groundwater resources, baseline air quality, baseline radiation and community health.

Data for other aspects of the environment (e.g. biodiversity) are also inadequate, as there are many areas of the central Namib that have never been studied. Obtaining a comprehensive knowledge base for all aspects of biodiversity in the vast Namib Desert would take decades, even centuries.

In spite of these constraints, thematic studies were undertaken by experts to collate all available knowledge. Many of these studies were undertaken in May-July 2009, but such is the nature of the "Uranium Rush", that some of the data presented in these reports is already out of date. Nevertheless, the Thematic Reports were used extensively as input material (updated as necessary) for the cumulative effects analysis in Chapter 7, and will be made available by MME as a separate stand-alone document.

Thus in spite of the specialist studies and thematic reports commissioned especially for this SEA, and the input of specialist knowledge on the Namib environment during the many workshops, there are still some significant gaps in information in this SEA, relating to:

- Detailed climatic data (needed for air quality and radiation modelling);
- Radon dispersion modelling;
- Long-term air quality monitoring data;
- Long-term water quality data sets;
- An analysis of the groundwater pathways for exposure to radionuclides and calculation of doses;
- Ecological processes and functioning in general and for key species in particular e.g. the Welwitschia;
- Archaeology;
- Cancer baseline for Erongo;

Perhaps the greatest limitation in this SEA was the fact that it had limited ability to consider alternatives, and so to fundamentally change the way the Erongo Region will develop. The "Uranium Rush" is a given (albeit the actual scope of it is not yet known), as are the associated industries and other development sectors. However, the implementation of many 'within sector' alternatives may be achieved, including:

- Acceptance of the need for 'red and yellow flag' areas, based on ecological, heritage, tourism and sense of place considerations;

- Restricting mines and their supporting infrastructure (e.g. rail, road, powerlines and pipelines) to a confined area so that they occupy a limited impact corridor;

- Achieving critical mass through co-investment by the mines and other sectors in a range of desired social, economic and biophysical initiatives (e.g. education, housing, skills development, conservation), rather than individual proponents pursuing self-interest based, fashion-driven corporate social responsibility spending.

It was not possible, within the scope of this SEA, as specified in the ToR (Appendix A) to evaluate all the various infrastructure alternatives e.g. the relative merits of all the power and water supply options, various transportation alternatives and so on. Nevertheless, this SEA does make recommendations in some instances as to what might be considered a preferred option and indeed, some of these are already being considered by the relevant parties, e.g. clustering the chemical industries and the power station, 'piggybacking' the NamWater desalination plant on the Areva plant, and so on.

2.4 Methodology used in this SEA

As described above, this SEA report has been derived from a number of thematic reports and specialist studies. The methodologies used in those studies are detailed in the individual reports and are not repeated here. This section provides the reader with an overview of the overall approach and methodology used to compile this SEA report.

Figure 2.2 illustrates the sequencing of activities in the "Uranium Rush" SEA.

2.4.1 Understanding the "Uranium Rush"

Over the past few years, people have speculated about how many mines will open in the central Namib, how long they will last, who buys the uranium, whether other countries have banned uranium mining while Namibia is being exploited by multi-nationals, etc. Also, some wondered what the future might be for this sector given the implications of the ongoing global economic crisis. Since the future is uncertain, this SEA began by producing a paper entitled 'Forces and Dynamics of the "Uranium Rush"', and circulating this widely for comment. This paper was updated every few months, as more information became available. A summary of this paper may be found in Chapter 3 and the full report will be made available in a separate stand-alone document by the MME.

In parallel, the team compiled a 'Mining Report', which showed the areas under prospecting and mining, the nature of the deposits and thus the technology that would be used to mine and extract the uranium, the development stage of each operation, when they might commence/cease operations, the resources they would need to operate (e.g. personnel, power, water, transport), information on company ownership and as many corporate details as could be obtained. The companies, the Chamber of Mines and the MME assisted with this exercise and helped to verify the accuracy of the report. However, the report quickly became outdated as company profiles changed, acquisitions took place, and exploration results poured in. A summary of this paper is provided in Chapter 4 and the full report will be made available by the MME.

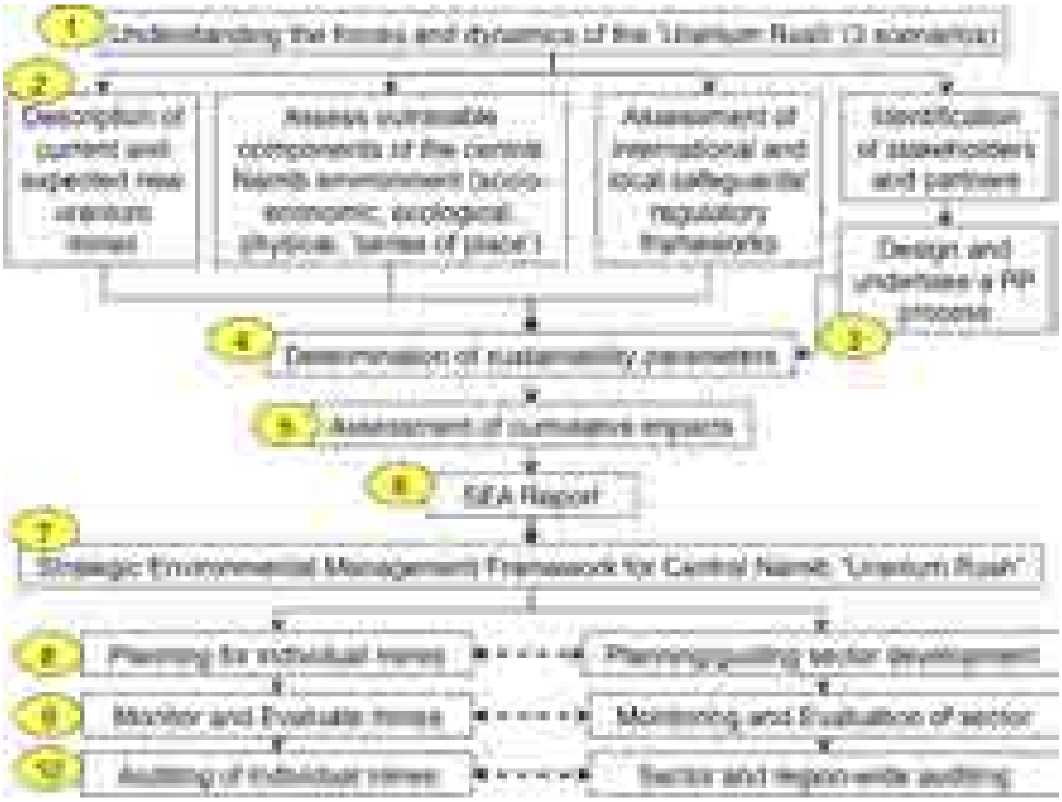

Figure 2.2: Sequencing of SEA activities

Based on the Forces and Dynamics paper, the Mining Report and expert opinion, the team constructed and tested four scenarios, which were used as the basis for the impact assessment. These considered both uranium mining and a more holistic overview of development in the Erongo Region. These scenarios are discussed in Chapter 4.

2.4.2 Baseline analysis

The next step was obtaining a thorough understanding of the current situation regarding the receiving environment, including biodiversity and heritage resources, the state of water, power and other resources, the adequacy of existing social and physical infrastructure (e.g. schools, roads, harbour, transportation, health facilities, etc), the availability of human resources and skills, radiation and health levels, etc. As noted earlier, some of this work had already been done and recorded in the various mine-specific EIAs, in GRN and parastatal reports, and other studies. But as noted above, some new studies were commissioned by the BGR-GSN after it became apparent that there were certain regional data deficiencies.

Thematic Reports were compiled by a small team of people who are very familiar with the literature (or have written much of it) and who could be considered experts in that field. In most cases, they held small ‘brainstorm’ workshops with local experts to obtain additional data or verify preliminary findings. The Thematic Reports were peer reviewed by the SEA Steering Committee and are regarded as representing a reasonably coherent collection of knowledge for future reference. These reports will be compiled into a separate stand-alone volume, but the findings of these studies were used extensively in the cumulative environmental assessment (Chapter 7) and in compiling the SEMP (Chapter 8).

Plate 2.1: The SEA benefited from a number of brainstorm workshops, both internally within the team, with the Steering Committee and with focus groups (photo M.Hauptfleisch).

Plate 2.2: Limited fieldwork was required since recently completed EIA reports for mines and other projects in the area provided a substantial amount of information that was used in the SEA (photo M.Hauptfleisch).

2.4.3 Stakeholder engagement

The TORs expected the SEA to be widely publicised as early as possible, so that Interested and Affected Parties (I&APs) could participate meaningfully from the start and so that the SEA could benefit from their knowledge and insights. Good public participation is always required in impact assessment, but even more so in this case as the uranium industry is to some extent ‘unknown’ to the public and its impacts prone to misinterpretation and exaggeration. Providing credible information on an ongoing basis and running a legitimate process were non-negotiable prerequisites. Furthermore, it was hoped that effective public involvement would build ownership amongst stakeholders of the SEA and SEMP process as well as stakeholder acceptance of their recommendations.

Stakeholder engagement for this SEA consisted of the following:

- Public meetings;
- Focus group meetings;
- One-on-one consultations with concerned organisations and individuals;
- Media interviews and newspaper articles;
- Questionnaires;
- Information sharing on the SAIEA website;
- The Youth Forum workshop and debate held on 6 November 2009;
- A multi-stakeholder workshop on the SEMP on 11-12 February 2010; and
- Discussions within the “Uranium Rush” SEA Steering Committee.

The stakeholder engagement process was initiated by compiling a comprehensive database of I&APs (see Appendix B). The many EIAs completed for various projects in the central Namib contained stakeholder lists (most overlapping) which were used as a basis. The list was expanded through recommendations from the client, SEA team members and the Steering Committee to be as inclusive as possible. It was acknowledged that the "Uranium Rush" would have local, regional and national impacts and consequently stakeholder engagement at all levels was encouraged.

Plate 2.3: Public meetings were held in a number of localities at various stages of the process, enabling people to obtain information and provide input. Participatory techniques were used to encourage effective public participation (photo M.Hauptfleisch).

A series of **public meetings** was held in order to:

- Introduce the public to the SEA process, create awareness of its purpose and limitations;
- Encourage and facilitate public enquiry about the process, and its possible outcomes;
- Provide a neutral platform for the public to communicate their hopes and concerns about the "Uranium Rush";
- Stimulate debate over some of the concerns of uranium mining in the region;
- Identify stakeholders to engage further through focus group discussions and informal interaction to provide meaningful input to the SEA.

It should be noted that the public and focus group meetings held as part of the SEA process, were in addition to the numerous meetings held over the past few years as part of EIAs for various mines. Within those project-level EIAs, members of the public, including local communities, unemployed, mine worker unions, NGOs etc, raised concerns and expectations relating to each mine specifically, as well as the "Uranium Rush" generally. Thus, the SEA was able to capitalise on the large body of information contained in the individual EIAs.

Notices of the scoping meetings were advertised in the following media:

Type of notice	Where placed	Date: (2009)
Advertisement	Namib Times, Namibian, New Era, Republikein	20 February & 6 March
Public Announcement	NBC Afrikaans, NBC Oshiwambo, NBC Otjhiherero, NBC German, Kosmos Radio, Channel 7 Radio, Radio Wave, NamFM 99	9 March
Public broadcast interviews	Kosmos Radio, NamFM 99, NBC Afrikaans	6 March 9 March
Newspaper articles	Namibian	9 March
Partner organisations	Namibian Environment and Wildlife Society, Nacoma	23 February
E-mail	Identified stakeholders (through SEA team brainstorming), I&AP lists from Uranium mine EIAs, and other EIAs in the region, Namibian Environment and Wildlife Society Network, Nacoma I&AP network	23 February to 5 March
Follow-up articles ensuring awareness about public input, and stating contact details for further input	Republikein, Namibian, Namib Times	12 March, 16 March 10 March, 24 March 20 March

In order to facilitate access by all members of society to the SEA process, meetings were held at the towns listed below. The meetings in Arandis and Usakos were specifically held to ensure participation by local communities, mine workers, mine worker unions, local farmers and the unemployed.

Town	Date	Time	Attendance
Windhoek	9 March, 2009	18h30	58
Usakos	10 March, 2009	17h30	12
Arandis	10 March, 2009	17h30	40
Walvis Bay	11 March, 2009	18h30	8
Swakopmund	11 March, 2009	18h30	46
Henties Bay	12 March, 2009	10h00	7

At each meeting, the public were provided with an overview of the scenarios and key elements of the "Uranium Rush". They were then asked to express their main hopes (expectations for benefits) and concerns (about negative impacts) on individual cards. These were then clustered by the facilitators and discussed further. The minutes of these meetings are provided in Appendix B and the hopes and fears are summarised in Table 2.2.

Focus group meetings were convened by the SEA team with key stakeholders at various times in the SEA process in order to identify and debate issues relating to the "Uranium Rush" as well as collaboratively identify interventions to address issues. Table 2.1 summarises the focus group meetings.

Table 2.1: A summary of focus group stakeholder meetings

Focus group	Location	Organisation	Purpose of meeting
Mining (12 June 2009)	Windhoek	Valencia Mine	Understanding of SEA process, discussions on possible impacts on mining operations
Housing (July 2009- various)	*Telephonic* Walvis Bay, Swakopmund, Arandis, Usakos, Windhoek	Walvis Bay Municipality, Swakopmund Municipality, Usakos Municipality, Estate Agents	Impacts of the Uranium Rush on the housing market in Erongo
Tourism (10 July 2009)	Windhoek	Tour and Safari Association	Understanding of SEA process, impacts on tourism
Housing (15 & 16 July 2009)	Walvis Bay & Swakopmund	Walvis Bay Municipality, Swakopmund Municipality	Impacts of the Uranium Rush on the housing market in Erongo
Tourism (16 July 2009)	Swakopmund (Longbeach)	NACOMA Contingency Management Committee	Issues and Impacts of the Uranium Rush relating to tourism
Biodiversity offsets (3 August 2009)	Swakopmund	Fauna and Flora International, Chamber of Mines, Uranium Mines, NACOMA, regional biodiversity specialists	Discuss the principle of offsets, and possible application to the Uranium Rush
Biodiversity (4 August 2009)	Swakopmund	Independent scientists, NBRI, State Museum, Gobabeb, NEWS, Nacoma, Environmental scientists, Tourism operators	Issues and Impacts of the Uranium Rush relating to tourism and biodiversity, possible offsets
Biodiversity (5 August 2009)	Windhoek	Namibia Environment and Wildlife Society	Understanding of SEA process, impacts on biodiversity
Mining (14 September 2009)	Windhoek	Langer Heinrich Mine	Understanding of SEA process, discussions on possible impacts on mining operations
Restoration and mine closure	Windhoek	Enviroscience, Gobabeb, DRFN,	Development of a central Namib

Focus group	Location	Organisation	Purpose of meeting
(22 September 2009)		DWAF, ASEC, Millennium Seed-bank Project	Restoration Unit to support SEMP implementation
Mining (2 & 30 October 2009)	Windhoek	Gecko Mining	Understanding of SEA process, discussions on possible impacts on mining operations
Mining (12 October & 17 November 2009)	Windhoek	Bannerman Mining	Understanding of SEA process, discussions on possible impacts on mining operations
Small scale mining in the central Namib (4 June 2010)	Karibib	Erongo Small-scale Miners' Association and stakeholder forum	Impacts of Uranium mining on small-scale miners in the region, possible synergies

One-on-one consultations were held with key individuals and organisations, as well as any group or individual requesting such a consultation. Groups that are known to be particularly sensitive about the "Uranium Rush" or especially vulnerable to its impacts (such as the tourism industry, landowners and conservation/environmental NGOs) were specifically encouraged to become involved in the process. In response, the Namibia Environment and Wildlife Society (the country's oldest and most representative environmental NGO) organised a consultative meeting so that its members could hear about the SEA and provide input. The landowners (a small group of farmers in the Swakop/Khan area) were particularly active in the EIA process for the mine that affected them most significantly (Valencia) and some of the farmers also attended some of the SEA meetings. They did not make use of invitations for additional meetings as part of the SEA process. Appendix B lists individuals who were consulted during the SEA.

Media interviews and newspaper articles were an important aspect of public participation to create an understanding of the SEA process and its outcomes. Newspaper articles appeared in The Namibian, Republikein, Allgemeine Zeitung and Namib Times, and radio interviews were held on an *ad hoc* basis with the Namibian Broadcasting Corporation, Radio 99 and Kosmos Radio. A Swedish film company interviewed the Uranium SEA team at a public meeting in Swakopmund as part of a documentary on the impacts of uranium.

Telephonic and face-to-face questionnaires were used to gather information and opinions on the following issues:

- Extent of tourism in the central Namib and possible impacts of the "Uranium Rush" on tourism;
- Current house market situation in towns of the central Namib, and the effect of the "Uranium Rush" on house and erven prices and availability.

Youth Forum: During November 2009, the GSN-BGR invited young Namibians, aged between 16 to 28 years, to a "Uranium Rush Youth Debate", to share their views and opinions on uranium mining in Namibia in general and their expectations on the booming uranium industry in the Erongo Region. The forty-nine people who attended the debate provided valuable input into the SEA, since it verified the validity of the Environmental Quality Objectives and enabled a refinement of the indicators. This was the first time that a forum specifically for the youth had been organised in Namibia as part of an impact assessment process.

Plate 2.4: Participants at the youth debate. This is the first time in an impact assessment process in Namibia that a forum was created especially for the youth. (photos R.Leonard).

The SAIEA website was used to disseminate information in the form of draft reports to Steering Committee members and selected key stakeholders. They were invited to comment on draft reports and their comments were addressed during report finalisation.

The Uranium SEA Steering Committee that was established at the start of the SEA consisted of representatives of key stakeholders in the Uranium Industry in Namibia (government, NGOs, parastatals, mining, tourism)[4]. This committee met eight times during the 16 month period during which the SEA was conducted. Besides steering the SEA process, another function of the Steering Committee members was the dissemination of information within their institutions and networks and providing critical feedback to the SEA team. To assist them with the latter task, the Steering Committee appointed an internationally recognised External Reviewer, Dr Barry Dalal-Clayton (IIED, UK) to assess the extent to which the SEA was adequate in terms of both process and product.

The hopes and concerns about the “Uranium Rush” collated from all the meetings described above are summarised in Table 2.2 according to the main themes of the SEA. Note that these reflect public perceptions and attitudes and do not necessarily reflect what is, or what will actually happen. Where relevant, these hopes and concerns were taken into consideration by theme authors and addressed as part of each thematic assessment.

[4] See Acknowledgements at the beginning of this SEA for the full list of Steering Committee members.

Table 2.2: Summary of hopes and concerns about the "Uranium Rush" expressed by the public

Category	Hopes of the public regarding the "Uranium Rush"	Public concerns about the "Uranium Rush"
Economic	• The "Uranium Rush" (UR) will bring strong economic growth to the towns of the Erongo region and an improved quality of life; • Through careful stewardship of revenues and taxes from the UR, the GRN will be able to address poverty and improve the lives of all Namibians; • The UR will have a major impact on the macro-economic indicators of Namibia; • The UR will create many direct and indirect new jobs; • The UR will be the catalyst for a Namibian nuclear energy industry including the beneficiation of uranium for use in a power station and the construction of nuclear power stations.	• Mining is not sustainable; • Mining is extremely vulnerable to fluctuations in the exchange rate and Uranium prices; • There will be no added value to the country from uranium beneficiation; • All revenues will leave Namibia because of foreign ownership of the mines; • Escalating property prices will make houses unaffordable; • The UR will have a negative impact on the tourism industry thus affecting the livelihoods of many people at the coast.
Infrastructure	• The UR will result in improved/upgraded infrastructure such as roads, railways, port, water supply, waste disposal etc.	• The existing infrastructure will not be able to cope and the GRN will not be able to maintain it or upgrade it in time; • There will not be enough water; • The current waste disposal systems will not be able to cope with additional waste, especially hazardous waste, including radioactive waste; • Power will cost more and power outages will become more common.

Social and health	• The UR will result in more, well-equipped schools and health care facilities;
	• There will be more opportunities for skills development and training;
	• Farmers who may lose their land or livelihoods will receive adequate compensation;
	• There will be a radiation-free community;
	• The UR presents an opportunity to develop a thorough health baseline for Erongo and a National Cancer Register.
		• The influx of employees and their families as well as aspirant workers will cause a number of impacts on:
		  o The incidence of disease, especially HIV/AIDS and TB;
		  o Social cohesion;
		  o Crime;
		  o Informal housing areas;
		  o Crowding;
		  o Pressure on social services and amenities resulting in the deterioration of these services and facilities;
		• There is currently a lack of skilled people and training opportunities;
		• Farmers may lose their land or be unable to farm anymore because of mine-related impacts on their livelihoods;
		• Unethical companies may exploit workers;
		• 'Brain drain' to the mining industry;
		• The mines will impact on health because of:

Category	Hopes of the public regarding the "Uranium Rush"	Public concerns about the "Uranium Rush"
		o More dust; o Increased exposure to radiation; o Increased traffic causing more accidents; o Higher risk of spills of hazardous materials in transit; o Groundwater pollution. • There will be more noise and visual impact resulting in a loss of sense of place; • The UR will result in loss of access to favourite recreation and tourist areas in the Namib.
Environment and heritage	• Mines must employ best practice with regard to: o Water use e.g. recycling and conservation; o Energy use e.g. use of renewable energy and energy efficient technologies; o Rehabilitation and mine closure; o Pollution control (air, water, soil); o Tailings management; • Mining operations must endeavour to reduce their footprint; • Mines must put monitoring systems in place and provide regular reports to the public; • The UR presents an opportunity to fund scientific research and improve the body of scientific knowledge about the Namib environment and heritage resources.	• The mines, associated industrial developments and new infrastructure will have a negative, cumulative impact on: o Water resources; o Biodiversity including the lichen fields; o Air quality and radiation; o Soil; o The integrity of the National Park; o Marine environment (desalination plants); • There will be an increase in poaching, fishing and illegal harvesting; • Mines will not provide sufficient funding for adequate closure; • Mine closure will not be adequate in the long-term resulting in long-term impacts on the environment.

The outcome of the stakeholder engagement process is articulated in the Strategic Environmental Management Plan (SEMP) (Chapter 8) as a set of 'desired states', or visions as to how people would like to see the central Namib in the future. The SEMP is a management framework with a set of indicators that will be monitored to show whether the "Uranium Rush" is contributing positively towards the goal of sustainability in the area, or not. Moreover, it is designed to include the public and civil society organisations as part of long term monitoring and engagement.

A **SEMP Workshop** was held in Swakopmund on 11-12 February 2010 to discuss the SEMP in detail. A total of 45 people attended, representing a wide range of stakeholders from national and local government, parastatals, uranium exploration and mining companies, representatives of the tourism industry, NGOs and others. Each element of the SEMP was projected on a screen and discussed and amended in plenary. This allowed for a divergence of views to be aired, robust debate and consensus to be built.

Public disclosure and comment on the SEA: A final round of public meetings was held on 19-21 April 2010, at which the findings of the SEA were presented.

Table 2.3: Schedule of SEA public disclosure meetings

Town	Date	Time	Attendance
Swakopmund	19April, 2010	18h00	53
Arandis	20April, 2010	18h00	27
Windhoek	21April, 2010	18h00	39

The meetings were advertised in the following newspapers: Republikein (3 days), Allgemeine Zeitung (2 days), The Namibian (3 days) and the Namib Times (2 days). In addition, announcements about the meetings were made on both Kosmos Radio and NBC Radio on the 19th of April. Kosmos Radio also held interviews with one of the team members before and after the Swakopmund meeting and before the Windhoek meeting.

The final draft SEA was made available to the public through various means on 17 August, 2010, and the public had 3 weeks in which to comment.

2.4.4 Assessment of cumulative impacts

The thematic working groups of the SEA team and key stakeholders participated in various meetings to workshop the key impacts of various components of prospecting and mining against the EQOs. This analysis was assisted by the completion of an impact matrix. Once all the working groups had assessed the key impacts of prospecting and mining using the matrix, a workshop was held to brainstorm synergies, cumulative and/or antagonistic effects of the "Uranium Rush". This enabled the construction of the bigger picture, which is what sets an SEA apart from project level EIAs.

It should be noted that while it was possible to identify cumulative impacts using this methodology, no attempt was made to quantify the magnitude, extent, duration and significance of each impact using standard EIA assessment tools. The reason for this lies in the highly speculative nature of the "Uranium Rush". By its very definition, a cumulative impact is an impact that is contributed to by several causes/sources. In the case of this "Uranium Rush", there are numerous variables which may or may not contribute to each cumulative impact to a greater or lesser extent, for a variable length of time, with a higher or lower degree of significance. Thus the magnitude, extent, duration and significance of each cumulative impact will depend on for example, which combination of mines will happen and when, the timing, level and nature of response by GRN to upgrading roads, providing power and water etc, as well as the response by local government in addressing issues such as housing, municipal services, town planning etc. It will also depend on the degree to which the mines adopt 'best practice' and the rigour in which the permit conditions are enforced by GRN. With this number of unknowns, every identified cumulative impact could be widespread or localised, long-term or short-term, severe or minor, significant or insignificant, positive or negative. This therefore presents an infinite number of combinations of possible impacts, depending on a large number of variables, dependencies and unknowns and therefore any attempt to quantify these impacts becomes a fruitless exercise.

2.4.5 Strategic Environmental Management Plan

Implementation of an organic, dynamic programme as complex as the "Uranium Rush", will create challenges at all levels - regional, local, community, household, and individual. It will also create challenges at the strategic level, which the Strategic Environmental Management Plan[5] (SEMP) will identify and address (see Chapter 8). In formulating the SEMP, it was important for the team to understand the relationships between the forces and dynamics of the global uranium industry (Chapter 3) and the cumulative impacts of the "Uranium Rush" and associated developments on other land uses and activities within the Erongo Region.

The "Uranium Rush" occurs in an area that already has a number of other land uses, such as tourism, fisheries, lifestyle investments, import/export and film making. While each of these is dependent on a different natural resource base (the geological occurrence of uranium, a desolate desert landscape, rich marine resources etc), there are inevitable points of potential conflict, e.g. between mining and tourism; increased industrialisation and lifestyle investments and so on. While the 'pull' factors are firmly rooted in the natural attributes of the central Namib, the drivers (or 'push' factors) are global in nature (Figure 2.3). Clearly the SEA cannot influence global forces, but it can create a development vision for the central Namib which is consistent with national policies (e.g. Vision 2030) and which provides an enabling environment to facilitate equitable development: one which balances short-term socio-economic benefits with long-term environmental protection.

Once the economic drivers and the vulnerability of the receiving environment were understood, we analysed the need for strategic investments, which include good governance at all levels, an improved physical infrastructure (e.g. roads, port), efficient social services (e.g. schools, clinics), and careful planning to maximise benefits and minimise negative impacts and opportunity costs. Translating the above broad investments into practical actions required the development of a series of Environmental Quality Objectives (EQOs). These are broadly stated desired future outcomes that are based on a combination of public input, expert opinion, scientific research and an examination of policy, ethical and legal requirements. These informants constituted the **'input'** into the (EQOs) (Figure 2.3).

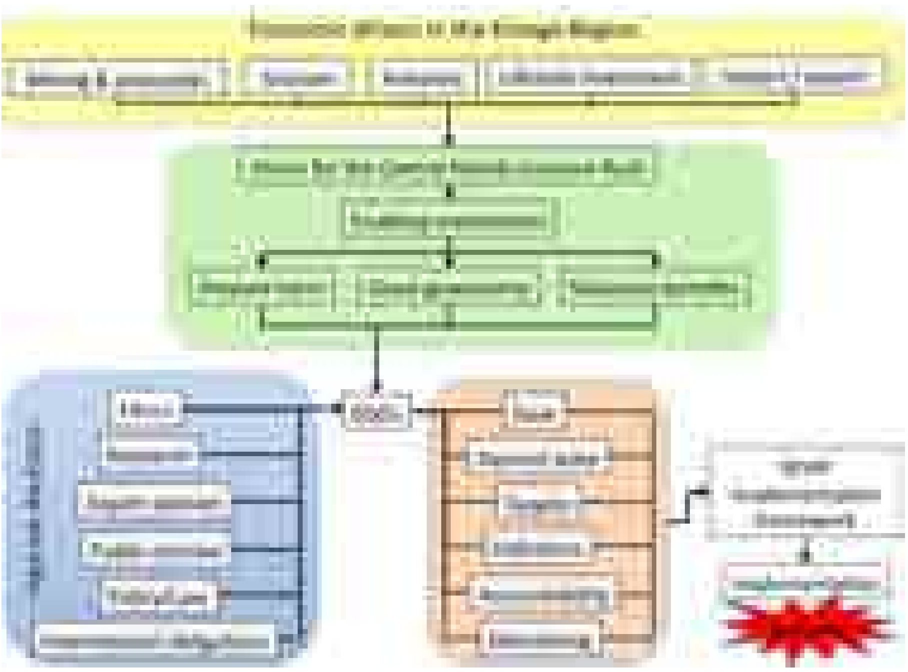

Figure 2.3: The broad sequence of activities that culminated in SEMP development

[5] Although the SEMP is called a plan, it is in fact a framework for developing and implementing detailed plans.

An EQO is typically a non-enforceable goal, which specifies a target for environmental quality which, it is hoped, will be met in a particular environment. In some cases, EQOs are a vague form of generally desirable objectives, but in other cases, they might be concrete quantitative measures. Wherever possible, they should be acceptable to all key stakeholders, quantifiable, verifiable and outcomes-oriented.

EQOs include a number of management objectives which are linked to one or more targets. These targets have been determined either by local and/or international laws (e.g. water quality standards), policy (e.g. National Park zonation), best practice guidelines (e.g. pupil: teacher ratio at a school), the markets (e.g. house prices) or societal choices (e.g. sense of place). The challenge in countries such as Namibia is that there are very different societal expectations from different cultural groups, meaning that great care was needed to reduce bias. Thus, determining the EQOs required a combination of research (e.g. what are the standards set by law?) and careful stakeholder engagement (see section 2.4.3 above). In this case, the public participation process was slightly different from conventional EIA work, as it required consensus building and visioning. The EQOs and indicators were finalised after eight months of public meetings, focus group discussions and expert input (see Chapter 8).

Implicit within all EQOs is a minimum management objective that states that any change to the environment must be within acceptable limits and that pro-active intervention will be triggered by the responsible party to avoid unwanted changes that breach a specified threshold. Achieving the desired outcomes specified in the indicators requires investments and actions by a range of stakeholders if Namibia is to succeed in managing the "Uranium Rush". There is thus a need to measure the progress of implementation, outputs and outcomes. This would best be done by a central 'SEMP Office' which would be responsible for coordinating all the monitoring duties and data and compiling the information into an annual report to inform the stakeholders about progress in implementing the recommendations of this SEA. Naturally, any shortcomings identified through monitoring will be documented and will require corrective action by the relevant party.

The EQOs that were identified are regarded as a proxy, which collectively indicates whether the "Uranium Rush" is moving the central Namib along a pathway towards or away from the goal of sustainable development. These EQOs collectively make up the SEMP, which is the ***framework*** within which individual projects need to be planned and implemented. If individual projects are well planned and implemented and they collectively contribute towards the sustainable development of the Erongo Region, then the desired **outcome** has been achieved (Figure 2.4).

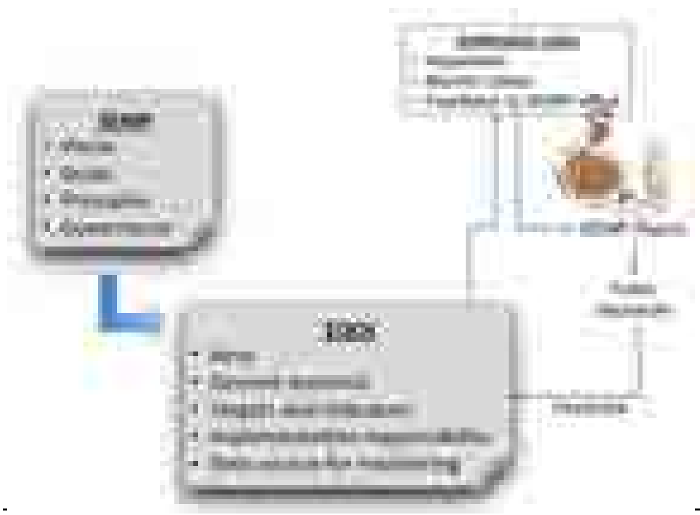

Figure 2.4: Key components of the SEMP and the link to annual reporting and public disclosure

3 FORCES AND DYNAMICS OF THE URANIUM RUSH

3.1 Power Demand

3.1.1 Global Growth in Electric Power Demand

The current uranium rush in Namibia is driven by various global forces as well as some local forces. Global forces behind the uranium rush operate at different levels of the global economy and energy economy. Until the economic crisis of 2009, the world had experienced a period of continued economic growth, fuelled in recent years by the fast expanding economies of threshold countries like China and India. Global economic growth, in turn, has driven growth in global energy demand, although world primary energy consumption has grown more slowly than world economic output. This "de-coupling" of primary energy demand growth from economic growth, first triggered by the oil shocks in the 1970s, has continued to date, as a result of steady gains in the energy productivity of aggregate economic activity (i.e. the economic output generated per unit energy input) in most national and regional economies.

On the other hand, the proportion of secondary energy that is consumed in the form of electricity has continued to rise worldwide, such that growth in global *electric* power demand has outpaced global primary *energy* demand growth, approximately keeping pace with global economic growth. Meeting growing electricity demand worldwide has required continuing expansions in global electric power generating capacity, as well as motivated efforts to use existing generating capacity more efficiently, as reflected in rising average capacity factors of nuclear power plants.

Whether global primary energy demand will continue to grow in the coming 10-15 years (and if so, at what rates) will depend on a number of factors including: the form, speed and extent of the current recovery from the worst financial and economic crisis since the Great Depression; the rate at which energy prices will continue to rise; and, depending on the economic recovery and energy price rises, the extent to which the past trend of decreasing energy intensity (increasing energy productivity) of aggregate economic activity will continue. Similarly, whether global *electric* power demand will continue to grow faster than overall *energy* demand (and if so, at what rates) and what mix of power sources will come to be deployed to meet future electric power demand, will depend on a number of factors, such as:

- The extent to which the past trend of increasing electricity shares in secondary energy supply mixes continues;
- Changing energy end use patterns;
- The rate at which electricity prices will continue to rise;
- Changing relative power generation costs for alternative power generation technologies;
- Changing perceptions of the relative environmental, safety and security risks of different power supply systems and technologies.

3.1.2 Global Nuclear Power Capacity

In recent years, nuclear energy has made a comeback as a relatively 'clean' (carbon-free) and relatively abundant source of base load power. This comeback has been triggered and propelled by a combination of factors, including:

- Concerns about global climate change and meeting greenhouse gas (GHG) emission reduction targets (mostly among developed countries and especially in Europe);
- The prospect of rising energy prices, especially for fossil fuels, and declining fossil fuel supplies and related energy security concerns - particularly in some countries with few if any domestic energy resources and hence few if any energy supply alternatives to importing fossil fuels;
- The need for meeting fast growing energy/power demand - above and beyond likely further improvements in energy efficiency and productivity (this refers, in particular, to populous, fast growing threshold countries, like China and India); and
- Ambitious nuclear power expansion plans in traditionally pro-nuclear developed and threshold countries.

These factors have helped to bring about a marked change in the dynamics of the global commercial nuclear power market. Since the turn of the millennium, orders for nuclear power reactors have resumed (after 15-20 years of relative nuclear power market paralysis and shrinkage) and a significant number of new nuclear power plants, corresponding to about 15% of current global nuclear generating capacity, are currently under construction (Figure 3.1). However, the nuclear power renaissance has yet to start translating into actual increases in installed nuclear capacity on the ground, as new nuclear plant builds and re-connections to the grid of already existing nuclear power plants have so far been offset by nuclear plant retirements.

Above and beyond the 45 nuclear power reactors (40 GWe of nuclear generating capacity) currently under construction worldwide, another 112 nuclear power reactors (131 GWe of generating capacity) are 'on order or planned' throughout the world, as summarized in Table 3.1. Of the 112 reactors on order or planned, more than half are in Asia: 33 are in China, 13 in Japan, 10 in India and 7 in South Korea. On top of that, 276 nuclear power reactors (300 GWe of capacity) are currently "proposed" (WNA, 2009), but these numbers are very uncertain. Longer term growth is expected to remain centred in Asia, in particular China.

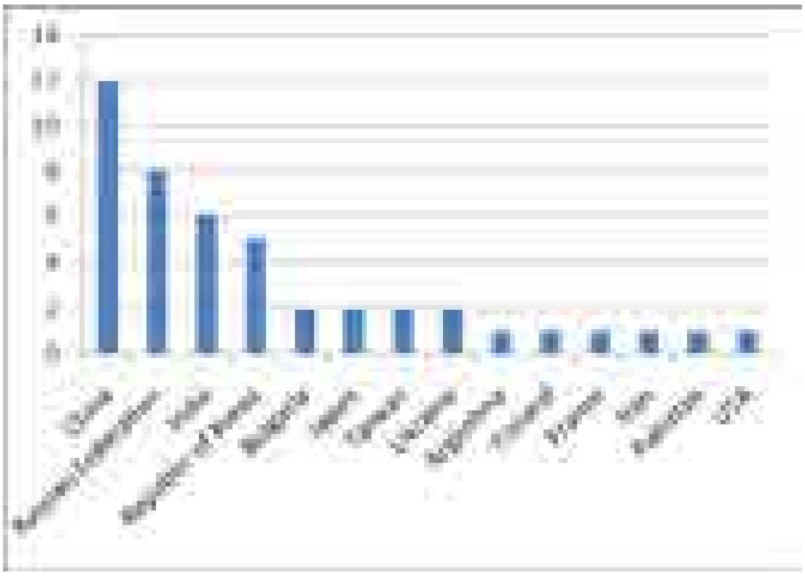

Figure 3.1: Nuclear power reactors under construction worldwide (Source: European Nuclear Society)

Table 3.1: Global nuclear power generating capacity – current and future (Sources: ENS, WNA)

	No. of nuclear reactors	**Installed capacity (GWe)**
Operating nuclear plants	436	372
Under construction	45	40
On order or planned	112	131
TOTAL	**593**	**543**

On the other hand, many of the older operating nuclear power reactors are having their operating licences extended – e.g. most of the 104 operating reactors in the US have had or will have their operating licences extended from 40 to 60 years – and this is likely to lead to net increases in installed nuclear power generating capacity, as the number of reactor retirements drops below the numbers of new builds and re-connections over the next 10-15 years. Whether these rather modest anticipated net increases in nuclear capacity over the next 10-15 years will be sufficient for nuclear power to maintain its global share of electric power supply at the current 14%, remains to be seen. In the longer run, maintaining this global share would certainly require a massive effort in nuclear plant construction only to replace retiring reactors, let alone adding new reactors.

Notwithstanding the current nuclear renaissance, the longer-term prospects for nuclear power remain uncertain. For nuclear power to become or remain competitive, energy policies will have to be favourable, regulatory regimes for nuclear power will need to be streamlined to shorten construction periods, and various uncertainties and risks will need to be addressed and managed effectively. These uncertainties and risks include: the need for strong and consistent government support and the extent to which this support will materialise; the complex and uncertain economics of nuclear power; safety, security and environmental risks of nuclear power; the degree of political and public acceptance of nuclear power; and the emergence, strong growth, and increasing competition from alternative power generating systems.

While the current generally more propitious climate for nuclear power has contributed to a positive dynamic and improved outlook for the global uranium market, it cannot by itself explain the current global uranium market rush, given the rather modest anticipated short- and medium-term increases in global nuclear power capacity and associated uranium requirements and given the remaining uncertainties and risks associated with nuclear power. This suggests that the main global forces behind the current uranium rush, in Namibia and worldwide, do not originate from the positive outlook of the nuclear power market, but rather from developments within the global uranium market itself.

3.1.3 <u>The Global Uranium Market</u>

Still further down in the hierarchy of the world energy economy is the global nuclear fuel market that meets the uranium fuel requirements of the current global fleet of nuclear power plants and will help to underpin the future role of nuclear power by delivering the necessary quantities of uranium fuel supplies in a timely and secure fashion. These global uranium fuel markets have undergone profound change as well in recent years. Subdued by chronic uranium oversupply in the 1980s and 1990s, the then lethargic buyer's market started turning into an increasingly buoyant seller's market around 2003, seeing uranium spot prices climbing to unprecedented levels in 2007 (before levelling off to current lower levels) and triggering a global wave of renewed uranium exploration activity and investments in new uranium production capacity (Figure 3.2).

This profound change in the dynamics of the global uranium market may be seen, in part, as a reflection of the renewed attention given to nuclear power and anticipated modest expansions in commercial nuclear power capacity since 2000. But more critically, the current uranium market dynamics appear to be driven by forces emanating from concerns about the security of uranium supply.

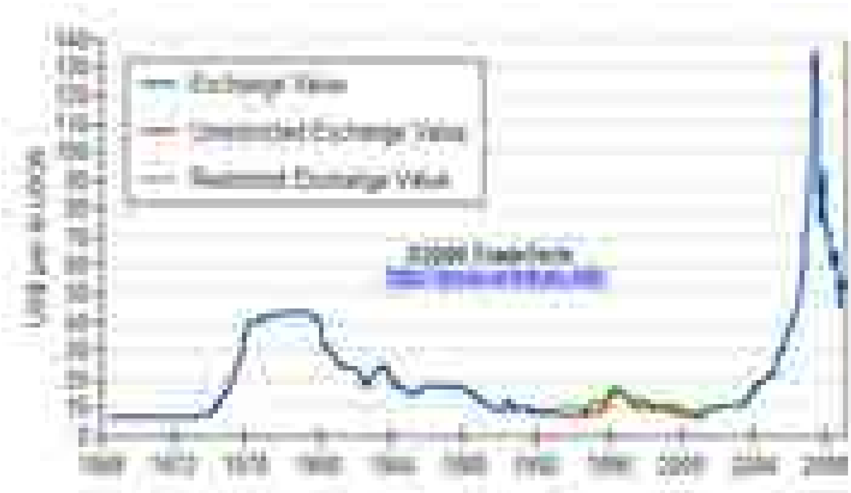

Figure 3.2: Uranium spot market price over time (Source: TradeTech, 2009)

3.2 Uranium Supply

3.2.1 <u>Primary uranium supply: nuclear reactor requirements versus mine production capacity</u>

About 200 tons of natural uranium concentrate are required annually to fuel a 1 GWe light-water reactor (LWR) operating at a capacity factor of 90 percent (IPFM, 2009). This implies that each 1 GWe LWR annually requires approximately 0.47 Mlb U_3O_8 (yellowcake). Therefore, the annual uranium fuel requirements of the entire global fleet of nuclear power plants are roughly 175 Mlb U_3O_8 or about 79,545 tonnes.

Primary uranium supplies, i.e. newly mined and processed uranium, currently cover only 55% of nuclear power reactor requirements. With secondary uranium supplies diminishing in absolute terms in coming years (see section 3.2.2), primary uranium production will have to expand significantly in order to be able to meet future supply requirements, which by 2020 will likely be at least equal to and possibly up to 40% higher than current requirements. This means that there are likely to be supply shortfalls in coming years unless new uranium production capacity is developed and deployed in the near future (Figure 3.3). However, long lead times from the discovery of uranium deposits to the beginning of production make it exceedingly difficult to develop and quickly deploy new production capacity from new mines or expansions of existing mines.

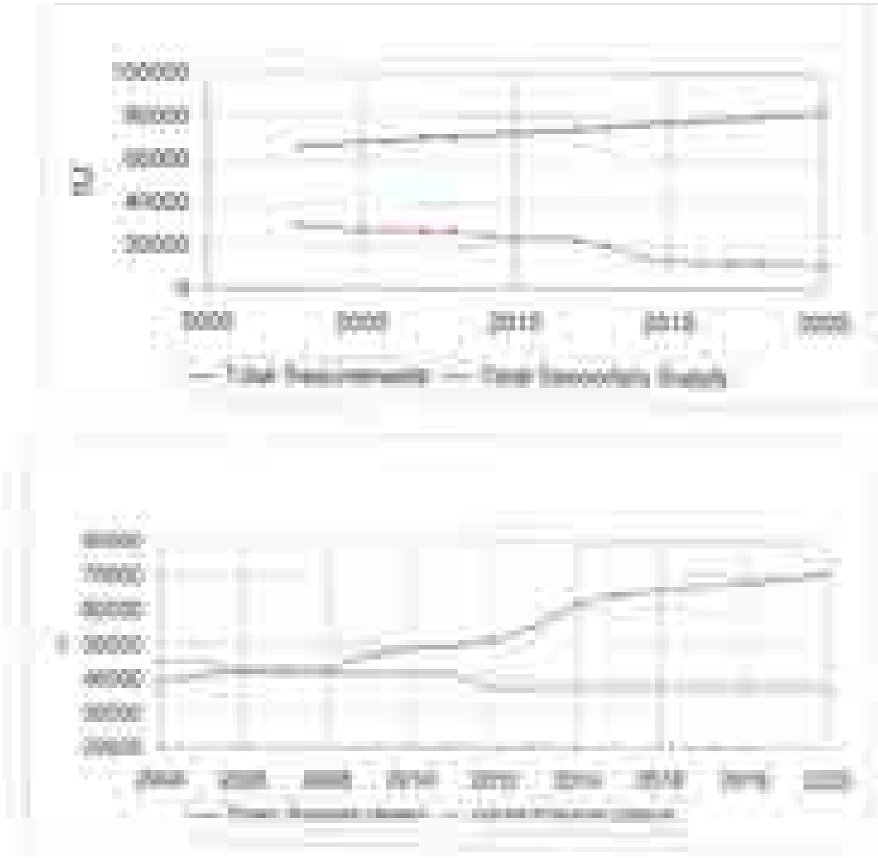

Figure 3.3: Primary and secondary uranium supply and primary uranium production capacity (Source: McMurray, 2005)

The current challenge for nuclear power producers is, therefore, to develop new uranium production capacity in order to prevent possible supply shortfalls in coming years. Higher uranium prices since 2003 have significantly increased available uranium reserves i.e. economically recoverable uranium resources, which are now sufficient to meet current nuclear power reactor needs for at least the next 100 years.

3.2.2 Secondary uranium supply

Another ‘anomaly’ of the uranium market has been the existence of very substantial streams of secondary uranium supplies entering the market, currently meeting some 45% of the total uranium requirements of nuclear power plants worldwide. The secondary supply, which displaces equivalent quantities of primary supply from mines, comes from various sources (McMurray, 2005):

- Highly enriched uranium (HEU) recovered from dismantled Russian nuclear warheads and transformed into low enriched uranium (LEU);
- Uranium stockpiles set up by governments, producers and/or utilities to store accumulated excess uranium for later use or sale;
- Plutonium recovered from spent nuclear fuel and recycled into mixed oxide fuel (MOX);
- Recovering uranium from spent nuclear fuel for re-use in nuclear power plants.

Of these sources of secondary uranium, the “Megatons to Megawatts Programme” (recovery and down-blending of HEU from dismantled Russian warheads) has been by far the most significant one since the late 1990s, when it reached a stage of full-scale implementation. Currently, this source accounts for approximately two-thirds of all secondary uranium. Should the HEU/LEU Agreement between the US and Russia expire in 2013, then secondary uranium supplies from the other sources are projected to meet only about 15% of total uranium requirements in 2020. In the more likely event of the HEU/LEU Agreement being extended beyond 2013, secondary supplies could still only cover an estimated 22% of total requirements by 2020 (McMurray, 2005).

3.3 Namibia and the Supply of Uranium

Namibia is currently the fourth largest producer of uranium in the world, producing 4,843 tonnes of uranium oxide (U_3O_8) in 2008 and forecast to exceed 5,100 tonnes in 2009, as Langer Heinrich ramps up production (see Table 3.2). However, depending on the number and timing of new mines coming into production in the next decade, Namibia’s production could outstrip Canada’s by a considerable amount. Under Scenario 1 (see section 4.5), which only considers the existing mines plus the two under construction, uranium oxide production could double to about 11,000 tpa (±24.3 Mlbs/a), making Namibia the largest producer in the world. Under Scenario 2, with 6 mines in full production in 2015, annual output (approximately 21,500 t U_3O_8 or >47 Mlbs/a) could be over 4 times that of 2008, and under Scenario 3, output from Namibia’s 8 mines (26,900 t U_3O_8) could account for more than half of the entire world production in 2017, (excluding further development worldwide). This certainly puts into perspective the scale of the uranium rush in Namibia.

Table 3.2: 2008 world production of uranium by country

Country	Tonnes U	% of world production
Canada	9,000	20
Kazakhstan	8,521	18.5
Australia	8,430	18.5
Namibia	4,843	10.5
Russia	4,366	9.5
Niger	3,032	7
Rest of the world	7,060	16
Total	**45,930**	**100**

The current uranium oxide requirement to meet global reactor demand is approximately 80,000 tonnes and depending on a number of global forces, this demand could increase by anything up to 40% by the mid-2020s (i.e. a total of 113,200 t would be required). As described in section 3.2 above, the demand is supplied from two sources: primary and secondary, but the future of the secondary supplies is uncertain, depending on whether the HEU/LEU Agreement is renewed or not. The worst case from a uranium supply:demand perspective is as follows:

Maximum projected increase in reactor requirements (40%) (t U_3O_8)	113,200 t
Secondary supplies if HEU/LEU Agreement is *not* renewed	11,000 t
Current supplies from primary sources (no further increase)	46,000 t
Therefore the shortfall would be:	56,200 t

If however, the HEU/LEU Agreement is renewed (a more likely scenario), the situation given maximum reactor demand would be:

Maximum projected increase in reactor requirements (40%) (t U_3O_8)	113,200 t
Secondary supplies if HEU/LEU Agreement is renewed	34,000 t
Current supplies from primary sources (no further increase)	46,000 t
Therefore the shortfall is	33,200 t

The projected supply of uranium oxide (t) from Namibia under the three mine development scenarios is:

Scenario 1: 11,000

Scenario 2: 21,500

Scenario 3: 26,900

Given that it is extremely unlikely that there would be no other increase in uranium oxide production worldwide, there is a real risk of possible world uranium over-supply under Scenario 3. The risk would be especially serious if the HEU/LEU Agreement is renewed in 2013 and if the net increment in nuclear power reactor capacity by 2020 turns out to be small (<40%). In this case, additional global primary uranium requirements might only amount to 25,000 t of U_3O_8 by 2020, and almost all of this could be covered by additional supplies from Namibia (under Scenario 3).

Namibia might be more affected by these risks than other uranium producers, given the low ore grades and higher production costs of Namibian mines. In any case, global uranium market development would likely undergo re-adjustments over time, depending on actual (versus projected) global nuclear power development, global secondary supply development, mine closures, possible mine accidents, etc. All this highlights the uncertainties and risks associated with investments in uranium mining capacity over the coming 10-15 years. GRN should be aware of the risk that Scenario 3 might well be an unrealistic scenario in that Namibia could easily over-supply the global uranium market (global supply security concerns might turn into global over-supply concerns) with corresponding downward pressure on global uranium prices and possible delays in mine openings or even closures of active mines – leading to the possibility of a boom and bust situation, as envisaged in Scenario 4.

The principal reason why Namibia may be more affected by the worldwide uranium rush than most other developing or developed uranium-producing countries is that Namibia is seen by the international nuclear and uranium mining industries as a politically stable, 'uranium exploration/ mining friendly' and 'foreign investor friendly' country with good infrastructure, a reasonably competent, principled and well functioning civil service, reasonably efficient and transparent regulatory procedures (permitting and licensing processes), and no major anti-nuclear or anti-mining opposition.

Some of the main local forces and factors behind the uranium rush in Namibia include:

- Namibia's long-standing experience with mining dating back to colonial times and the country's active interest in mining since Independence, with the current mining sector being one of the strongest, most diversified and export-oriented within the Namibian economy;
- Namibia's significant past experience with and information generated by uranium exploration (accumulated during early international interest in the late 1960s, 1970s, and early 1980s) and uranium mining (the Rössing uranium mine has successfully operated for over 30 years) – which provides an information and operational basis on which current uranium exploration and mining activities can build;
- National development and poverty reduction policies and plans (Vision 2030, NDP3, etc) emphasizing foreign investment as a mechanism for employment creation and enhanced national economic development growth.

It seems plausible to assume therefore that the uranium rush worldwide and particularly in Namibia will continue for as long as supply security concerns drive the global uranium market. Factors like the typically long (and uncertain) mine development lead times, especially for the "super-rich deposits" in Australia and Canada, and the possibility of recurring production interruptions at existing mines e.g. in Niger, taken together, suggest that the current uncertain uranium supply situation is unlikely to fundamentally change over the next 10-15 years. A fundamental shift away from nuclear power that could destabilize the global uranium market before 2020 is conceivable only in the rather unlikely event of a cataclysmic global incident or development.

4 BACKGROUND AND HISTORY OF URANIUM MINING IN AFRICA

4.1 Regional Context – Uranium Mining in Africa and SADC

Uranium deposits are found throughout Africa and currently, exploration is being carried out in 30 countries on the continent, 10 of which are members of the Southern African Development Community (SADC). However, there are only a few mines in actual operation at present. According to the uranium mining website, www.wise-uranium.org, these are:

Table 4.1: Operating uranium mines in Africa (as of 11/11/09)

Country	Mine name	Major shareholder
Malawi	Kayelekera Mine	Paladin Resources Ltd
Namibia	Rössing Uranium Mine	Rio Tinto
Namibia	Langer Heinrich	Paladin Resources Ltd
Namibia	Trekkopje (pilot stage)	Areva
Niger	Arlit	Areva
Niger	Akouta	Areva
RSA	Ezulwini	Ezulwini Mining Co (Pty) Ltd
RSA	Vaal River Area Mines	AngloGold Ashanti

However, with the worldwide increase in the demand for uranium, there are a number of projects throughout the continent which are in an advanced stage of development, especially in Niger, Central African Republic, Namibia (see section 4.3 below), South Africa, Tanzania, Malawi and Zambia. The large, near-surface deposits in Niger are relatively high grade (>0.1% U) and therefore there remains significant interest in this country in spite of the political difficulties that often beset the mines.

In South Africa, uranium is most usually associated with gold or copper ores. Up until the recent surge in the price of uranium, the generally low grades of uranium at the gold and copper mines did not make uranium extraction a commercially viable proposition. Therefore, it has been discarded as waste rock or in mill tailings. Thus, although the grades are typically low, ranging from 0.002 – 0.08% U, the resources are easily and cheaply extractable, which makes their future exploitation more attractive.

As in South Africa, the Zambian uranium ores are usually associated with copper, but due to a combination of public opposition to the development of a uranium processing industry in the country, and the lack of a national policy framework for uranium mining, Zambia only started to issue new licences in early 2009.

In addition to the operating mines and uranium projects which are currently under development, as described above, there is extensive exploration being carried out throughout the continent: for example, Niger issued more than 100 exploration permits in the last 2 years and Botswana issued 138 exploration licences for nuclear fuels in the same period. On the other hand, although Namibia granted 66 Exclusive Prospecting Licences (EPLs) for nuclear fuels up until 2007, the Ministry of Mines and Energy (MME) put a moratorium on granting any more EPLs until a policy on uranium exploration and mining has been developed.

Regionally, Namibia appears to be popular amongst the exploration companies for a range of technical, financial and regulatory reasons. The ore bodies are all found on or close to the surface which allows open cast mining; while the ore grades are not as high as those found in Niger, they are high enough to make large-scale mining economically viable; the infrastructure, although stretched, is considerably better than that found in many other African countries; the mines are located close to a port facilitating the import of process chemicals and the export of yellow cake; and there is a relatively straight forward regulatory framework in place to manage and control uranium mining and all related impacts.

Negative factors however, include an inadequate supply of naturally-occurring water in the central Namib and desalinated sea water will be expensive; regional power shortages; crumbling road infrastructure (many of the roads in the area were not built to accommodate heavy vehicles); port congestion and delays; overburdened health and educational facilities in the local towns; and a shortage of skills and government structures which have limited capacity to cope with the uranium rush. Many of these constraints can be addressed through a combination of political will, policy coordination, competent governance, proactive planning and government spending.

4.2 Types of Uranium Deposits in Namibia

The uranium deposits in the Erongo region are mainly confined to the Central Zone of the Damara Belt. Two main types of deposits are found, namely the ‘granite type’ sheeted leucogranite / alaskite-hosted primary deposits and the ‘calcrete type’ superficial secondary deposits (Figure 4.1).

The predominant primary uranium mineral in the leucogranites is uraninite (UO_2), however, betafite might be a major phase in some places. Beta-uranophane is usually the dominant secondary mineral in these granites. These uraniferous leucogranites, known as alaskites, occur preferentially in and around anticlinal and dome structures along the Khan and Swakop River valleys to the east of Swakopmund.

Secondary uranium deposits are found in the calcretes which occur in the coastal plain of the Namib Desert. The main uranium-bearing mineral in the calcretes is carnotite, a bright yellow potassium-uranium vanadate mineral. These deposits are related to fluvial environments within palaeo-valleys of ancient rivers that flowed westwards from the Great Escarpment during the upper Cretaceous and the lower Cenozoic periods (88 to 25 Ma). The carnotite is usually found in calcretised fluvial channels as thin films in cracks, disseminations and as coatings on sediment grains, it also occurs along grain boundaries forming a cavity fill, and is best developed in regions of high porosity (LHU, 2009; Roesener and Schreuder, 1992).

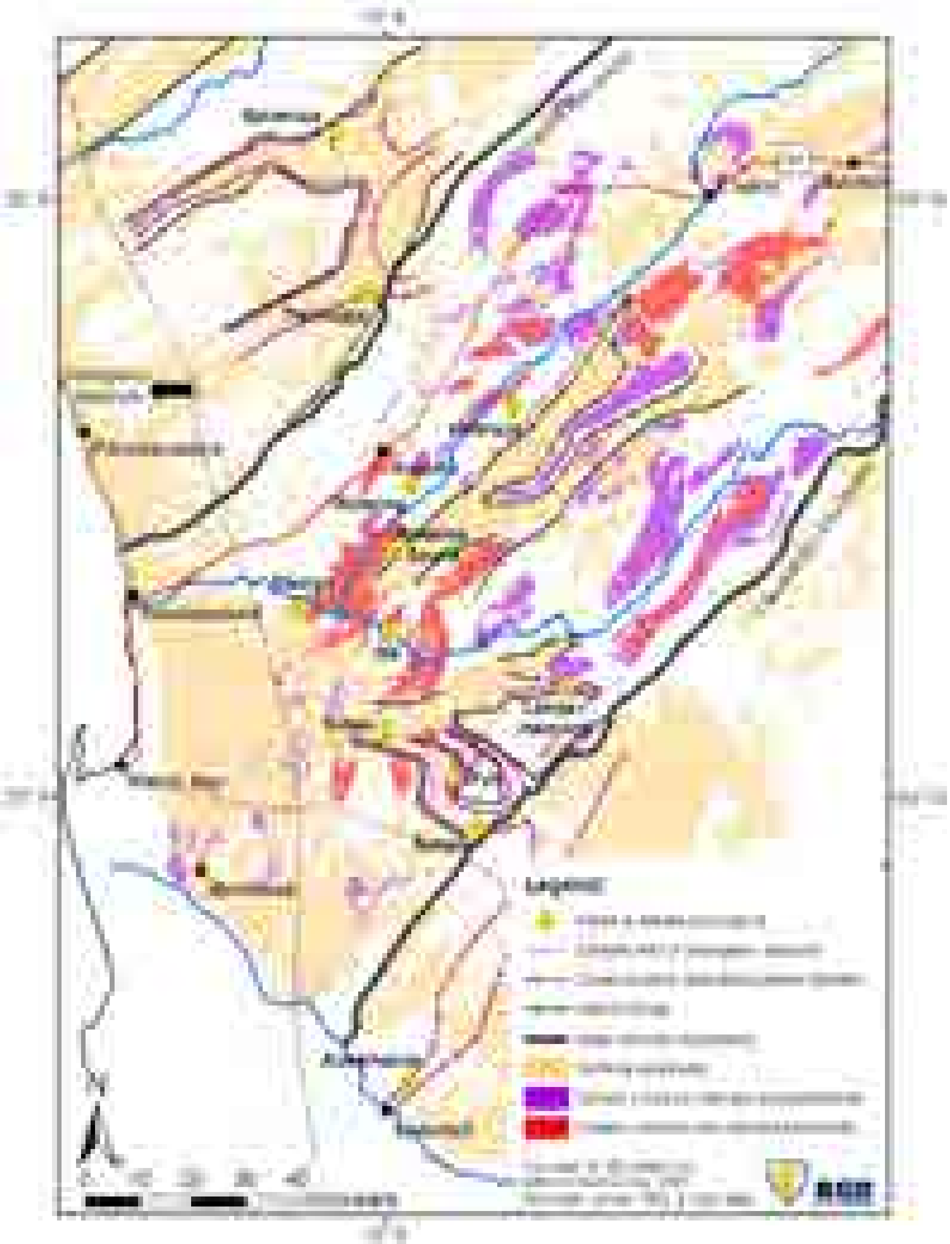

Figure 4.1: Part of the Central Zone of the Damara Belt showing domes and the location of the known uranium deposits (Geological Survey of Namibia, 2010).

4.3 History of Uranium Exploration and Mining in Namibia

Captain Peter Louw discovered radioactivity in the vicinity of the current Rössing mine in 1928. Anglo American Corporation subsequently carried out exploration in the area, but it was not until Rio Tinto acquired the exploration rights in the 1960s that a number of low-grade alaskite ore bodies were identified along the north side of the rugged Khan valley. After extensive test work, construction of the current Rössing mining plant and the development of the open pit started in 1974, with commissioning taking place in 1976 (Plate 4.1). Full production was only achieved in 1979 due to major teething problems in the plant.

Plate 4.1: Rössing, with almost 35 years of production, is the most established uranium mine in Namibia. In this photo, an ore truck passes under a scanner to determine the ore grade (photo Geological Survey).

Following the discovery of Rössing and the global increase in the demand for uranium for nuclear energy production during the 1960s and 1970s, several international mining companies actively started prospecting for uranium in Namibia e.g. Falconbridge and Elf-Aquitaine in addition to Rio Tinto. Furthermore, during the 1970s, the South African government had secretly embarked on the development of 6 atomic bombs under the guise of nuclear fuel enrichment. Thus there was significant interest in Namibia (then a South African Trust Territory) from South African mining companies to find primary sources of uranium to supplement the low-grade output from the South African gold mines. Thus companies such as Anglo American, General Mining and Gold Fields carried out extensive exploration for uranium in the central Namib up until the 1980s, but no new mines were ever developed. Thereafter the uranium price slowly declined and even the well-established Rössing Mine considered early closure several times during the 1990s and early 2000s (see Figure 3.2 in Chapter 3).

In addition to uranium, sporadic exploration and mining has been carried out in the central Namib for decades for a variety of minerals, notably gold, tin, copper, lead, zinc, fluorspar, tungsten, graphite, gypsum, lithium, semi-precious stones and dimension stone. Most of these mines were small and widely spread, both geographically and over time (Figure 4.2). Unfortunately, none of these mines was properly rehabilitated and evidence of mining in the form of tracks, debris, concrete plinths, excavations and waste rock dumps can still be seen today (Plate 4.2).

Plate 4.2: The Namib, like many other places in Namibia, carries debris and scars from mines that have long closed and now lie abandoned (photo Geological Survey).

4.3.1 Current mining activity in the Central Namib

Currently, there are three large mines in operation in the Erongo Region (Rössing Uranium Mine, Langer Heinrich Uranium and Navachab Gold Mine), and two uranium mines are under construction (Trekkopje and Valencia). In addition, there are nine licensed, small dimension stone operations throughout the region and artisanal mining operations are being carried out in the Spitzkoppe area targeting semi-precious stones (e.g. tourmaline, aquamarine, garnet, topaz and rose quartz). There are also two large salt works, one located north of Swakopmund and the other lies south of Walvis Bay, as well as six other smaller salt mining licence holders (Figure 4.2). The output, number of employees or contractors for the smaller mining operations in the region e.g. the gemstone and dimension stone mines, are unlikely to contribute significantly to the cumulative impacts of the Uranium Rush. However, the cumulative impact of their activities on the landscape and their contribution to the degradation of landscape quality is an important factor to be taken into consideration in this SEA.

The three large operating mines in the Erongo Region (Rössing, Langer Heinrich and Navachab) contribute a significant amount to the Namibian economy through employment, sub-contracting, wages and salaries and taxes (Table 4.2). The combined employment at these mines in 2008 of 1,834 represents almost 3.5% of the economically active working population of the Erongo region (based on 2001 census figures).

Research by Ashby (2009) at the Langer Heinrich mine found that the dependency ratio for workers:dependents on the mines is higher (1:4.3) than the average for the Erongo Region as determined in the 2001 census (1:3). Thus the number of dependents benefitting from employment at the 3 larger mines is approximately 7,886. The 2008 combined wages and salaries bill comes to N$453.3 million, but according to research work conducted at Langer Heinrich (Ashby, 2009), an average of N$919 of a worker’s salary is remitted ‘home’ to the northern communal areas of Namibia. Even so, approximately N$451.6 million is spent in the Erongo Region per year. From these 3 mines alone, the Namibian government collected N$876.4 million in taxes and/or royalties in 2008 and the mines had a collective annual turnover of N$5,635 million (2008).

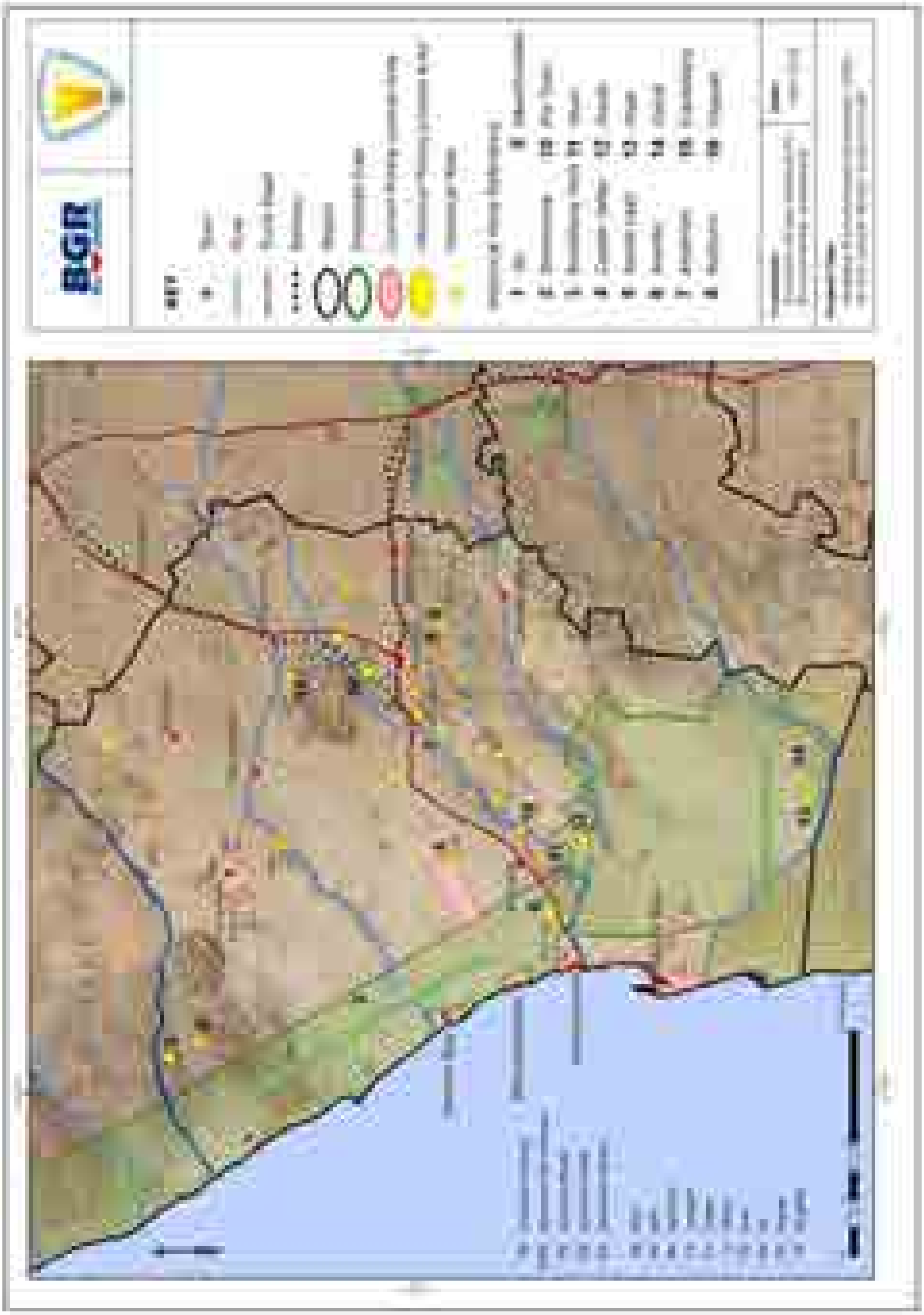

Figure 4.2: Current Mining Licences and Historical Mines in the Erongo Region

The two operating uranium mines produced a total of 4,843 t (10.7 Mlbs) of U_30_8 in 2008, elevating Namibia from the world's fifth to fourth largest producer (see Table 3.2). A target of 5,180 t (±11.6 Mlbs) U_3O_8 is expected in 2009 as Langer Heinrich ramps up production.

Table 4.2: Key statistics for the three large mines currently in operation in the Erongo Region for 2008

Name of mine	Owner	Start date	Projected closure date	Product output*	No. of employees*	No. of sub-contractors	Turnover mill N$	Wages and salaries mill N$	Royalties and/or taxes mill N$
ML28: Rössing Uranium Mine	Rössing Uranium Ltd	1976	2020	4,067 t or >9 Mlbs of U_3O_8	1,307	1,154	4,492	319.4	786.9
ML140: Langer Heinrich	Langer Heinrich Uranium Ltd (Paladin Energy)	2006	2024	776 t or 1.7 Mlbs of U_3O_8	167	415	713	50.7	16.8
Sub-total Uranium mines				*4,843 t or >10.7 Mlbs*	*1,474*	*1,569*	*5,205*	*370.1*	*803.7*
ML31: Navachab	Anglogold Namibia (Pty) Ltd	1989	2016	2,126 kg gold	360	138	430	83.2	72.7
TOTAL				**-**	**1,834**	**1,707**	**5,635**	**453.3**	**876.4**

* 2008 figures as reported in the Chamber of Mines 2008 Review

A brief overview of the three large operating mines and the two uranium mines currently under construction is given below.

4.3.1.1 Rössing Uranium Ltd

Rössing Uranium Ltd (RUL) mines uranium ore from 500 million year old granitic rock in the Namib Desert about 70km north-east of Swakopmund (Figure 4.2). The mining licence covers an area of 18 km^2 and the ancillary works area covers a further 5.95 km^2 giving a total mine footprint of 23.95 km^2 (Plate 4.3) (Rössing Annual Report, 2007). Uranium occurs in very low concentrations at Rössing (0.03% uranium) and therefore the mine has to operate on large tonnages. The open pit measures 3 km long by 1.2 km wide and 345 m deep. In 2008, Rössing produced more than 9 Mlbs of uranium oxide (U_3O_8), which comprises about 7.7% of the world's production of primary produced uranium (www.rössing.com). The uranium ore requires a sulphuric acid leach process to liberate the uranium from the host rock. In 2008, Rössing employed 1,307 people and had 1,154 sub-contractors working at the mine (Chamber of Mines 2008 Review).

During 2006, exploration began on known uranium occurrences within the mining licence area, with particular emphasis on the area known as SK, lying directly to the east of the current open pit. Development of the SK ore body and/or extending the existing pit could extend mine life to at least 2026 at the current level of production.

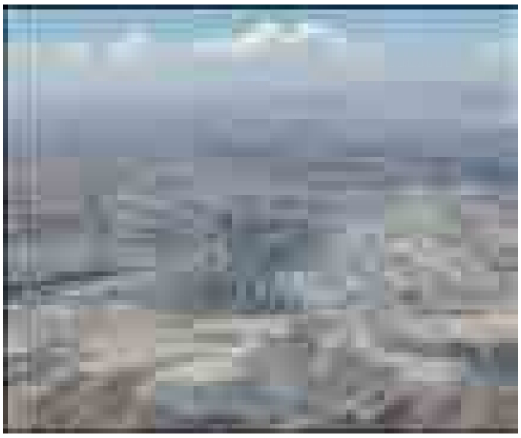

Plate 4.3: Aerial views of Rössing mine and part of the Rössing plant. Much of the total footprint of 24 km^2 is taken up by waste rock dumps (photo SAIEA and Rössing).

4.3.1.2 Langer Heinrich Uranium (Pty) Ltd

The Langer Heinrich Uranium Mine (LHU) is located some 80 km east of Walvis Bay and Swakopmund (Figure 4.3). Uranium mineralisation at Langer Heinrich is associated with the calcretisation of valley-fill fluvial sediments in an extensive palaeo-drainage system. The Cenozoic uranium mineralisation occurs as carnotite. The deposit occurs over a 15 km length in seven higher grade areas within a lower grade mineralised envelope. Mineralisation is near surface, between 1 to 30 m thick and is 50 to 1,100 m wide depending on the width of the palaeo-valley.

Site works began in September 2005 and the first commercial product shipment occurred in December 2006; Langer Heinrich thus became the second operating uranium mine in Namibia. The uranium is liberated using a tank-based alkaline leach process followed by an ion exchange process and roasting to produce the final U_3O_8 product.

Work is now nearing completion on the Stage II Expansion which will lift production from 1.7 Mlbs/a to 3.7 Mlbs/a. On 30 June 2009, Paladin announced Board approval of the Stage III Expansion, which will increase production to 5.2 Mlbs/a U_3O_8. The original target was 6 Mlbs/a, but uncertainties and likely delays in the construction and commissioning of the NamWater desalination plant has necessitated this reduction in the production target.

A fourth expansion is also planned, which will allow the mine to produce about 10 Mlbs/a U_3O_8 by 2014. This would require the installation of a second water pipeline and an upgrade to the existing power supply line (www.wise-uranium.org).

In 2008, Langer Heinrich employed 167 people and 415 sub-contractors (Chamber of Mines 2008 Review).

4.3.1.3 Navachab Gold Mine

Navachab Gold Mine is located 170 km north-west of Windhoek, 10 km south-west of Karibib and 135 km north-east of Swakopmund (Figure 4.2). It is wholly owned by Anglo Gold Ashanti Namibia. Production commenced in 1989 on ML31, with a life of mine to 2016. However ongoing drilling programmes and a feasibility study into extending the pit and constructing a new DMS plant has extended the life of mine to at least 2023. Gold is found in replacement skarn and sheeted quartz veins in the Damaran Orogenic Belt. Ore is mined from an open pit and treated in a typical cyanide leach plant (Plate 4.4). Production in 2008 totalled 2,126 kg of gold bullion (68,000 oz), slightly down on the 2007 total of 2,496 kg. The Navachab Mine employed 360 people in 2008 and 138 sub-contractors (Chamber of Mines 2008 Review).

Plate 4.4: Navachab Gold Mine open pit (photo Geological Survey).

4.3.1.4 Trekkopje Uranium Mine

The Trekkopje deposit owned by Areva Resources Namibia, located some 70 km north-east of Swakopmund (Figure 4.3), is a shallow, high tonnage, low grade uranium deposit hosted by calcretised palaeo-channels. The main mineralisation covers an area of approximately 16 km by 4 km. Trekkopje will be a shallow, open pit mining operation using conventional truck and shovel methods with limited drilling and blasting. Proven reserves have been estimated at over 300 Mt U_3O_8 at an average grade of 150 ppm (Uramin, May 2007), yielding an estimated 8.5 Mlbs of uranium oxide per annum. At full production, the Trekkopje Mine will be processing 100,000 tonnes of crushed ore per day, based on the stripping ratio of 1:15.

The process route for the Trekkopje ore is via an alkaline heap leach process. Commissioning of a pilot plant commenced in July 2008 and full production is anticipated to commence in 2011 with a life of mine initially estimated to be 11-12 years. Currently Areva Resources Namibia employs 140 people, but it is expected that approximately 320 more jobs will be filled by the end of June 2010 (www.cogema.fr).

The Trekkopje mine is currently under construction, as shown in Plate 4.5.

Plate 4.5: Trekkopje mini heap leach pad and storage tanks for the 'pregnant leach', during early trial stages of the mine design and construction in 2008 (photo Geological Survey).

3.3.1.4 Valencia Uranium (Pty) Limited

Valencia Uranium (Pty) Limited, a wholly owned subsidiary of Forsys Metals Corporation listed on both the Canadian and Namibian Stock Exchanges, is currently finalising the definition of the open pit of the Valencia Uranium Mine (Plate 4.6). The site for the proposed mine is located on the privately owned farm Valencia (No. 122), approximately 80 km inland from Swakopmund, 25 km from Rössing Uranium Mine and 50 km south-west of Usakos (Figure 4.3). The Mining Licence (ML149) was granted in August 2008 and is valid for 25 years.

The proposed Valencia Uranium Mine will utilise traditional surface mining techniques of drilling and blasting in an open pit to extract the low grade alaskite uranium ore. Most probably the pit will develop to a maximum size of approximately 1,400 m long, 700 m wide and 360 m deep. The preliminary geotechnical surveys and pit design work at Valencia Uranium have defined a probable reserve of 117 Mt of ore (at an average grade of 125 ppm) and 122.4 million tonnes of waste rock (Snowden, 2007). Haul trucks of 150 t will typically be used to haul waste rock to spoil sites and ore to the crusher. The operation will have a run of mine (RoM) capacity of one million tonnes per month with a life of mine of only 9 years, based on proven resources (Digby Wells and Associates, 2008). Construction is currently on hold pending funding and so the earliest date of commissioning is now expected to be in 2012.

Plate 4.6: Percussion drilling samples during definition of the proposed pit of Valencia mine (photo Geological Survey).

4.3.2 Current exploration activity in the central Namib

In terms of exploration activity, the database of the Ministry of Mines and Energy (MME) lists a total of 78 exclusive prospecting licences (EPLs) for nuclear fuels in Namibia. Of these, there are 33 current EPLs in the central Namib and 3 applications are pending renewal (Figure 4.4). A further six EPL application decisions are pending, but as mentioned earlier, no new EPLs have been granted by MME since 2007. The companies with the most advanced projects are described briefly below.

4.3.2.1 Bannerman Resources Ltd

Bannerman Resources Ltd is an Australian company, listed on both the Namibian and Australian stock exchanges. The company has interests in two key properties in Namibia: their principal and most significant asset is their 80% interest in the Etango Project (EPL 3345) situated on the south bank of the Swakop River near Goanikontes (Figure 4.5); and the second prospect is EPL 3346, known as Swakop River, which is located at Bloedkoppie east of Langer Heinrich mine (Figure 4.4).

Bannerman is currently focused on accelerating the feasibility study on the Etango Project. This EPL measures 500 km^2 and is located some 35 km east of Swakopmund in an area known in the tourist trade as the 'Moon Landscape'. The EPL contains 8 prospects, known as: Anomaly A, Ompo, Oshiveli, Onkelo, Ombepo, Anomaly B, Rössingberg, and Ombuga. Drilling is being conducted on most of these prospects, but sufficient work has been done on Anomaly A, Oshiveli and Onkelo to allow a preliminary feasibility study to be undertaken. As of February 2009, the total resource from Anomaly A and Oshiveli was estimated to be 126.6 Mlbs U_3O_8, with an indicated JORC Code[1] resource of 195.5 Mt grading at 207 ppm (89.2 Mlbs of metal) and an inferred resource of 87 Mt at 195 ppm U_3O_8 (37.4 Mlbs of metal). Drilling is continuing on the Oshiveli, Onkelo, Rössingberg and Ombuga prospects, but more drilling is planned for Anomaly A to define the resource at depth and along strike to the north and south, where indications are promising.

The uranium throughout this prospect is found in alaskites, similar to those found at Rössing. The mineralisation is also low grade and therefore the development of this prospect is likely to be a large tonnage operation similar to Rössing. Several process route options are being considered: an acid leach, heap leaching and flotation. The pre-feasibility study was completed by December 2009, and the Bankable Feasibility Study was completed by mid 2010. Projected mine commissioning is in 2013 and a mining licence has been applied for.

[1] The Australasian Joint Ore Reserves Committee (JORC) is sponsored by the Australian mining industry and its professional organisations. The Code for Reporting of Mineral Resources and Ore Reserves (the JORC Code) is widely accepted as a standard for professional reporting purposes. It was first published in 1989, with the latest revised version being published late in 2004. Since 1989 and 1992 respectively, it has been incorporated in the Listing Rules of the Australian and New Zealand Stock Exchanges, making compliance mandatory for listing public companies in Australia and New Zealand (www.jorc.com).

4.3.2.2 Extract Resources

Extract Resources is an Australian and Toronto Stock Exchange listed uranium exploration company, whose primary interest is in Namibia. Rössing Uranium Ltd holds almost 20% of the shares. The Company's principal asset is its 100% owned Husab Uranium Project which contains two known uranium Prospects: Rössing South and Ida Dome (Figures 4.4 and 4.5) (www.extractresources.com). The Rössing South deposit (EPL 3138) is interpreted as being an extension of the same stratigraphy that hosts the Rössing mine, and striking from Rössing mine 15 km onto the Husab Project, buried under some 30 m of desert sands.

The Rössing South deposit was initially drilled in 2007 and chemical assay results in February 2008 confirmed the discovery. By February 2009, Zone 1 of the deposit was found to contain an initial resource of 108 Mlbs at 430 ppm U_3O_8 and Zone 2 was expected to show 69-106 Mlbs U_3O_8.

Additional zones of high grade alaskite confirm that Rössing South is the highest grade, granite-hosted uranium deposit in Namibia and possibly one of the largest deposits in the world (Extract Resources, February 2010).

4.3.2.3 Reptile Uranium Ltd

Probably the next most advanced project in terms of resource definition and effort is that of Reptile Uranium Namibia (Pty) Ltd (RUN). RUN is a wholly owned subsidiary of Deep Yellow Ltd, an Australian and Namibian stock exchange listed company. It is interesting to note that Paladin Energy Ltd owns a 19.29% stake of Deep Yellow and therefore future linkages with the Langer Heinrich operating uranium mining project are possible.

RUN holds 100% of four contiguous Exclusive Prospecting Licences (EPLs) covering 2,681 km^2 and three additional adjoining EPLs covering 1,323 km^2 where it is earning 65% in JV with Nova Energy Namibia. The areas contain historical discoveries of gypcrete, calcrete and sand-hosted secondary uranium mineralisation. Exploration by RUN has increased the extent of these and also delineated new areas of primary alaskite hosted and skarn hosted uranium (and iron) mineralisation.

The deposit types, processing and products (roughly in order of development) can be summarised as follows:

- Inca uraniferous magnetite - primary mineralisation in hardrock; requires drill and blast and crushing/milling followed by processing in an acid plant. Products: uranium and iron.

- Tubas Red Sand - secondary uranium mineralisation in free-digging and milling sand and gravel, with processing in an acid or alkali plant. Products: uranium and vanadium.

  Together these two prospects are known as the **Omahola Project** with a projected annual U_3O_8 production of 2-3 Mlbs, with about 2-3 Mlbs of vanadium and 100,000-300,000 tonnes of iron as by-products.

- M62 Iron Project was discovered from airborne magnetic surveys and subsequent limited RC drilling and diamond drilling to 500 metre depths indicated that it may be a substantial source of magnetite/iron. Beneficiation tests as part of a scoping study are being undertaken and given that it is located between 25 and 30 km from Walvis Bay it may be economically viable to export.

- The Eastern palaeo-channels comprising Tumas, S-Bend, Oryx and Tubas contain secondary uranium mineralisation in free-digging and milling sand and gravel, or in cases where the material is too well cemented, drilling and blasting will be required. This would be followed by crushing/milling and processing in an alkali plant. From interpretation of airborne electromagnetic (AEM) surveys, the Tumas - Tubas palaeo-channel system can now be traced for a cumulative total of 80 km of which only about 15 km has been investigated in detail by drilling; an additional 35 km by previous explorers and/or RUN and 30 km remain untested. Products include uranium and vanadium.

- Aussinanis and Ripnes sheet-wash areas contain secondary uranium mineralisation in free-digging and milling sand and gravel, or in cases where the material is too well cemented, drilling and blasting will be required. This would be followed by crushing/milling and processing in an alkali plant. Products include: uranium (between 1.5 and 2 Mlbs of U_3O_8 per annum) and vanadium (between 2-3 Mlbs/a).

4.3.2.4 Others

Other than the companies discussed above, the following companies currently hold EPLs for uranium in the Central Namib (see Figure 4.4 for locations):

Australian Companies:

Erongo Energy Ltd (EPLs 3453, 3454, 3477)

West Australian Metals (formerly Marenica Minerals) (EPL 3287)

Toro Energy Ltd (formerly Nova Energy) (now in a JV with Deep Yellow (Reptile) (EPLs 3668, 3669, 3670)

Swakop Uranium (owned by Extract Resources) (EPLs 3138, 3439, 3327, 3328)

Green Mineral Resources (70% owned by Africa Uranium and 30% Bastos Foundation) (EPL 3664).

Canadian Companies:

Cheetah Minerals (owned by Manica, which is 51% owned by Pitchstone Exploration) (EPLs 3516, 3517, 3518)

Xemplar Energy Corp (formerly Namura) (EPLs 3569, 3570, 3571)

Dunefield Mining (owned by Forsys) (EPLs 3635, 3636, 3632, 3637, 3638)

Russian Companies

SWA Uranium Mines (owned by Arlan 75% and VTB Capital 25% with Atomredmetzoloto) (EPLs 3850, 3851)

Chinese Companies

Zhonghe Resources Namibia (EPLs 3600, 3602)

British Virgin Islands

Petunia Investments 3 (100% owned by Barlow Holdings Ltd) (EPL 3780).

Most of these companies are at the early stages of exploration, conducting airborne and ground radiometric surveys, geological mapping, radon surveys and reconnaissance drilling with variable effort. West Australian Metals is probably the most advanced, since they have recently started diamond drilling on their Marenica prospect, south-west of Klein Spitzkoppe.

There is a reasonable expectation that some of these exploration projects may actually be converted into operating mines, but there is considerable uncertainty as to which ones, how many and when. However, based on current information we have been able to build four possible development scenarios, as described in section 4.5 below.

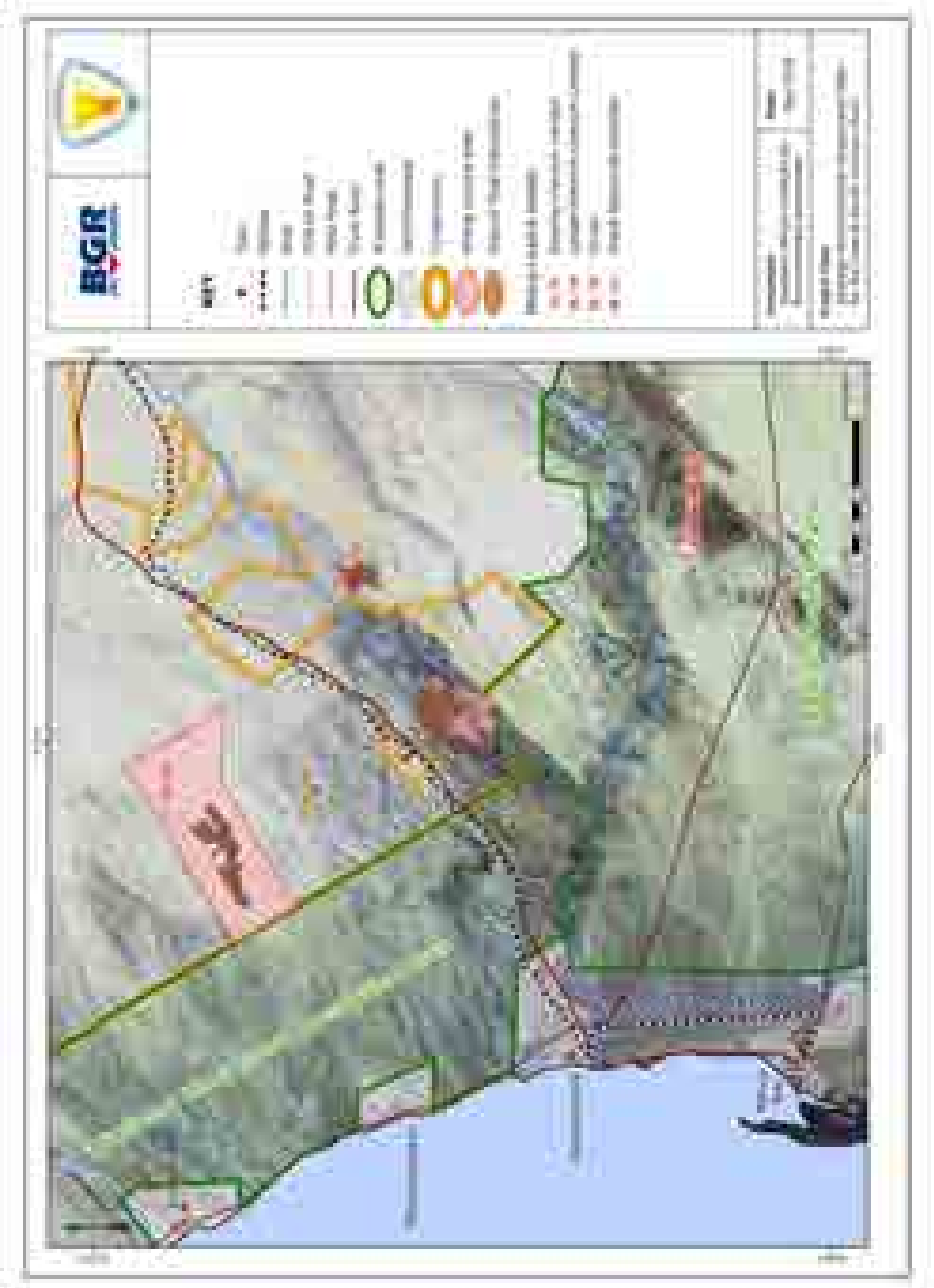

Figure 4.3: Scenario 1 mines

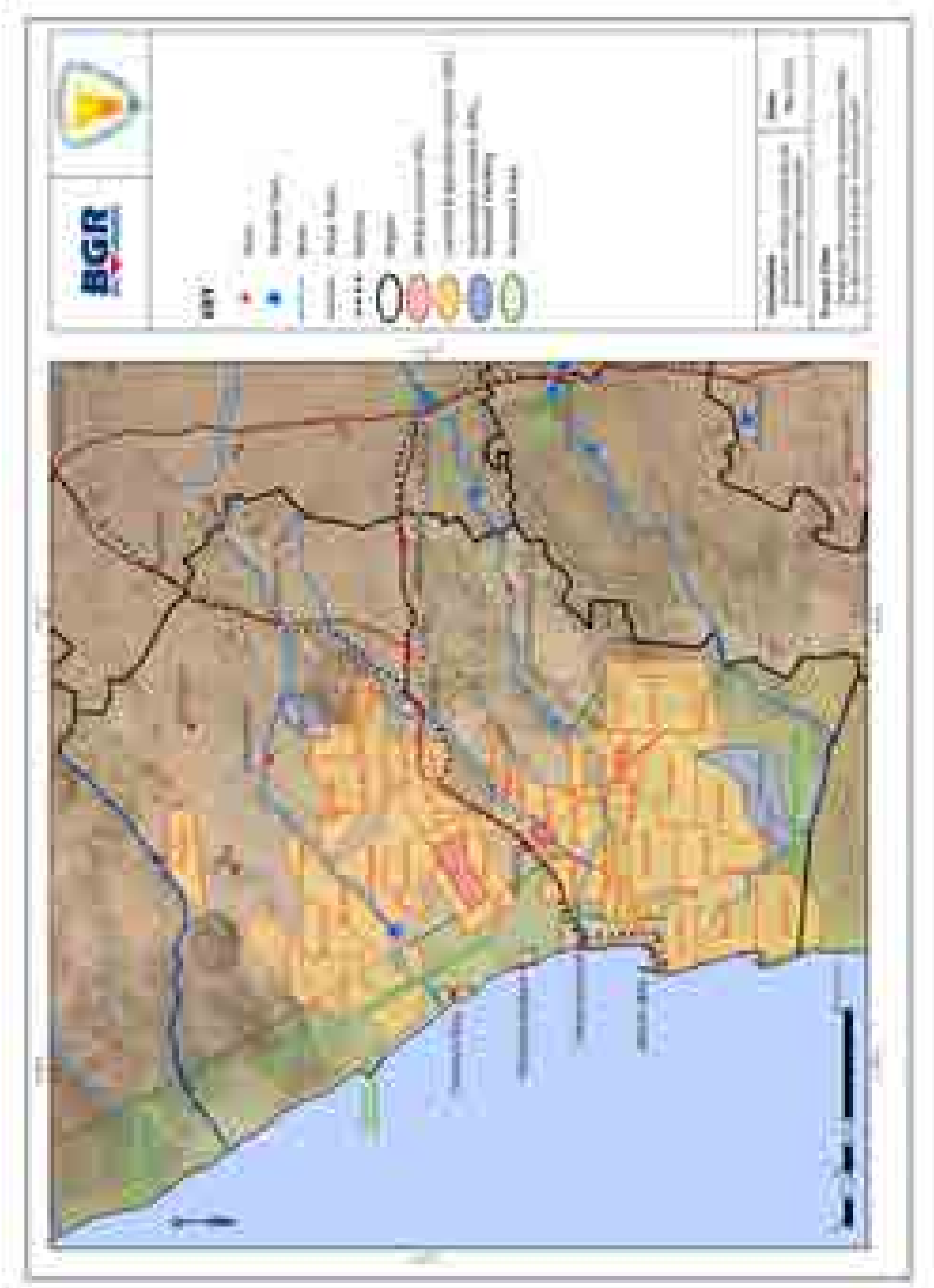

Figure 4.4: Uranium EPLs in the Erongo Region

Figure 4.5: Scenario 2: Probable additional mines in yellow

4.4 Overview of Associated Industrial Developments

There are a number of industrial developments that are being built or planned to support the Uranium Rush. It is unlikely that these developments would have taken place in the absence of the uranium mines and so they are considered as part of the direct cumulative impacts of the Uranium Rush

4.4.1 Walvis Bay Power Station

In view of the expected increase in demand for electricity at the coast due to the uranium rush and other coastal developments, combined with the current electricity shortage within the SADC region as a whole, NamPower has recently investigated a number of new supply options. There are two possible alternatives to supply base load power on a long-term basis in the Erongo Region: generation of power by an Independent Power Producer from Compressed Natural Gas (CNG) imported to Walvis Bay from the Kudu Gas Field; and a coal-fired power station at Walvis Bay. NamPower has conducted several investigations into the coal-fired power station option, looking at several different locations and sizes. For the sake of scenario planning for this SEA, we have assumed that a 200 MW station would be sufficient to meet the demands of Scenario 1 mines; a 400 MW station would be needed for Scenario 2 and an 800 MW station would be required for Scenario 3 (see section 7.5).

4.4.2 Desalination Plants

Areva Resources Namibia has commissioned a desalination plant at Wlotzkasbaken, approximately 30km north of Swakopmund - a first for Southern Africa – that supplies sufficient water to support the mining operations at Trekkopje Mine, approximately 40 km inland. The plant has the capacity to produce 20 Mm^3/a of potable water. State-of-the-art technology was introduced which entails screen filtration, ultra filtration, reversed osmosis and chemical treatment.

NamWater is also investigating the possibility of constructing a desalination plant near Mile 6 on the northern outskirts of the Swakopmund municipal area. The plant is expected to be commissioned in 2012 and will have a capacity to produce 25 Mm^3/a of potable water. This water will be expensive but the water will be allocated to all the existing and future mines.

The Trekkopje desalination plant was designed and built to accommodate a second intake pipeline and space for modular extensions to the plant in anticipation that NamWater would ‘share’ the facility. Unfortunately, NamWater has pulled out of negotiations with Areva for various reasons and is still pursuing its own desalination plant at Mile 6. All the proposed new mines, except Trekkopje are dependent on being supplied with water by NamWater, but there are insufficient freshwater resources available. Thus the development of these mines is completely dependent on Namwater completing the construction of its desalination plant before they can start full operations.

Since Valencia, Etango and Rössing South plan to start production in 2012/2013, there is not much time left to build a new desalination plant (see section 7.4). From a strategic perspective, where one of the goals of this SEA is to minimise the footprint of all developments and to optimise the use of facilities, and given that water supply is on the critical path, it is strongly recommended that NamWater reconsiders the joint use of the Wlotzkasbaken desalination plant.

4.4.3 Gecko Mining and Chemicals

The Gecko Group envisages a substantial investment in Namibia that, to a large extent, is directly linked to the central Namib Uranium Rush. The project in its entirety encompasses several different mines for a variety of minerals throughout Namibia and in its territorial waters, several factories for the manufacture of chemicals, loading and offloading facilities at the Port of Walvis Bay, the transportation of raw materials and products, and all associated infrastructure such as power, water, access roads etc.

The primary products proposed to be supplied to the uranium mines comprise:

- Sulphuric acid from a 3,600 t/d acid plant near Swakopmund using imported sulphur prills;
- 150,000 tpa soda ash and 175,000 tpa bicarbonate from a soda ash plant near Swakopmund using salt mined near Cape Cross; and
- Caustic soda from a plant to be built at Arandis using soda ash mined at Otjivalunda as the input.

The support industries described above (power station, desalination plants and chemical plants) will require power, water, import/export facilities, rail and road transportation routes, and skilled and unskilled labour. They will also contribute to air pollution, noise, dust, waste and traffic. Thus they will collectively add to the cumulative impacts of the uranium mines and will largely be competing for the same limited resources and services. It is for this reason that we have included these industries in the scenarios set out below.

4.5 Uranium Rush Mining Scenarios

From the analysis of the forces and dynamics of the Uranium Rush presented in Chapter 3, we may assume that the main short- to medium-term drivers behind the uranium rush, (namely concerns about uranium supply security due to diminishing secondary uranium supplies and typically long lead times involved in expanding primary uranium production capacity), are unlikely to go away over the next 10-15 years. It is also reasonable to assume that the rate at which new uranium production capacity is brought on stream in Namibia by 2020 will depend primarily on how fast each individual project manages to make progress towards getting the feasibility study and environmental impact assessment completed and approved, obtaining a mining licence and commencing mining operations. This, in turn, will depend on a range of project-specific factors including the attractiveness of the project, the seriousness of the investor, the quality of project management, the degree to which the project manages to establish good working relations with and be accepted by local stakeholders, etc.

Thus bearing in mind the global forces and from an analysis of the current mining and prospecting situation, we have developed four possible scenarios for the purposes of this SEA. The scenarios are not restricted to the number of uranium mines, but rather a more holistic picture of development has been described for the Erongo Region, including other large-scale mines and mining-related industrial developments.

<u>Scenario 1: 'Below-expectations'</u> (1-4 mines operating by 2020)

In addition to the two uranium mines already in operation, the two other projects which have received their Mining Licences, Trekkopje and Valencia, will commence operation in 2010-12, but no further mines will be started up before 2020. Under this scenario, it is also assumed that some of the planned mine expansions will not take place during the forecast period due to depressed uranium prices. The uranium mines in Scenario 1 are shown on Figure 4.3 and include:

- Rössing
- Langer Heinrich (Stages I and II only)
- Trekkopje
- Valencia

In addition, cognisance needs to be given to the other large mining projects in the area, which under this scenario is only Navachab Gold Mine. With regard to other related industrial developments directly linked to the Uranium Rush, the projects already under construction or most likely to proceed will include:

- Trekkopje desalination plant; and
- 200 MW coal-fired power station at Walvis Bay.

In this scenario, it is unlikely that the NamWater desalination plant would be built, nor would it be economic for Gecko to develop its mining and chemical plant.

Under Scenario 1, the joint production of Rössing, Langer Heinrich, Trekkopje and Valencia will keep output at about 23-25 Mlbs/a U_3O_8 up to 2020 and beyond (see Table 4.3 and Figure 4.6). Direct employment in the region will reach about 4,000 during the period 2011-12, boosted by the construction phases of Trekkopje, Valencia, and the power station, but it will reduce to less than 3,500 for the rest of the period (Table 4.4 and Figure 4.7).

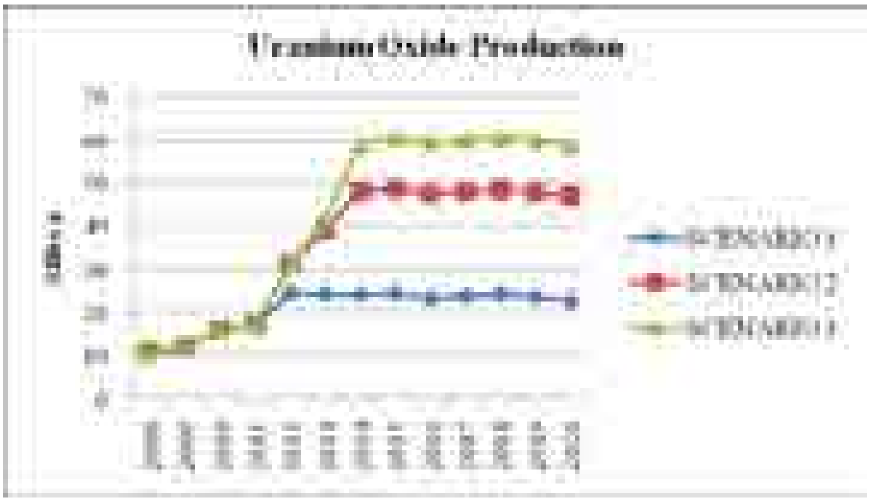

Figure 4.6: Uranium production per scenario over time

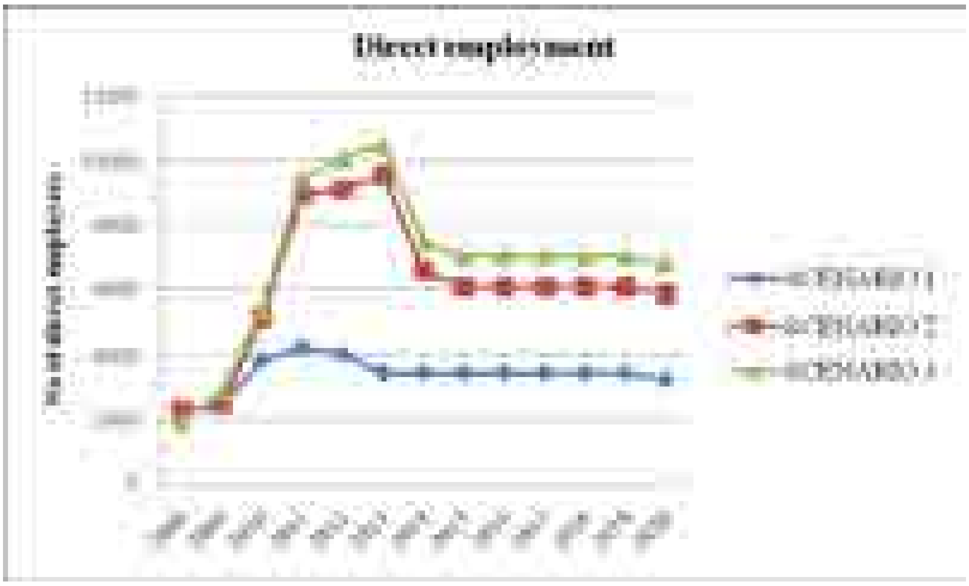

Figure 4.7: Direct employment arising from construction and operation of uranium mines and associated industries per scenario over time

<u>Scenario 2: 'In-line-with-expectations'</u> (5-7 mines operating by 2020)

In addition to the 4 mines with Mining Licences identified under Scenario 1, one or two more companies will successfully bring their mines on stream by 2013. It is also assumed that uranium prices will be buoyant and that the existing mines will press ahead with their significant expansion projects. The mines and expansions under this scenario are shown on Figure 4.5 and include:

- Rössing plus expansion
- Langer Heinrich (Stages I, II and III only)
- Trekkopje
- Valencia
- Rössing South (Husab Project)
- Etango Project.

Under this medium growth scenario, it is possible that only one more non-uranium mine (e.g. Kalahari Minerals' re-commissioning of the Namib Lead mine) may be developed in the Erongo region by 2020 in addition to the existing Navachab Gold Mine.

Under Scenario 2, there is a strong possibility that several of the related industrial developments will be commissioned to meet the increased needs from the uranium mines. The envisaged projects will or might include:

- Trekkopje desalination plant;
- NamWater desalination plant;

- 400 MW coal-fired or CNG power station at Walvis Bay;
- Gecko Mining and Chemicals operations.

From Table 4.3 and Figure 4.6, it can be seen that there will be a significant increase in uranium oxide production from 2012, when Langer Heinrich implements its Stage III expansion. Uranium oxide output is expected to peak at over 48 Mlbs/a in 2014, when all 6 mines are at full production. This will drop off slightly if Valencia does not extend its current mine life beyond 2020, to around 47 Mlbs/a U_3O_8 (see Table 4.3 and Figure 4.6).

Under Scenario 2, there will be a massive demand for employment from 2010 (>5,000), rising to around 9,000 in the period 2011-13, due to the simultaneous construction of 4 mines, a power station, the NamWater desalination plant, the Walvis Bay power station and the Gecko Chemicals plants. This number will decrease once these facilities are in operation to around 6,100 (Figure 4.7 and Table 4.4). Compared to the 2008 direct employment figure in the uranium mining industry in the central Namib of some 1,834, these numbers represent a significant increase. It should also be noted that many other jobs will be created in a range of service industries and other sectors e.g. the Port of Walvis Bay, housing construction, banking, schools, clinics, shops etc. If a multiplier of 8 is assumed[2], the total number of new jobs generated in the economy could be much higher, possibly in the order of 48,000.

Scenario 3: 'Above-expectations' (8-12 mines operating by 2020)

In addition to mines which may be operating by 2015 (as per Scenario 2), at least two more companies may be successful in bringing their uranium deposits into production before 2020 and the existing mines will increase production from expansion projects. It is not clear at this point which of the current EPLs might be developed into a mine before 2020, but at present, the most likely combination is shown on Figure 4.8 and includes:

- Rössing plus expansion
- Langer Heinrich (Stages I-IV)
- Trekkopje and extensions
- Valencia and extensions
- Rössing South (Husab Project)
- Etango Project
- Omahola Project (Inca and Tubas Red Sand)
- Marenica.
- Other developments on Reptile EPLs.

[2] Gerrie Muller (Metago), pers comm.

Table 4.3: Cumulative uranium oxide production in million pounds per annum per scenario over time

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
SCENARIO 1	10.7	11.6	15.9	17	24.4	24.2	23.9	24.2	23.1	22.7	24.1	23.6	22.6
Rössing Uranium Ltd	9	9	9	9	9	9	9	9	9	9	9	9	9
Langer Heinrich (Stage I & II)	1.7	2.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.3	1.5
SCENARIO 2	10.7	11.6	15.9	17	31	39.2	48.2	48.6	47.4	48	48.4	47.9	46.9
Rössing (the expansion)	9	9	9	9	10	11	11	11	11	11	11	11	11
Langer Heinrich (Stages I, II & III)	1.7	2.6	3.6	3.6	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.3	1.5
Etango	0	0	0	0	4	4	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Rössing South (Husab) (Zones 1 & 2)	0	0	0	0	0	7.5	15	15	15	15	15	15	15
SCENARIO 3	10.7	11.6	15.9	17	31	41.4	59.8	64.7	59.8	60.4	61.5	60	59
Rössing (the expansion)	9	9	9	9	10	11	11	11	11	11	11	11	11
Langer Heinrich (Stages I to IV)	1.7	2.6	3.6	3.6	5.2	5.2	10	10	10	10	10	10	10
Trekkopje	0	0	3.3	4.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Valencia	0	0	0	0	3.3	3	2.8	3.2	2	2.6	3	2.3	1.5
Etango	0	0	0	0	4	4	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Rössing South (Husab) (Zones 1 & 2)	0	0	0	0	0	7.5	15	15	15	15	15	15	15
[illegible] Project	0	0	0	0	0	2.2	3.3	3.3	3.3	2.9	1.5	3.3	3.3
Marenica	0	0	0	0	0	0	3	4	4	4	4	4	4

Table 4.4: Direct employment from the uranium mines and associated industries per scenario over time

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Numbers in *italics* indicate construction employment

The increase in projects in Scenario 3 does not necessarily mean that there will be a concomitant increase in the number of processing plants because it is likely that the existing mines will seek ore body extensions (e.g. Langer Heinrich, Rössing, Trekkopje) and use their existing plants to process the ore. Furthermore, synergies could be established between say Trekkopje and Marenica as well as Reptile and Langer Heinrich, where the same type of ore might be toll processed at the existing plant, or where companies may form mergers and acquisitions to capitalise on economies of scale.

Under Scenario 3, it is assumed that the world will have recovered from the economic recession faster than predicted and that metals prices will be rising. It is possible therefore that in addition to the existing Navachab Mine and the likely development of the Namib Lead mine by Kalahari Minerals, another mine could be developed by 2020 (e.g. Kalahari Minerals' Ubib copper-gold project near Navachab, or Reptile's M62 iron ore project near the Omahola Project).

Under Scenario 3, the proposed (or actual) associated industrial developments will be essential to meet the increased needs from the uranium mines and other developments. The existing and envisaged projects will include:

- Trekkopje desalination plant;
- NamWater desalination plant;
- 800 MW coal-fired or CNG power station at Walvis Bay;
- Gecko Mining and Chemicals operations.

Under this scenario, there will be a period from 2015-2019 when there will be 8 mines in production, with an output of about 60 Mlbs/a U_3O_8 being attained (see Table 4.3 and Figure 4.6). Even considering a rapid increase in demand for uranium, it is unlikely that the market could sustain such an output and as a consequence there may well be an oversupply. This might trigger a drop in prices and more marginal (low-grade) mines may face closure as a result, or new deposits may not be developed. The ability of the market to absorb production may well be the main regulating force determining how many mines can be sustainable at a given time in Namibia.

Under Scenario 3, employment will peak at over 9,000 for the main three year construction period (2011-2013), thereafter it will stabilise at around 7,000, reflecting the full operation of 8 mines, 2 desalination plants, an 800 MW power station and 3 chemical plants. Although employment may drop off slightly after 2019, it will remain high (>6,000) for the foreseeable future (Figure 4.7 and Table 4.4).

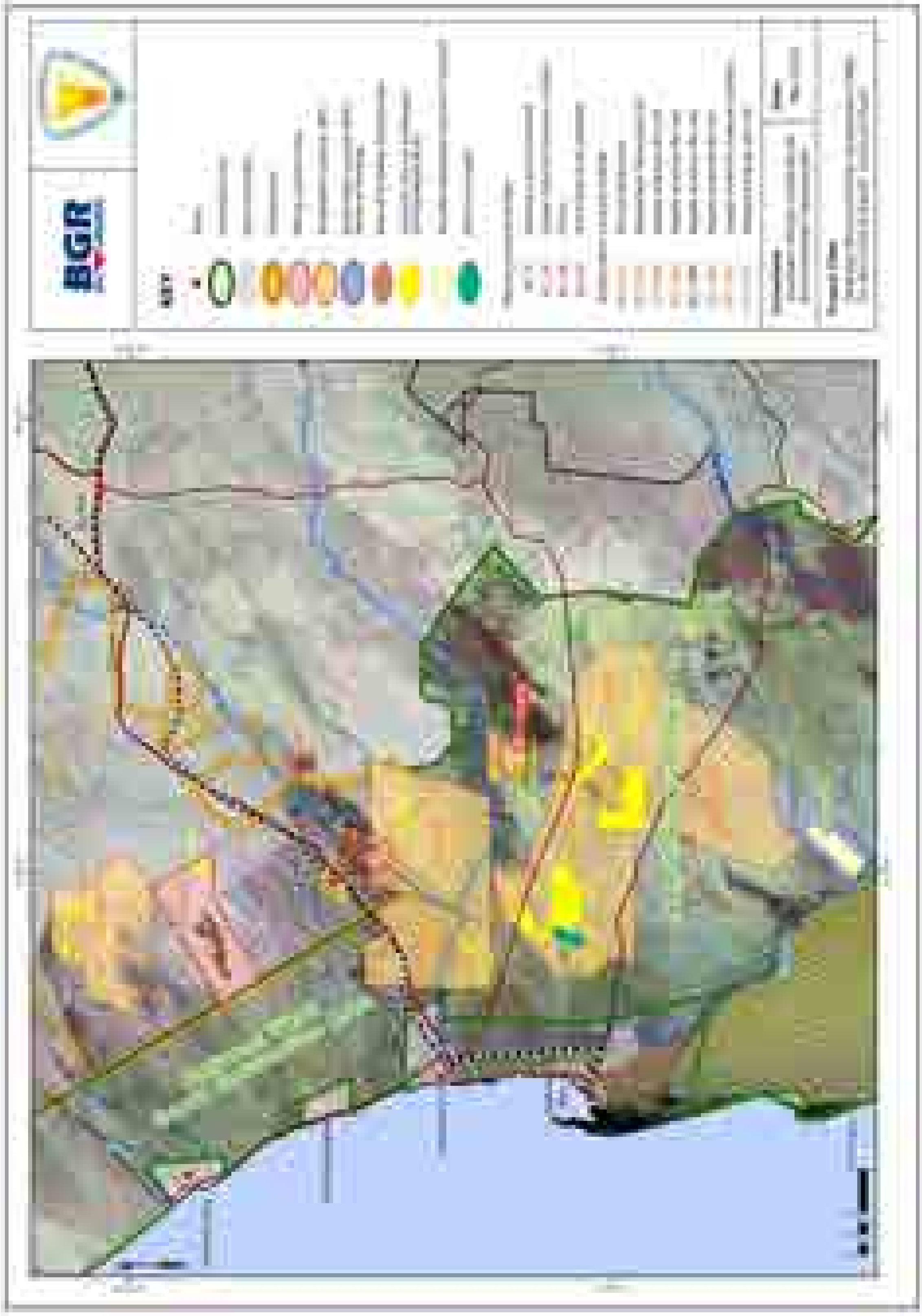


Figure 4.8: Scenario 3 mines

<u>Scenario 4: "Boom-bust" scenario</u> (5-12 mines operating and then shutting down in a hurried, unplanned fashion before 2020).

The fourth scenario is termed the 'boom and bust scenario' whereby a number of mines first open and then shut down in a hurried, unplanned fashion, without any remedial or stabilisation measures, leaving the mines and all associated infrastructure behind. This scenario could be triggered by one or more global drivers such as a significant drop in uranium prices.

This scenario would also affect some of the associated industrial developments at the coast which will have been built specifically for the uranium rush. While alternative users could be found for, say, the power generated by the new power station (even through energy exports if economic), some industries may also have to close down e.g. the Gecko chemical plants, unless overseas buyers could be found for their products.

This would have devastating consequences for the thousands of people and businesses directly and indirectly employed in the uranium rush and would put a severe dent in Namibian GDP, foreign exchange earnings and income from taxes and royalties. It would also mean that the government will have over-capitalised on infrastructure (roads, power generation and transmission, water supplies) and community facilities (schools, clinics) etc.

4.6 Overview of Typical Mining Operations

4.6.1 <u>Description of prospecting activities</u>

Prospecting involves a range of activities which become progressively more intrusive as the ore body is defined to a greater degree of accuracy. The early stages of exploration include activities such as airborne radiometric surveys, radon cap surveys, and surface grab rock sampling. Once the site shows a degree of prospectivity, the next stage involves reconnaissance drilling on a fairly widely spaced grid. This requires the establishment and presence of a small exploration camp, usually located on or nearby the EPL and which comprises a few temporary structures e.g. caravans, shipping containers, and a core yard. The camp requires power (generators) and water (usually boreholes or water tankers) and generates a small amount of domestic and industrial waste. Issues include litter, local loss of vegetation, noise, poaching, localised pollution from diesel tanks and oil spillage.

If the reconnaissance drilling results look promising, a more intensive drilling programme will be pursued to more clearly delineate the lateral and vertical extent of the ore body. The drill hole spacings are on a 50 m grid and often more than one rig will be operating at a time. At this stage, the exploration company may take a bulk sample for detailed lab testing to determine the best metallurgical process route.

4.6.2 <u>Description of construction activities</u>

Construction of a large mine is a big operation, requiring land clearing, bulk earthworks, the establishment of a construction camp to house up to 1,500-2,000 workers, laydown areas, workshops and the entire area needs to be fenced off.

Once the bulk earthworks have been completed, all the structural, mechanical and electrical components of the plant need to be constructed e.g. crushing circuit, process plant, offices, workshops, etc. These activities are often noisy and generate a considerable amount of waste.

The uranium deposits will require the development of the open pit, with surface blasting, removal of overburden, construction of haul roads etc. The shallow secondary deposits will require slightly less work and may not require blasting during the initial stages. The impacts include noise, vibration, dust and light at night.

One of the biggest impacts is that every component required for the construction of the mine needs to be brought to site using existing roads, railways and ports. During the peak of construction this can result in hundreds of vehicles per day (see section 7.3). The impacts include: traffic congestion, increased accident risk, deterioration of the road surface, port congestion, vehicle fumes, dust, noise and so on.

Water is required during construction for mixing concrete, dust suppression, washdown, drinking, ablution facilities and change houses. Often this water is supplied from groundwater while the permanent water pipeline is being built. Excess groundwater abstraction can lead to a local drop in water table level and reduced yields for other local users, e.g. farmers.

The new mine will require both power and water which will be brought to the mine via transmission lines and water pipelines respectively. Infrastructure on site will include a substation and step-down transformers for the electricity supply and a bulk water reservoir and pump stations for the water.

A considerable amount of waste is generated on a construction site including hazardous and non-hazardous waste. Non-hazardous waste usually includes all office waste, canteen waste, as well as all industrial waste such as scrap metal, wooden pallets, offcuts, packaging, construction rubble, waste concrete etc. Much of this waste can be recycled but the rest needs to be disposed of in a properly constructed waste disposal site. Most of the hazardous waste on a construction site comprises tyres, vehicle batteries, fluorescent tubes, oily rags, contaminated soil, chemical containers, solvents and so on. Much of this can be recycled via the original suppliers, but the remaining waste needs to be removed from site to the registered hazardous waste site in Walvis Bay. Issues therefore include the safe storage of these wastes until they are removed from site and the capacity of the Walvis Bay hazardous waste cell to receive such wastes.

At peak construction there will be many different contractors working on site, each of whom will require skilled and unskilled labour. Some contractors may bring their own workforce, while others will hire local labour. At the peak, there may be up to 2,000 workers on the site.

In addition to the main building contractors, there will be need for a range of support services such as banking, legal, accounting, catering, cleaning, office equipment, telephony, computer services, accommodation etc. Most of these services will be sourced from local towns, but national and even international suppliers may be used in the absence of local contractors.

4.6.3 Description of mining and processing activities

4.6.3.1 Mining

In Namibia, both uranium ore types occur on and close to the surface in the central Namib and therefore can be mined from surface as open cast or open pit operations. The hard rock alaskites generally extend to depth and are typically mined in an open pit using drilling and blasting techniques. These pits can become quite large – for example, the current Rössing pit is over 3 km long, 1.2 km wide and about 345 m deep (Plate 4.7) (www.Rössing.com). The alaskite pits are developed *downwards* and will remain as permanent deep holes in the ground surrounded by huge waste rock dumps.

Secondary calcrete-hosted uranium mineralisation tends to occur at shallower depths but over larger areas and requires slightly less drilling and blasting because the surface material can be mechanically excavated in some circumstances. The Langer Heinrich pit for example will only reach a maximum of 30m deep and the Trekkopje pit (Klein Trekkopje deposit) is planned to be 15 km long by 1-3 km wide and up to a maximum of 30 m deep (Turgis Consulting, 2008). The shallower calcrete pits have much less waste rock and can be backfilled with tailings and overburden as the pit proceeds *laterally*. This has significant implications in terms of the total mine footprint, with the calcrete mines having a much larger area of disturbance during operations but with a smaller final footprint.

Plate 4.7: The Rössing pit is about 3 x 1.2 km in size, and 345 m deep. This, and the surrounding waste rock dumps, are permanent features that cannot be rehabilitated to the original landscape. The channel of the Khan River is visible top right (photo P.Tarr).

It can be seen from Figure 4.1 that the alaskite deposits are all aligned in a broad north-east to south-west corridor in the leucogranites associated with the Khan and Swakop Rivers. This zone has been referred to by some as ‘Alaskite Alley’. Development of these mines would have significant impacts on both the river valleys in terms of groundwater resources, and visual impacts, since the rugged topography associated with this same geology is a major tourism attraction (see section 7.6).

The secondary deposits on the other hand, are all associated with shallow palaeo- and current drainage lines which traverse the gravel plains to the north and south of the Khan-Swakop drainage system (Figure 4.1). These plains appear featureless, but they in fact support a relatively high biodiversity, including lichens, plants, birds, mammals and reptiles (section 7.7). Of particular significance is the occurrence of the protected, rare and ancient Welwitschia plants in these drainage lines (Plate 4.8).

The typical direct impacts resulting from open pit/cast mining are:

- Noise (blasting, hauling);
- Vibration (blasting);

- Dust (blasting, excavating, loading, hauling, waste rock dumps);
- Radon emissions (blasting, excavating, loading, low grade stockpile);
- Pollution of groundwater (runoff/seepage from waste rock dumps and open pit);
- Visual impact (open pit and waste rock dumps);
- Loss of biodiversity (open pit and waste rock dumps);
- Light.

Noise and vibration are localised and sporadic impacts, but dust, radon, groundwater pollution, loss of biodiversity and visual impact could all contribute to a regional cumulative impact, if not properly controlled through on-site environmental management plans. The visual impact might have an impact on tourism, especially where current tourism activities overlap with existing and proposed mines e.g. Etango (Moon Landscape), Rössing South (Welwitschia Flats), Langer Heinrich (Bloedkoppie) or where several mines may be located in a relatively small area: Rössing, Rössing South, Etango, and Tubas (Figure 4.8).

Plate 4.8: A Namib biodiversity icon, the Welwitschia plant, is found near proposed uranium mines . Etango and Rössing South are likely to have the greatest impact on tourists coming to the Namib to see this plant (photo P.Tarr).

Although Rössing Mine attracts some 2,000 tourists per year (www.Rössing.com) to see the huge open pit, there are few additional opportunities for synergies between mining and tourism, and tourism offsets need to be investigated by each mine where current tourist activities will be affected. This presents an opportunity for future collaboration between mining, tourism and nature conservation to develop and protect new sites of tourist interest.

4.6.3.2 Ore processing

Irrespective of the rock type, the ore has to be crushed to a finer size before the uranium can be extracted. Typically, ore is delivered to the primary crushers from the open pit via haul truck although some mines may place the primary crushers in the pit and haul crushed rock to surface. Crushing circuits usually have several stages (typically up to 4) in which the ore is progressively reduced to a fine particle size. In spite of noise attenuation systems and dust extraction systems, crushers usually have noise, radon and dust impacts. All workers in the crushers have to wear respirators to minimise their exposure to radiation and particulates. These impacts are all localised and do not have regional implications.

4.6.3.3 Ore processing and refining

The other major difference between the alaskite ore bodies and the calcrete deposits lies in the processing method: alaskite ores require acid leaching, while the calcrete ores are extracted using an alkaline leaching process. These processes are briefly described below.

- **Leaching** in closed tanks or in open heaps with sulphuric acid or with sodium bicarbonate;
- **Cycloning and thickening** in tanks to separate the barren solids from the uranium-bearing solution ('pregnant' solution). The solids go to the tailings dam (see section 4.6.3.4 below);
- **Continuous ion exchange (CIX)** where the uranium ions in the pregnant solution are adsorbed onto specially formulated resin beads. The beads are then washed with an acid wash to produce a more concentrated uranium solution;
- **Solvent extraction (SX)** is where the acidic eluate from CIX is mixed with an organic solvent and then a neutral aqueous ammonium sulphate solution;
- **Precipitation** is where gaseous ammonia is added to the solution to raise the pH and thus precipitate the ammonium diuranate which is then thickened and filtered to form a yellow paste called 'yellow cake';
- **Final roasting** drives off the ammonia to leave uranium oxide (U_3O_8), which is packed into metal drums for shipment overseas for further conversion and enrichment before it can be used in power generation facilities.

Several new mines are investigating the possibility of using the 'heap leach' process whereby ore is placed onto a lined pad and acid or alkaline chemicals are sprayed onto the heap and the leachate is then collected from collection systems around the pad. Once the uranium has been leached out, the residue is removed from the pad and discarded on an engineered dump. In addition to the above, other process routes are being considered by Bannerman and Extract Resources as part of their feasibility studies.

4.6.3.4 Mining and process wastes and emissions

The mining and processing plants produce a variety of different waste streams in liquid, solid and gaseous forms. Liquid wastes include sewage effluent, grey water, contaminated runoff from the plant and mine area, process effluents, tailings dam return water and seepage. Most liquid waste can be recycled or re-used and all the mines in the desert environment of the central Namib should have a policy of zero liquid effluent. For example, Rössing has reduced its freshwater requirement per tonne of uranium oxide produced by 46% since 1981 due to continual increases in the use of recycled water through various technological advances.

Solid wastes generated from the mine include waste rock and tailings. The processing plant produces low-grade radioactive tailings or heap leach residues, baghouse dust and a range of hazardous and non-hazardous industrial wastes. Other wastes are generated in the workshops, offices, mine clinic and the canteen.

Several operations on a mine produce gaseous emissions, such as sulphur dioxide from the acid plant (if there is one), and roaster, as well as fumes (CO, CO_2 and NOx) from vehicles, chemical processes in the plant etc. Particulate emissions arise from wind action on unconsolidated surfaces such as the tailings dams, disturbed ground and gravel roads, as well as from vehicle entrainment of dust on gravel roads.

4.6.4 Closure and rehabilitation

On closure, all structural elements will be removed from site, including foundations and concrete plinths. Access roads will be ripped and graded over and all external infrastructure such as pipelines and powerlines will be removed. However, in the case of alaskite mines, the open pit, waste rock dumps, and tailings dam or heap leach residue facility will remain. In this desert environment, surface stabilisation by means of revegetation is a very slow process and therefore the mines must leave these facilities in a safe, stable and non-polluting state. One of the challenges with uranium mines is to minimise the radon exhalation and dust emissions from the tailings dam. This has been done at some mines by covering the surface and sides of the dam with a thick layer of waste rock, but the long-term effectiveness of this needs further research and monitoring.

In the case of the shallow calcrete mine pits, it is possible to backfill the pits with tailings (or heap leach residue) and waste rock as the pit progresses laterally, thus reducing the final footprint considerably.

Irrespective of the closure method employed, it will not be possible to utilise the closed mine sites for any future beneficial use and they will be permanently closed to the public on account of the radiation and safety risks inherent on such sites.

Planned closure of a mine should start during the planning and feasibility stages prior to mine commissioning to ensure that it is implemented in a logical, cost-effective and equitable manner. This includes ongoing planning of waste rock disposal to minimise the visual impact, use of future waste rock sites for the construction camp, ongoing rehabilitation of disturbed areas during construction and so on. Once the mine is in operation, the closure plans need to be regularly updated and the required actions implemented such as the timeous notification of closure to all employees, re-skilling programmes and a planned programme of retrenchment. Production is then progressively scaled down over a period of a year or two prior to actual closure.

In the event of Scenario 4: Boom and Bust, mine closure will be rapid and largely unplanned. Unscrupulous operators or those without a sufficiently large rehabilitation bond will tend to walk away from the operation without undertaking any of the costly rehabilitation work described above. This would leave the mine and process plant in an unsafe and polluting state. Furthermore, the workforce would not be given due warning of closure and retrenchment would be immediate. If all the mines were to close within a short period of time, the government would be left with a huge legacy of pollution and land degradation and the economies of the towns of Swakopmund and Walvis Bay would collapse. It would also mean that some of the industries set up to support the uranium rush (such as the desalination plants, the coal-fired power station at Walvis Bay and the Gecko Chemicals plants) would either have to close down or rapidly find other customers in order to survive. The cumulative effects would be extremely severe.

5 ERONGO REGION OVERVIEW

5.1 Physical geography

The Erongo Region is located in the central western part of Namibia (Figure 5.1). Landmark features of its boundaries include the Atlantic Ocean in the west, the Ugab River in the north, and the Kuiseb River as part of the southern border. Much of the region is occupied by the Namib Desert which stretches parallel to the coast for the length of the country, to about 120-150 km inland. The 'Uranium province' which is the focus of the present Uranium Rush lies entirely within the central Namib in the Erongo Region.

Figure 5. 1: Erongo Region in Namibia

5.1.1 <u>Topography and hydrology</u>

In the Erongo Region, the land rises steadily from sea level to about 1,000 m across the breadth of the Namib (Figure 5.2). The Namib land surface is mostly flat to undulating gravel plains, punctuated with occasional ridges and isolated 'inselberg' hills and mountains. Namibia's highest mountain, Brandberg (2,579 m), lies in the far northern part of the Erongo Region. The eastern edge of the Namib is marked by the base of the escarpment in the southern part of the region. In the northern part, the escarpment is mostly absent and there is a gradual rise in altitude to over 1,500 m. South of the Kuiseb River lies the central Namib Sand Sea, and sand dunes also form a narrow coastal belt between Walvis Bay and Swakopmund.

Figure 5.2: Main physical features of the Erongo Region

The Namib plain is incised by a few main ephemeral rivers that run seawards from wetter parts of their catchments further inland. Of the four main rivers in the Erongo Region, the Swakop (including its main tributary the Khan) and the Omaruru Rivers have approximately similar mean annual runoffs of about 40 million cubic metres per annum, although surface flows in the Omaruru reach the Omdel dam on average every second year, and only every fourth year in the Swakop (Heyns and van Vuuren, 2009). Mean annual runoff of the Kuiseb and Ugab Rivers is about half that of the former two.

However, while the surface flows are important, they are short-lived and the real value of the rivers lies in their alluvial aquifers (Heyns & van Vuuren, 2009). Palaeochannels in the Omaruru River about 40 km from the coast form the underground Omaruru Delta which is an important water source for the central Namib. Some alluvial water in the Swakop and Khan is abstracted for prospecting and mining. In the Kuiseb there are water supply schemes at Gobabeb, Swartbank and Rooibank, the latter two forming part of the Central Namib Water Supply Scheme.

5.1.2 Climate

The climate of the Erongo Region is characterised by aridity. Prominent features of the climate include:

- Very low rainfall, averaging about 300 mm in the north-eastern parts and less than 15 mm at the coast. The Namib proper, i.e. within roughly 120 km of the coast, has median annual rainfall less than 150 mm;

- Great variability in annual rainfall, with most years in the Namib receiving less than the average, and occasional years receiving very heavy rains (>100 mm);

- Coastal fog that brings moisture in frequent but small amounts, which moderates the heat and moisture extremes on the western side;

- A steep rainfall gradient across the short breadth of the Namib and relatively wetter areas in the eastern part of the region. The rain and fog gradients run in opposite directions, with the zone of low precipitation from both sources in the middle zone (see below);

- The wind regime which includes prominent southerly and south-westerly winds during the summer, and north-easterly winds in the winter that sometimes reach gale force and mobiles the entire desert surface (including tailings) (see Plate 5.1);

- Very hot temperatures can occur in the inland areas during the day, cooling at night is due to outgoing solar radiation under typically clear skies. Maximum and minimum temperatures at the coast are moderated by the effects of the cold Benguela current and the regular fog bank;

- Very high rates of evaporation which has significant implications for water balance management.

The climate of the central Namib can be divided into zones that run roughly parallel to the coast (Mendelsohn *et al.*, 2002), (Figure 5.3):

- The coastal foggy zone extends about 20 km inland; it is generally cool and humid with frequent occurrence of fog in the late afternoon, night and early morning. Fog precipitation is more than double the annual average rainfall of 15 mm;

- The middle zone (roughly 20 – 90 km from the coast) experiences fairly frequent fog (less to the east) and average rainfall slightly higher than in the zone to the west, so that average fog precipitation is roughly in the same range as average rain precipitation. Humidity is lower than in the coastal zone, especially in winter when warm dry north-easterly winds predominate. This is the most extreme arid zone of the Namib;

- The eastern zone extends up to ~120 km from the coast. Fog is rare, and some rain falls in most years, averaging about 90 mm per year;

- Further inland lies the 'Pro-Namib' which is the transition zone to the more mesic climate of central Namibia.

Most rain in the Namib falls in late summer, between January and April (73%), while some rain falls in winter (22%) with the driest phase from September to December (Mendelsohn *et al.,* 2002). Wet years of >100 mm rainfall are very rare in the middle and coastal zones, and have been recorded only in 1934, 1976, 2000, 2006 and 2009. The increasing frequency of high rainfall events in the past decade may be a reflection of climate change or may be a short-term fluctuation. The important point is that variability of rainfall is very high and all mine and infrastructure designs need to take this into account.

Seasonality is not strongly developed in the Namib and the average temperature and humidity do not differ markedly in the course of the year. Average summer temperature in the middle zone of the Namib is 23.1ºC, and in winter is 19.2 ºC (Lancaster *et. al*., 1984).

5.1.3 Episodic events

The physical setting of the Namib is harsh and extreme episodic events are an important feature of the natural environment. While they are very rare, they can have a severe impact on the environment and on man-made infrastructures. The photos below illustrate some of the extreme events that have been recorded in the Namib in the recent past – events that are certain to recur in future.

5.1.4 Climate change

According to Turpie *et al.* (2010), there is still considerable uncertainty regarding the accurate detection of future global and regional climate change scenarios. These doubts arise from:

- Uncertainty regarding future global GHG emissions*;*
- Limitations in our understanding of the dynamics of global climatic systems;
- Natural climatic variability displayed in the baseline data;
- Uncertainty pertaining to the CO_2 'fertilisation' effect on plants; and
- Limitations in the downscaling techniques employed to produce Regional Climate Models from Global Circulation Models – simulations which, at best, produce only a possible evolution of future climate systems.

The paucity of hydro-meteorological stations in the country and the lack of homogenous, long term, high quality datasets, hampers the construction of plausible climate models and constrains the reliable assessment of potential scenarios, vulnerability and adaptation to climate change in Namibia (Warbuton and Schultze, 2005; von Maltitz *et al.,* 2005; Dirkx *et al.,* 2008).

In spite of data limitations, experts expect Namibia to experience an increase in temperature and evapo-transpiration at all localities, with the maximum increase in the interior. Warming is likely to be less along the coast than along the escarpment and inland regions (Turpie *et al.,* 2010). Also, most models predict that southern Africa and Namibia will become drier, that rainfall variability is likely to increase and that extreme events such as droughts and floods are likely to become more frequent and intense (Turpie *et al.,* 2010).

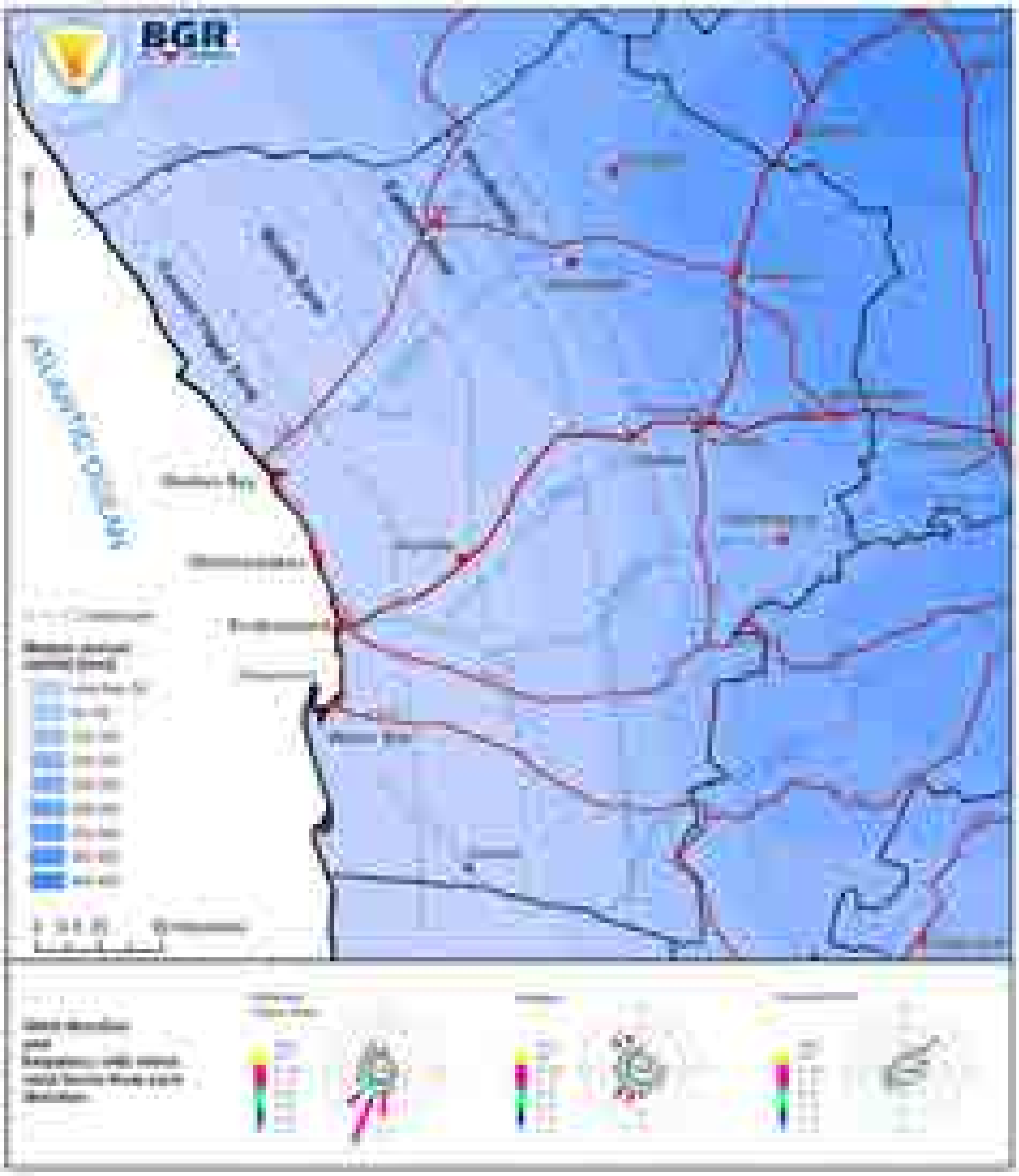
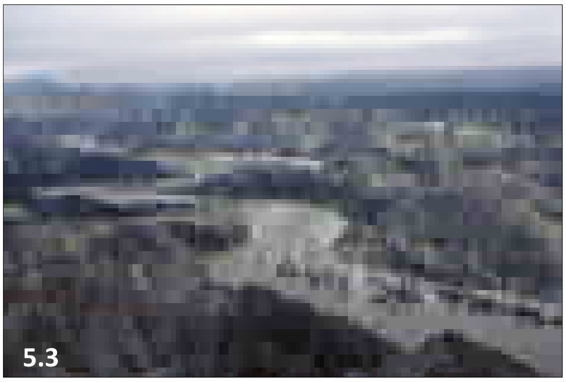


Figure 5.3: Main climatic features of the Erongo Region (adapted from Mendelsohn *et al.*, 2002)

An important feature of Namibia's climate is the coastal fog system, which is known to be key for several elements of biodiversity, but there are unfortunately currently no credible projections of change for this system.



Plates: 5.1) Dust storm approaching Gobabeb 2005; 5.2) Flood damage at Walvis Bay 2006; 5.3) Khan River in flood 1998; 5.4) Tornado approaching Gobabeb 2008.
[Photo credits 1-Hartmut Kolb; 3-Dirk Heinrich; 4-John Guittar]

The implications of expected climate changes in Namibia for the Uranium Rush are that:

- Water availability will be an even more significant issue in future than it is now
- As a result of the above, it will be increasingly important for all users of water to use this scarce resource sparingly and efficiently, and to avoid polluting groundwater (both during life of mine and after closure and decommissioning)
- Design of tailings dams and other installations and infrastructure must assume regular or increased occurrence of 1/100 year floods, more extreme winds and unreliable weather patterns
- Natural rehabilitation of scarred areas will be extremely slow, and pro-active restoration will be required, and
- Current knowledge of sensitive areas, whether based on biodiversity or landscape attributes, will require regular updating.

5.2 Socio-economic status

5.2.1 Land use and people

Large parts of the Erongo Region are desert and owned by the State as protected areas under conservation management; these include the Namib-Naukluft Park (NNP) in the south and central area, and the National West Coast Recreation Area (NWCRA) in the north. The Namib-Naukluft-Park was originally established as a buffer zone in 1908 to protect diamond mining interests on the coast and due to the fact that the land was not suitable for agricultural land use. The Ministry of Environment and Tourism carries responsibility for management of these protected areas, and intends expanding the formal protected area to include the area around Walvis Bay and the dune belt running northwards to Swakopmund. This will proclaim the entire coastal belt of the country as the Namib Skeleton Coast National Park. Protected areas will then comprise almost exactly 33% of the Erongo Region (Figure 5.4).

Government land around Walvis Bay is presently under the control of MRLGHRD, but will fall under MET when it is amalgamated with the surrounding protected areas. Some inconsistencies in control of land, viz. around Arandis, Usakos and between the two towns, reflect unresolved or unclear delineations of communal land, conservancies, Traditional Authorities and Local Authorities.

Communal land makes up about one third of the region and lies to the east of the NWCRA. Most of it is under conservation management through the following conservancies: ≠Gaingu (centred around Spitzkoppe); Tsiseb (focused on Brandberg), Otjimboyo and Ohungu. East of these, the land is under freehold title (another third of the region) and is mostly used for commercial cattle ranching.

The arid nature of the landscape means that very little of the area has agricultural potential. Only 10 km² of the Erongo Region is cleared for cultivation (NPC, 2007); this includes the area of small-scale farming in the Swakop River bed, as well as small areas at Omaruru and Okombahe. Small stock farming is the most important agricultural activity in the region. This is mostly practised on the communal land described above, where goats and sheep are run on conservancy land. Also, Topnaar people living along the Kuiseb River in the NNP keep goats, cattle and donkeys.

Land under Local Authority responsibility makes up 1.5% of the total area of the region. Eighty percent of the Erongo population lives in urban areas; most of these are concentrated in Walvis Bay and Swakopmund. Table 5.1 shows the towns, the area of their townlands, and the population of each.

Figure 5.4: Land use and ownership in the Erongo region

Table 5.1: Statistics of the urban areas in the Erongo Region.

Town	Townland area (km²)	Population	Source for population data
Arandis	29	7,600	NPC, 2007
Henties Bay	121	3,300	NPC, 2003
Karibib	97	3,800	NPC, 2003
Omaruru	352	4,800	NPC, 2003
Swakopmund	193	42,000	2006 polio vaccination campaign, quoted in UraMin 2007
Usakos	58	3,000	NPC, 2003
Uis	10	?	
Walvis Bay	29	43,700	NPC, 2003
Total urban population		**108,200**	
Total estimated Erongo Region population		**135,250**	

The rural population is dispersed in the communal and freehold areas, and concentrated in small settlements such as Spitzkoppe, Otjimbingwe and Okombahe.

5.2.2 Economic activities and livelihoods

Erongo is a relatively prosperous region in Namibia, with the second highest per capita income (after Khomas) derived mostly from mining, fishing and tourism. Fishing and mining industries are the major employers, but industrial activity is limited and based mainly on the fishing industry (NamPower, 2009). The drivers of economic development in the region have been identified as the mineral sector, fisheries, tourism, NamPort and the Walvis Bay Corridor Group.

5.2.2.1 Commercial fishing and fish processing

The commercial fishing industry is the largest single employer in the Erongo Region, accounting for 33% of the economically active population in 1998 (Anonymous, 1999). Recent declines in fish stocks have led to fishing companies being granted smaller quotas and some fish processing factories closing.

Angling is an important recreational and livelihood activity for residents of, and visitors to the coast. Aquaculture (oyster cultivation) is practised in specific areas in the Walvis Bay lagoon and salt pans as well as at the Swakopmund salt works.

5.2.2.2 Mining

The mining sector in the whole country accounts for 20% of GDP and employs about 3% of the population (NEPRU, 2009). Uranium from the two operating mines contributed 4% of the total GDP in 2008 (NEPRU, 2009) and is likely to become the strongest contributor to GDP if Scenario 3 takes place.

In the region, important mining operations are concentrated on gold (Navachab Mine), dimension stone (numerous marble and granite quarries), salt (at Walvis Bay, Swakopmund and Cape Cross), stone and sand quarrying, and gemstones. Many old mines are now abandoned, such as various tin mines (e.g. Uis, Arandis, Strathmore), and mines for lead, lithium, copper and rutile (amongst others). There are two operating uranium mines, Rössing and Langer Heinrich, and two under construction, Trekkopje and Valencia (see Chapter 4 for more detailed information). The Uranium Rush is likely to not only see development of more uranium mines but also new or expanded mines for salt, phosphate, gypsum and marble that will feed the associated chemicals industry.

5.2.2.3 Tourism

Tourism is currently the third largest economic sector in Namibia and was expected to contribute 3.8% to GDP in 2007 (NEPRU, 2009). According to a survey conducted by World Travel & Tourism, the sector in Namibia is expected to grow by 6.9% annually over the next ten years – the eighth fastest growing tourist destination globally. Direct employment related to tourism is estimated at 18,800 jobs in the national economy, equivalent to 4.7% in 2006 (Bannerman, 2009).

Erongo's coastal area from Walvis Bay to Henties Bay is a major holiday destination, with many accommodation establishments and camping sites. Swakopmund is the main centre for tourism.

Accommodation capacity in the Erongo Region is 20% of Namibia's complete capacity, with over 247,000 beds available in August 2008 (NTB, 2009). The second most visited town is Swakopmund with 50% and Walvis Bay with 32% of all tourists visiting these towns. There is constant growth and development in the coastal regions to accommodate the increase in this demand.

Tourism usually employs less skilled workers than the mining industry and thus salaries are generally much lower, but it offers employment to a significant number of people, mainly women.

5.2.2.4 Transport hub

Walvis Bay, Namibia's main port, is situated at the end of the Trans-Kalahari Highway that links Namibia with Botswana and Gauteng Province in South Africa. Namibia's road network also connects Walvis Bay, via the Trans-Caprivi Highway, with the country's northern business centres, as well as Zambia, Zimbabwe and the Democratic Republic of Congo. The Port of Walvis Bay is the main focus and economic nucleus for these two highways. The Walvis Bay Corridor Group as an organisation and a public-private partnership, promotes the harbour in playing a crucial economic link to any economic centre in Southern Africa (Bannerman, 2009). Walvis Bay and Swakopmund are also linked to Windhoek on TransNamib's national railway system (see Chapter 7.3 for more detailed information).

6 POLICIES AND LAWS RELEVANT TO THE URANIUM RUSH

6.1 Introduction

Before examining specific policies and laws pertinent to the Uranium Rush, it is necessary to reflect on some broader principles and Namibia's long term vision.

Of fundamental importance to the concept of sustainable development and the application of environmental safeguard tools, is the precautionary principle, which states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those taking the action.

The principle implies that there is a social responsibility to protect the public from exposure to harm and in some legal systems (e.g. the European Union) the application of the precautionary principle has been made a statutory requirement. The precautionary principle is given weight in international law through the UN World Charter For Nature (section 11(b)) which states: *"Activities which are likely to pose a significant risk to nature shall be preceded by an exhaustive examination; their proponents shall demonstrate that expected benefits outweigh potential damage to nature, and where potential adverse effects are not fully understood, the activities should not proceed."* The most common tool used to effect the 'examination' referred to above, is environmental assessment (EIA) as required by the Environmental Management Act (2007).

In order to provide direction to government ministries, the private sector, NGOs and local authorities and to obtain an understanding of where the country is heading, a document entitled 'Vision 2030' was formulated by the Namibian government in 2001/02. 'Vision 2030' helps to guide the country's five-year development plans, while fully embracing the idea of sustainable development which, for the natural resource sector, states:

> *The nation shall develop its natural capital for the benefit of its social, economic and ecological well-being by adopting strategies that: promote the sustainable, equitable and efficient use of natural resources; maximize Namibia's comparative advantages; and reduce all inappropriate resource use practices. However, natural resources alone cannot sustain Namibia's long-term development, and the nation must diversify its economy and livelihood strategies.*

Vision 2030 is ambitious since it aims to both optimise Namibia's comparative advantages as presented by the wildlife and tourism sectors, whilst also fully exploiting the country's mineral wealth. The need for applying environmental safeguard tools (such as SEA and EIA) is emphasised in order that negative impacts and opportunity costs are minimised.

There are five sources of law in Namibia: the Constitution, statutory law, common law, customary law, and international law.

The Constitution is the Supreme Law of Namibia and all government agencies are therefore required to abide by it. Laws are valid only if they are passed according to the procedures described in the Constitution and consistent with the rights protected by the Constitution.

In terms of Statutory Law, Namibian legislation consists of pre- and post-Independence laws. Many of the 'old' laws have been repealed and replaced by Namibia's own domestic laws, while others remain in force.

Common law, also known as 'Roman-Dutch law' is the law developed over time through the decisions of individual court cases. Parliament can change the common law by passing statutes that say something different.

Customary law, which is not normally written down, is law that has developed over the years in different traditional communities in Namibia. Parliament can change customary law by passing a statute that applies to all communities in Namibia.

Article 66 of the Namibian Constitution provides that both the customary and common laws in force on the date of Independence shall remain valid unless they conflict with the Constitution or any statutory law. Subject to the terms of this Constitution, any part of such common law or customary law may be repealed or modified by an Act of Parliament.

International law includes the international agreements that Namibia has signed and ratified, as well as the rules of customary international law. Article 144 of the Namibian Constitution provides that unless otherwise provided by this Constitution or an Act of Parliament, international agreements are binding and shall form part of the law of Namibia.

In addition to the five sources of law in Namibia, national policies also govern and influence government activity with regard to the Uranium Rush. A policy is defined as the high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body. While legislation is enforceable in a court of law, policies cannot be enforced by a court without implementing legislation.

Though government policies do not have the same legal weight as official statutes, courts consider policies when interpreting laws and deciding cases. When dealing with controversial or unclear cases, Courts will resort first to the Constitution as the supreme law and bear in mind its preponderance when interpreting parliamentary legislation. When cases are still unclear after analysing existing sources of law, courts utilise policies as persuasive authority to reach a final decision.

Apart from the legal significance of policies, governments generally abide by them as they often represent the consensus regarding a particular topic, and policy deviation usually attracts negative attention.

6.2 Overview of key policies and laws

The high importance of environmental protection in Namibia is borne out by the Namibian Constitution. There are provisions ensuring the sanctity of the natural environment (95(l)), mechanisms by which the government can investigate misuse of resources (91(c)) and mechanisms for the enforcement of sound management policy. The Constitution entitles an aggrieved stakeholder to seek administrative justice in the event the Government makes a decision that has an adverse impact on his or her substantive rights. Thus, it establishes that when the Government acts, it does so on behalf of the people, and that it should act with an effort to ensure both the rule of law and justice for each person. Moreover, Article 18 requires a fair, direct process for persons to challenge agency action.

Important in the context of the SEMP, is that Article 91 of the Constitution empowers individuals to monitor the treatment of the environment and to help ensure its continued vitality.

While the Constitution emphasises the need for sustainable development and human rights, Government is still required to make laws that are specific and enforceable. Since Independence the Namibian Government has enacted a number of laws and policies intended to protect fragile ecosystems, manage mining operations, and ensure that all commercial development projects eliminate or, at the very least, mitigate adverse impacts on the environment, people and wildlife. These laws establish clear mandates in some cases, but not in others. Consequently, many gaps remain in the enforceable regulatory structure.

For example, parks are established under the pre-independence Nature Conservation Ordinance of 1975 for the purposes of conservation and tourism by MET, yet the post independence Policy on Mining in Protected Areas allows prospecting and mining in protected areas under certain circumstances, which undermines conservation and tourism objectives and policies.

Also, article 95(l) of the Constitution requires management for sustainability, yet DWA gives permits for groundwater abstraction without knowing, for example, the sustainable yield of the aquifer, because the Water Act of 1956 does not make provision for this.

A major contributing factor to the inconsistency and conflict between different sectoral laws is arguably the fact that some laws are outdated and ignore the realities of the physical resources and socio-economic circumstances of modern-day Namibia. For example, the Water Act of 1956, ignores the hydrological reality of Namibia and fails to account for the natural environment's new status under the Namibian Constitution since it does not recognise the natural environment as a user of water nor as a provider of essential processes and services. Thus it cannot deal effectively with the challenges that a growing mining sector places on scarce water resources. On the other hand, the Water Resources Management Act which was passed in 2004, from a sustainable water management perspective, could deal with these challenges more effectively, but the Act is not yet enforced, due to lack of personnel capacity to do so.

As a result, Namibia continues to rely on outdated and ineffective legislation that is inconsistent with the provisions of article 95(l) of the Namibian Constitution. The enactment of the Environmental Management Act and the appointment of an Environmental Commissioner would operate as a control mechanism over ministerial decision making powers, harmonise inter-ministerial decision-making processes and create a platform of transparency and accountability to serve the needs of the citizens of Namibia.

The most important policies and laws in relation to the Uranium Rush are discussed briefly below.

6.2.1 Biophysical environment

The **Water Act, 54 of 1956** regulates groundwater abstraction for mining purposes. The passed, published, but not yet in force **Water Resources Management Act, 24 of 2004**, provides more specific procedures for water abstraction permitting that are much more tailored to Namibia's climate and geohydrology than the Water Act of 1956. Once enacted, it will supplant the Water Act.

In the context of groundwater aquifers, the Water Act appears to apply only to subterranean water control areas. Whilst no permit for groundwater abstraction can be lawfully issued without the above designation, a landowner may abstract subterranean water underneath his land, but s/he may not sell the water without a permit. Section 30(4)(a) allows a mine to abstract water without a permit when that water is necessary for the efficient carrying on of such mining operations or the safety of persons employed therein, unless the Minister otherwise directs. A permit is *only* required if a mine owner uses subterranean water from the mining land for any other purpose. However, if a mine abstracts groundwater from land other than the mine licence area, a permit is required.

The Water Act does not delineate any specific qualifications that applicants must meet before the Minister will issue a water abstraction licence. The uneven patchwork of regulations and the *ad hoc* approach to enforcement of the permitting scheme, coupled with the unfettered discretion vested in the Minister by the Water Act, No. 54 of 1956, means that Namibia's scarce water resources are not adequately protected from overuse. Also, the Act fails to create any incentive for compliance for large enterprises given that the threat of prosecution is negligible and the penalties are easily absorbed into the costs of doing business. For these and other reasons, the Water Act is unsuitable for modern-day Namibia.

It is expected that the Water Resources Management Act of 2004 will improve commitments by government to ensuring that water resources are managed and used to the benefit of all people and in furtherance of environmental needs and ecosystems functioning.

The **Namibia Water Corporation Act, 12 of 1997** enables the supply of bulk water so long as the required quantity and quality of water is available. This Act also imposes on the Corporation a duty to conserve and protect water resources and to take a long term view on the management of catchments and water.

The **Minerals Act, 33 of 1992** governs the granting of permits for prospecting and mining in Namibia. The Act states that the Minister shall not grant an application by any person for a mining licence unless the Minister is on reasonable grounds satisfied that the operation will ensure adequate protection of the environment. In the absence of specific EIA legislation, the Mining Act has been a useful tool in ensuring EIAs are done for mining projects. Thus, whilst the Ministry of Mines and Energy is not the designated authority for the protection of the environment, it clearly has responsibilities for the application of environmental safeguards as part of its licensing and oversight responsibilities.

Namibia's **EIA Policy** (1995) requires that all listed policies, programmes and projects, whether initiated by the government or private sector, be subject to an EIA. The purpose of the Policy is seen as informing decision makers and promoting accountability, ensuring that alternatives and environmental costs and benefits are considered, promoting the user pays principle, and promoting sustainable development. The **Environmental Management Act, 7 of 2007** (EMA) is not yet in force, but it will give legislative effect to the EIA Policy. The EMA will enable the establishment of the Sustainable Development Advisory Council and the appointment of the Environmental Commissioner and environmental officers. It is expected that these institutions will improve the management of impact assessment in Namibia. The EMA requires government agencies to work with a unity of purpose in ensuring sustainable resource management. Beyond this, it commands developers to gain clearance from the Environmental Commissioner (not yet appointed) before proceeding with plans. Criminal penalties for violating the conditions of a granted environmental clearance are stiff.

Section 3 of the EMA sets out principles of environmental management. Section 3(2)(k) of the EMA is particularly relevant for the mining industry, since it mandates a cautious approach, including the precautionary principle and the principle of preventative action. Section 3(2)(h) instructs generators of waste to use the best practicable environmental option and the 'polluter pays principle' is affirmed in section 3(2)(j). Taken together, these principles provide for impact avoidance, mitigation, and rehabilitation.

The Environmental Commissioner will review the EIAs and consult outside expertise if necessary before granting/denying the environmental clearance certificate. All EIAs and decisions regarding environmental clearance will be made public.

The **Parks and Wildlife Management Bill of 2009** (Parks Bill – in preparation), aims *"to provide a legal framework to provide for and promote the maintenance of ecosystems, essential ecological processes and the biological diversity of Namibia, and the utilisation of living natural resources on a sustainable basis for the benefit of Namibians, both present and future, and to promote the mutually beneficial co-existence of humans with wildlife, to give effect to Namibia's obligations under relevant international legal instruments, and to repeal the Nature Conservation Ordinance 4 of 1975."* Whilst the Bill envisages MET and MME agreeing to withdraw certain areas within parks from mining ('no go areas'), it should be noted that the Minister of Environment already has this authority under section 18 and 83 of the Nature Conservation Ordinance. There is concern that the new Act may be weaker than the old ordinance in this regard.

Apart from these 'no go' areas, mining within parks under the new Act would only be permitted with written authorisation from the Minister of MET. An applicant for a mining permit in a park will be required to pay a fee to MET, provide an EIA, an EMP, a rehabilitation plan, and a rehabilitation fee in accordance with the EMA. One of the outputs of this SEA is a recommended decision-making framework for MME and MET when awarding EPLs and Mining Licences in Protected Areas and very sensitive areas (see Chapter 8).

Environmental Investment Fund of Namibia Act, 13 of 2001 provides for the establishment of the Environmental Investment Fund of Namibia to support sustainable environmental and natural resources management in Namibia.

The Fund provides a mechanism to turn environmental crimes into positive protection for the environment. Fines paid in terms of the Environmental Management Act, and money made from the sale of property which is forfeited in connection with such crimes, will be paid into the Environmental Investment Fund. The money in the Fund could be used for:

- The sustainable use and management of natural resources;
- The maintenance of the natural resource base and ecological processes;
- The maintenance of biological diversity and ecosystems;

- Economic improvements in the use of natural resources for sustainable rural and urban development.

The **Forest Act, 12 of 2001** has some relevance to the Uranium Rush as the Minister (of Agriculture, Water and Forestry) may declare protected areas for the purposes of soil protection, water resources protection, protection of plants and other elements of biological diversity. The Minister may also declare any plant or species of any plant a protected plant and impose conditions under which it shall be conserved, cultivated, used or destroyed by any person. Of potential importance in the context of the Uranium Rush, is the fact that the Forest Act requires a permit before clearing any living vegetation within 100 metres of a river or stream. This has implications for existing and planned mines.

6.2.2 Heritage

This **National Heritage Act, 27 of 2004** replaced the *National Monuments Act, 28 of 1969,* and provides for the protection and conservation of places and objects of heritage significance. All archaeological and palaeontological objects belong to the State and once an artefact or fossil has been discovered, all mining operations must cease, the area must be cordoned off, and the National Heritage Council needs to be notified. A person who removes, demolishes, damages, despoils, develops, alters or excavates, all or any part of a protected place is liable to a fine of up to N$100,000 or to imprisonment for up to 5 years, or to both the fine and imprisonment. If damage is caused to a heritage place or object as a result of failure to comply with the Act, the person responsible must remedy the damage, failing which the Council may itself take the necessary action and recover the cost from that person. Declared World Heritage sites such as the Brandberg are required to have legal protection status according to Article 5 of the World Heritage Convention (of which Namibia is a party). Section 55 of the Act grants the Council the ability give an order to stop any activity or development that is being carried out in or on any area of land which is believed to be an archaeological or palaeontological or meteorite site.

6.2.3 Socio-economy, services and planning

There is no legislation in Namibia that requires the preparation of a coherent, national and regional land use framework but it is envisaged that this will be introduced when the Draft Urban and Regional Planning Bill is enacted. Currently the establishment of towns and the subdivision of land are regulated by the **Townships and Division of Land Ordinance of 1963** while the development and application of town planning schemes is regulated by the **Town Planning Ordinance, 18 of 1954**. Both these Ordinances must be read with the Local Authorities Act 23 of 1992.

The **Decentralisation Enabling Act, 33 of 2000** established procedures for decentralising governmental powers. The Minister responsible for regional and local government matters may transfer the responsibility of a specific government function from the ‘line ministry’ to a regional or local authority. The **Regional Councils Act, 22 of 1992** provides for the establishment of regional councils while the **Local Authorities Act, 23 of 1992** establishes local authority councils. It also sets forth the powers, duties and functions of such councils. Local authorities are given wide-ranging powers including: to supply water to residents; to provide and maintain sewerage and drainage systems; to provide waste removal services; to supply electricity or gas to residents; to establish and operate sand, clay, stone or gravel quarries; and to promote tourism. However, the Act does not oblige local authorities to address environmental conservation.

The **Namibian Ports Authority Act, 2 of 1994** establishes the Namibian Ports Authority (NPA) to undertake the management and control of ports in Namibia and the provision of related facilities and services. The **National Planning Commission Act, 15 of 1994** empowers the National Planning Commission to plan the priorities and direction of national development. In reality, individual ministries do their own sector planning, and coordination is minimal. The Ministry of Regional and Local Government, Housing and Rural Development is responsible for spatial land use planning at a regional level, while the Ministry of Lands and Resettlement is in charge of land use planning for communal land in rural areas. State owned land is controlled by the Ministry of Works, Transport and Communications but the Ministry does not routinely undertake land use planning. The Ministry of Environment and Tourism has on occasions undertaken land use planning in respect of areas designated as parks.

The **Town Planning Ordinance** makes provision for the preparation and carrying out of town planning schemes which, *inter alia*, must adequately address: drainage and sewage disposal; regulation or control of the deposit or disposal of waste materials and refuse; zoning of areas for residential, business, industrial, and other specified purposes; and the preservation of buildings or other objects of architectural, historic or artistic interest and places of natural interest or beauty.

The Namibia Planning Advisory Board (NAMPAB) advises the Minister of Local Government and Housing in relation to town planning matters. The **Draft Urban and Regional Planning Bill** provides for the establishment of national, regional and urban structure plans, and the development of zoning schemes. It also deals with a variety of related land use control issues such as the subdivision and consolidation of land and the establishment and extension of urban areas. The Bill will likely promote health, safety, order, amenity, convenience and environmental and economic sustainability in the process of development.

6.2.4 Radiation protection

6.2.4.1 National laws

Namibian legislation concerning ionizing radiation is contained in the **Atomic Energy and Radiation Protection Act** (Act No. 5 of 2005). The Act fills a gap that was created when the Minerals Act of 1992 repealed previous pre-independence nuclear energy and radiation protection legislation and it also amends the Hazardous Substances Ordinance (Ordinance No.14 of 1974), specifically with respect to hazardous substances that constitute radiation sources or radioactive materials. The Act provides for:

- Adequate protection of the environment and people in current and future generations against the harmful effects of radiation by controlling and regulating the production, processing, handling, use, holding, storage, transport, and disposal of radiation sources and radioactive materials, and by controlling and regulating prescribed non-ionising radiation sources – by means of ‘authorisations’, ‘licences’ and ‘registrations’ as administrative tools (chapter 4);

- The establishment of an Atomic Energy Board and its composition and functions (chapters 2 and 3); and
- The establishment of a National Radiation Protection Authority (chapter 5).

Chapter 4 of the Act lists all activities requiring authorization, licenses, and registration, including: possession of radiation sources or nuclear material; importation or exportation of nuclear materials; disposal of nuclear materials; operation or use of radiation sources; and storage of radiation sources. Licences are issued by the Director-General of the National Radiation Protection Authority, who is a secretary of the Atomic Energy Board (AEB). Licences can be cancelled by the Director General if registration or licensing conditions are no longer being met. Licensees are responsible for the protection of health, safety, security, and the environment and for respecting Namibia's international commitments.

Two sets of (draft) regulations have been drafted to assist in the implementation of the Act[1]:

a) **Regulations for Protection Against Ionizing Radiation and for the Safety of Radiation Sources** (MoHSS, 2008a); and

b) **Regulations for the Safe and Secure Management of Radioactive Waste** (MoHSS, 2008b).

Both of these Regulations are directly relevant to the uranium mining industry. Protection of workers and the public from additional ionizing radiation forms a major part of the public responsibility of the mines, and the management and containment of radioactive waste, both during operation and after closure of the mines, presents one of the environmental aspects which requires comprehensive management plans and monitoring programmes to be developed.

Both sets of regulations are envisaged to be finalised and promulgated in the course of 2009 (or early 2010), with inputs and advice from the Atomic Energy Board (AEB). Once promulgated, the regulations, along with the Act, will constitute a legal and regulatory basis for the National Radiation Protection Authority (NRPA) to enforce its provisions, including the licensing and monitoring of establishments (like uranium mines) working with sources of radiation.

The Ministry of Health and Social Services (MoHSS), the lead ministry for matters concerning atomic energy and radiation has developed the concept of a **Radiation Management Plan** (RMP) into an operational instrument that forms the basis of any licence applications and is the pre-requisite for any government authorisations under the Atomic Energy and Radiation Protection Act. Each operator handling radiation is now required to develop and submit a RMP addressing applicable aspects of radiation safety. The RMP is conceived as a comprehensive document describing organisational and technical arrangements to be put in place to satisfy the requirements of the Act and its Regulations. MoHSS has issued detailed guidelines for the development of a RMP in support of applications for authorisations under the Act (MoHSS, 2009).

Just like any other operator or practice handling radiation, each new uranium mine will now be required to prepare and submit a RMP for review and approval by the NRPA prior to the issuance (or refusal) of an authorisation and licence by the Authority – and to implement the RMP once

[1] Both sets of regulations are expected to be gazetted in the near future, possibly still in 2009.

approval has been obtained. The RMP will be the basis for ongoing monitoring and verification by the Authority. It can also be expected that each operating mine (RUL and LHU) will be required to submit a RMP in due course for purposes of ongoing monitoring and verification by NRPA. In their RMP, future and existing mines need to address the management of both occupational and public radiation exposures.

6.2.4.2 International organization(s)/networks

The **International Atomic Energy Agency (IAEA)** is the world's centre of cooperation in the nuclear field. It was set up as the world's 'Atoms for Peace' organisation in 1957 within the United Nations family. The Agency works with its Member States[2] and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. The IAEA's mission is guided by the interests and needs of Member States, strategic plans and the vision embodied in the IAEA Statute. Three main pillars - or areas of work - underpin the IAEA's mission: safety and security; science and technology; and safeguards and verification (www.iaea.org). It is under the aegis of the latter that IAEA conducts regular inspections of the uranium mines in Namibia. The codes of practice for both Rössing and Langer Heinrich have been inspired by the IAEA's International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IAEA, 1996, 2004).

The **International Commission on Radiological Protection (ICRP)** is an independent Registered Charity, established to advance for the public benefit, the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionising radiation. It is an advisory body, providing recommendations and guidance on radiation protection, but the responsibility for formulating specific advice, codes of practice, or regulations is left to the national protection bodies of each country. In the case of Namibia, this would be the newly formed Atomic Energy Board for example. While the ICRP has no formal power to impose its proposals on anyone, legislation in most countries adheres closely to ICRP recommendations (www.icrp.org).

The **World Nuclear Association (WNA)** is the global organisation that seeks to promote the peaceful worldwide use of nuclear power as a sustainable energy resource for the coming century. It advocates collective responsibility and commitment by all players to the safe and responsible management of the uranium product. The Chamber of Mines of Namibia supports the concept of stewardship, which involves the care and management of uranium throughout its entire lifecycle (CoM, Annual report, 2007).

6.2.5 Mine closure

The **Minerals (Prospecting & Mining) Act, No 33 of 1992** stipulates in Sections 54 and 128 that the licence holder has to rehabilitate the land when it ends mining operations. The act also requires mining applicants to submit an environmental management plan prior to the granting of a mining licence but this does not include the closure plans. A fine of N$100,000 or five years imprisonment is imposed on any mining operator who fails to rehabilitate the mine upon closure.

The **Minerals Policy of Namibia, 2002** stipulates in sections 2.2.5 that mine closure should be well planned and communities should be involved while Government will ensure compliance to

[2] Namibia is a member of IAEA.

policies and guidelines during rehabilitation. Meanwhile contingencies will be provided by the Government in circumstances where, the mining company is forced to close in an unplanned manner (as in Scenario 4) and cannot be traced. This policy, just like the Minerals (Prospecting and Mining) Act of 1992, emphasises in section 53 the fact that mining companies should be responsible for their actions with the ‘polluter pays’ option, thus rehabilitation is a responsibility of the mining company while Government facilitates the process to ensure compliancy.

Namibia's Environmental Assessment Policy for Sustainable Development and Environmental Conservation, 1994 states that a binding agreement (based on the procedures and recommendations contained in the EIA report) to ensure that mitigatory and other measures recommended in the EA, and accepted by all parties, is complied with. This agreement should address the construction, operational and decommissioning phases in the mine closure process, as applicable, as well as monitoring and auditing.

Namibia’s Environmental Management Act 2007 requires mining companies to submit closure plans every three years and to provide guarantees for the rehabilitation of mining sites after closure.

6.3 Key conclusions and recommendations

Namibia has reasonably good environmental legislation, but the existing framework does not adequately protect the environment from abuse by some mining companies. However, the implementation of corporate responsibility programmes and environmental management plans by all companies should help to ensure a high degree of environmental awareness and best practice management. The following recommendations are suggested to improve the current situation:

6.3.1 Modification of Proposed and Existing Legislation

Strengthen the **Environmental Management Act 2007** by:

- Amending section 57(1) to allow existing projects only one year to submit an application for an environmental clearance certificate, removing the minister’s discretion to grant any further extensions;
- Adding a provision that defines EIA circumvention as a form of corruption punishable by criminal law; and
- Adding a clause to the Act that requires the development of an Environmental Management Plan (EMP), which should be developed from the findings of the EIA.

Establish detailed and appropriate regulations to allow for the enforcement of the Environmental Management Act 2007. These regulations should include at a minimum the following provisions:

- Ensure that all life cycle costs are identified in the EIA report, including the cost of reclamation, closure, re-contouring, land stabilisation, post-closure monitoring and maintenance. Mine sites should be rehabilitated to their natural or pre-determined states or to a generally accepted level for future use of the area;
- Set minimum standards for an EIA, so that both process and content are of an acceptable quality, and the information presented is accurate, reliable and useful;

- The structure of Records of Decision (ROD) should be reviewed to include much more precise and detailed information, specifically with respect to: the criteria used in making the decision; reasons for arriving at a decision; transfer of rights and obligations if there is a change of ownership of the project or property; and specific conditions to protect the environment;
- Define a mechanism for the establishment and governance of a rehabilitation and restoration fund that will enable proper management of project closure; and
- Provide mechanisms for public or civil society involvement in monitoring of projects, whether in parks or elsewhere, so that vigilance is enhanced and broad based.

Improve and pass the **Parks and Wildlife Management Bill 2009** as follows:

- Create a legal mechanism for identifying and classifying parks to ensure their adequate protection;
- Establish protected areas or parts thereof that will not be available for prospecting or mining. Section 23(1) creates a discretionary process whereby the minister of the MET may agree in accordance with the Minerals Act upon 'no go' areas, but the law should require that the minister must use this power;
- Create provisions whereby designations of areas declared off limits under section 25(1) may only be altered or revoked by an Act of Parliament.

Amend the **Minerals Act 1992**, requiring mining licence applicants to make, adequate and sufficiently liquid financial provisions for the costs of mine closure, including reclamation, long-term monitoring, and maintenance. Also, the Act must require MME to conduct background checks on corporations as well as individuals to look for history of prior environmental violations or other illegal practices. The Act must clearly establish the legal criteria applicable to proposals for mining within parks. At present, mining projects proposed for parks are treated the same as any other proposal.

6.3.2 Increase Enforcement and Proper Implementation of Current Law

The fees due for all permits and applications at present are both insubstantial and not effectively collected by the reviewing body, this leads to a general non-payment of fees.

There needs to be improvement in the way that DEA sets conditions that proponents must adhere to when they are authorised to proceed with their project. Currently, many RODs are vague and very short on detail.

Ensure quality control in the EIA guide and review process by screening unethical or unqualified EIA consultants out of the system.

Use independent experts to help with assessments, inspections, and audits to remedy any lack of technical expertise among ministry staff.

Appoint an Environmental Commissioner to enforce the EMA and, through that office, ensure that regular inspections are undertaken of projects in the field.

7 CUMULATIVE EFFECTS ANALYSIS OF THEMATIC ISSUES

7.1 Introduction

Chapter 7 presents a thematic analysis of the cumulative effects of the Uranium Rush on various components of the receiving environment of the central Namib, namely: public health, towns, transportation infrastructure, water, energy, recreation and tourism, biodiversity, archaeological heritage, macro-economics, education and skills, air quality, and institutional capacity and governance. These aspects represent the main areas of concern raised by the public and other stakeholders during the public participation process (described in Chapter 2).

The source data were taken from the specialist studies and theme reports prepared by the SEA team, which will be made available by MME. The information provided in these reports has been summarised in the following sections in order to provide:

- A concise statement of the issues relating to each environmental component;
- An analysis of the cumulative impacts on each environmental component;
- A statement, based on the Environmental Quality Objectives contained in Chapter 8, of the desired state of the environment during and after the Uranium Rush;
- A set of recommendations as to how to achieve this desired state, through the mitigation of the negative cumulative impacts and the enhancement of the beneficial effects of the Uranium Rush.

It should be noted that the intention of this chapter is to provide an analysis of the strategic or regional level cumulative impacts i.e. impacts felt beyond the Mining Licence area and thus the individual impacts which may be caused by each mine within their ‘fence’ are not specifically dealt with here – these are covered in each mine’s EIA and EMP.

The cumulative effects analysis in this chapter is arranged topically as follows:

7.2 Towns	7.9 Macro-economics
7.3 Transport infrastructure	7.10 Education and skills
7.4 Water	7.11 Air quality
7.5 Energy	7.12 Radiation
7.6 Tourism and recreation	7.13 Community health
7.7 Biodiversity	7.14 Institutions and governance
7.8 Archaeology	7.15 Summary and discussion

7.2 Cumulative effects analysis - Towns in the central Namib

7.2.1 Introduction

The Uranium Rush, particularly under Scenarios 2 and 3 (see section 4.5 for elaboration) is likely to impact on four key aspects of towns in the central Namib, namely sense of place, the incidence and type of crimes committed, the availability of affordable erven and housing, and waste management. Although each aspect is dealt with separately within this section, their combined influence in possibly creating undesirable, unaffordable, unsafe and unsustainable towns is implied.

7.2.1.1 Sense of Place

The concept of 'sense of place' is relative and highly subjective. To some people a specific place or town is unattractive, but to others it is the place where they choose to live or visit, and they may resist actions that cause its character to deteriorate.

In the context of the Erongo Region, Swakopmund is labelled 'beautiful with character, laid back and inviting'. This is evidenced by the fact that this is a popular tourist and holiday destination, sought after by property investors. The municipality requires new buildings to be 'consistent' with the ambience of the town so that sense of place can be maintained or enhanced, and the centre of town has been declared a conservation area under the National Heritage Act. Henties Bay is even more of a holiday town, though there is no consistency in terms of architecture and planning, and a reduced sense of place. The same comment may be valid for the Langstrand/Dolphin Park areas.

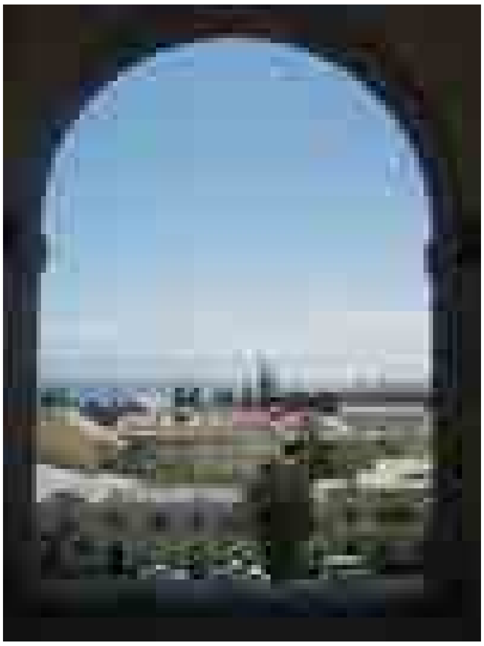


Plate 7.2.1: Swakopmund has a coastal holiday sense of place
(Photo: courtesy of www.commons.wikipedia.org)

By contrast, Walvis Bay is regarded as an 'industrial town', since it has developed around the port and fishing industry (Plate 7.2.2). This implies that the authorities or indeed the public, are somewhat more tolerant of 'ugly' structures such as stacks, cranes, bulk-fuel reservoirs, coal heaps, shunting yards, etc. Also, the unpleasant odour from the fish factories is fondly dismissed as 'the smell of money'. However, the municipality has tried to market Walvis Bay's tourism potential, especially its prolific birdlife that includes charismatic species such as flamingos and pelicans. In this sense, one may think of Walvis Bay as having a 'split personality'.

Plate 7.2.2: Walvis Bay is Namibia's biggest port and has a more industrial sense of place (Photo Rössing).

In other towns, such as Uis, Arandis, Usakos and Karibib, sense of place is somewhat less nurtured. These towns are neglected, under-developed, poorly resourced and desperate for almost any kind of investment. In such cases, the authorities appear to work on an *ad hoc* basis, with no coherent plan or strategy.

The emerging consensus is that the Uranium Rush will almost certainly change the character of many Erongo towns. While urban development will be welcomed by many, particularly in the smaller towns of Arandis and Usakos, it was agreed that such development needs to be anticipated and properly planned.

7.2.1.2 Crime

It has been argued that crime is expected to increase in poor economic conditions and decrease in good economic times as a result of more jobs and income for people who would otherwise be tempted to commit crimes for economic gain (CS&CPC, 1996) (Bidinotto, 1995). However, much evidence points to the opposite, where improved economic conditions lead to an increase in crime (Lehrer, 2000). The expected influx of labour to uranium mines and the increase in revenue and disposable income for people in the area could therefore attract crime syndicates to the area.

Namibia's overall rate of crime is relatively low compared to world standards. Its reported rates of theft and drug related offences are comparable to countries with the lowest incidences in the world. It does however have a relatively high rate of violent crimes such as assault and murder, but compared to other regions of Namibia, the Erongo region has a low rate of crime incidence (Shilongo *pers.comm.)*.

Incidence of crime is monitored for town districts in the central Namib by the Ministry of Safety and Security's regional police department. An analysis of crime incidents for this area over the period 2004-2009 revealed a decline in total crime[1] over the past five years (Figure 7.2.1). This is particularly evident for the last two years, and is reflected in Figure 7.2.2 which compares total crime for each town district individually.

[1] Crime incidents are categorized as: assault, drug-related crime, murder, robbery and theft.

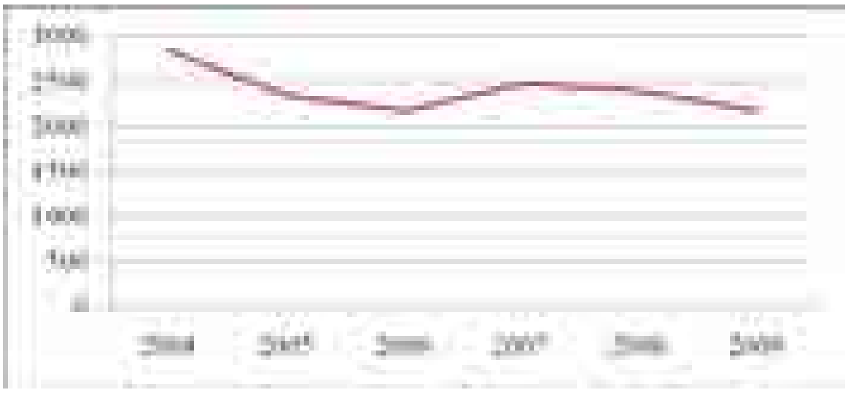


Figure 7.2.1: Total reported crime for central Namib town districts (Walvis Bay, Swakopmund, Arandis, and Usakos)

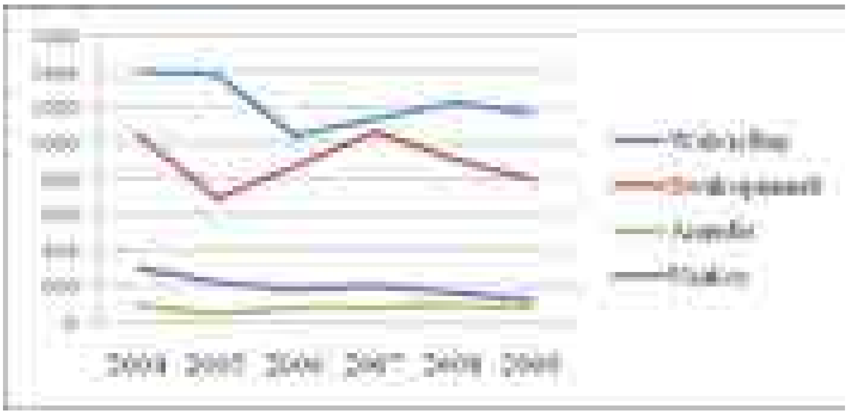


Figure 7.2.2: Total crimes reported for the four town districts in the central Namib

This improvement can be partly attributed to the increase in community policing which was initiated in 2007 (van Staden *pers. Comm.*). Communities partner police in patrolling areas of concern, and develop and implement crime prevention activities which complement official police operations. Changes in command in the regional structure since 2007 have led to greater efficiency in the use of available resources, which further contributed to the decrease in crime experienced over the past two years. The approach to law enforcement has changed from one of crime control to crime prevention (Shilongo *pers. Comm.*).

At the last census in 2001 it was calculated that there were 180 residents to each law enforcement official, and that this figure is still valid (Shilongo *pers. Comm.*). This compares favourably to the rest of Namibia (average ratio 492:1). The average ratio for South Africa at the same time was 408:1 (ISS Crime index, 2000).

7.2.1.3 Property and erven availability in towns

<u>Availability of land</u>

Swakopmund is sought after for property investment, and sustained property price increases make this coastal resort largely unaffordable to low income earners. The municipality plans to make 2,000 erven available to accommodate the expected influx of people due to the Uranium Rush, and to collaborate with the private sector (including mining companies) to develop the erven. The planning and servicing of new erven will take an estimated three years before they will be ready for construction of housing. In a special effort to accommodate low-income earners, the National Housing Enterprise (NHE) and the Municipality have entered into a contract to further extend Mondesa township, while discussions are underway to establish a Progressive Development Area for low cost housing. In addition, planning is underway for 850 erven to be developed in the so-called DRC township area. The Swakopmund Development Master Plan envisages the following intended housing extensions: Kramersdorf East, Northern Tamariskia Precinct, Northern Mondesa Precinct, Rossmund, and Mountainview Precinct. The Smallholdings will not be allowed to subdivide or be developed into housing estates in the short to medium term.

Figure 7.2.3: Swakopmund Structure Plan (SIAPAC, 2002)

Usakos has a stagnant economy and a small and relatively inactive property market. The municipality has approximately 200 serviced erven and an unknown number of unserviced erven that may be allocated to the mines for housing. The municipality has adequate land available but lacks financial resources to service the land. For low-income earners, the NHE has shown interest in providing the necessary support to acquire houses, while a Build Together Programme is administered by the municipality.

Walvis Bay is growing rapidly (5% per annum) as a result of current and proposed new developments. The Municipality recently allocated approximately 900 erven to the NHE to develop. Another 100 have been allocated to smaller groups (savings schemes) of local people. In Kuisebmond and Narraville approximately 300 erven are being serviced and made available. The Walvis Bay Municipality intends extending Meersig, Kuisebmond, Narraville and the CBD, and developing an upmarket golfing estate.

Figure 7.2.4: Walvis Bay Structure Plan (SIAPAC, 2002)

Plate 7.2.3: Servicing of erven in Kuisebmond, Walvis Bay (photo M. Hauptfleisch).

Arandis was established in 1976 by Rössing to cater for its low-income employees. The property market in Arandis is relatively inactive, but this is expected to change as more people move to Arandis because of the availability of affordable housing. The Town Council is trying to diversify its economy by providing additional plots for industrial, commercial and residential developments. Affordable land will be offered to mainly the lower and middle income segments of the community, and mining companies are being encouraged to initiate developments at Arandis (see section 7.2.2.1).

Table 7.2.1: Total available erven in towns and expected demand from Scenario 2 of the Uranium Rush

Town	Commercially available houses and erven (July 2009 survey)	Erven being made available by municipalities	Expected new erven required to service the Uranium Rush (estimated from scenario 2)	Percentage of demand met by current and planned erven and housing
Swakopmund	642	2,850	3,906	89%
Walvis Bay	550	1,300	516	100% +
Arandis		No formal plans	900	0 %
Usakos		200+	516	39%
Total	**1,192**	**4,350+**	**5,977+**	**93%**

Table 7.2.1 shows the planned availability of serviced erven in towns of the central Namib. As can be seen the expected demand of the Uranium Rush scenario 2 seems to be nearly met through available housing and planned developments. However disproportionate developments in different income categories of houses and erven, as well as a shortage of low cost housing in Arandis and Usakos, are a cause for concern. Section 7.2.2.3 below elaborates on this.

Property for sale and rent

The properties in the various categories for sale and rent in June 2009 are illustrated in Figure 7.2.5. These graphs show that the majority of available erven at the coast are mostly in the high and middle-income categories, while the poor majority continue to have an unmet demand. There was a shortage of low-income properties to rent in Swakopmund during the survey period, and none available in Walvis Bay.

The average waiting time for selling a property in mid 2009 was about 2-4 months. In Windhoek it was roughly the same, but it could take up to 12 months.

Figure 7.2.5: The number of properties for sale by town and category (left graph) and available for rent (right graph).

Trends in property prices

In all three towns, house prices in all categories have increased sharply over the past 3 years and are predicted to continue increasing in the future (Figure 7.2.6)[2]. Determination of house prices in the low income price category was difficult as there is not an active buy-sell market. This is partly as a result of buyers in this price category finding it difficult to get financing. Municipalities and programmes such as 'Build Together' and the National Housing Enterprise (NHE) are more influential in movements in low income housing than the free-market system.

The price trends of **erven** were difficult to analyse because of the varying price regimes adopted by the market for this category of property. It was not possible to use the norm (price per square metre) because the market uses mainly auctions, both public and silent, in handling erven. In Swakopmund, erven are sold by the municipality to private individuals only through public auction. Consequently the average prices for erven shown in Figure 7.2.7 are a combination of the various methods used to value erven in the market.

The trend shown is a slow rise in prices in the past 3 years followed by a sharp rise for the projected 5-year timeline. The highest increases were expected for erven in the high income category for Walvis Bay (N$525,000 to about N$1,600,000). A general observation was that erven are currently out of reach and will continue to be out of reach of the majority working class.

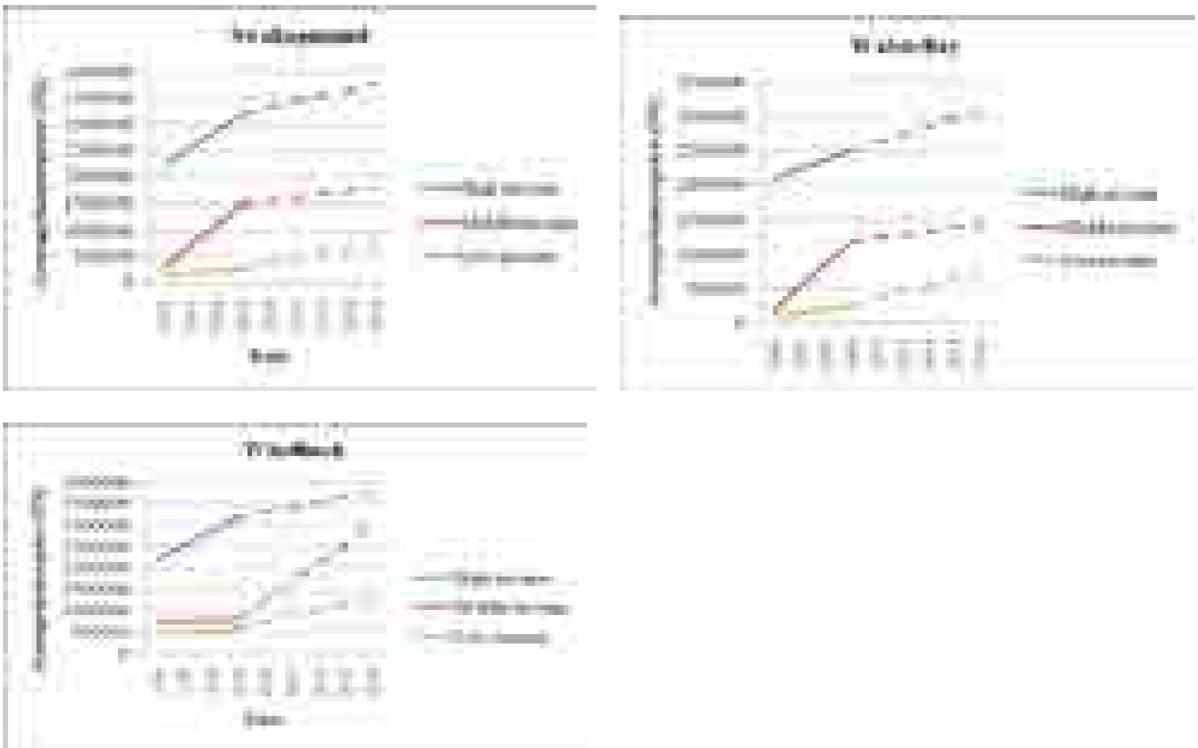


Figure 7.2.6: Past and predicted future price trends for houses

[2] Middle and high income category prices were determined through estate agent interviews, while low income category prices are based on average house price estimates by municipal development officials.

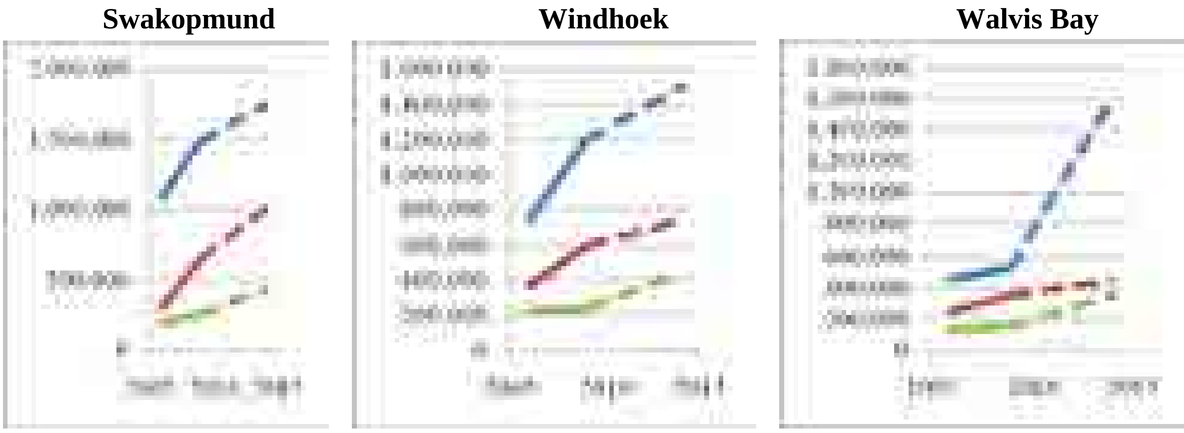


Figure 7.2.7: Long-term erven price predictions (blue/top line = high income areas, red/middle line = middle income and green/bottom line = low income).

7.2.1.4 Waste management

Waste likely to emanate from the mines and associated industries can be divided into three main types:

- General domestic waste, a broad category consisting of normal household waste from domestic sources as well as businesses and industry;
- Special waste, referring to large volume waste such as building rubble, obsolete machinery and garden refuse; and
- Hazardous waste, which refers to waste composed of hazardous substances defined in the draft Pollution Control and Waste Management Bill as '*any pesticide, herbicide or other biocide, radioactive substance, chemical or other substance and any micro-organism or energy form that has properties that, either by themselves, or in combination with any other thing, make it hazardous to human health or safety, or to the environment, and includes any substance, micro-organism or energy form defined as a hazardous substance in (future) regulations'*.

Although general domestic waste and special waste can both be classified as non-hazardous waste, the distinction between them is due to the fact that there are separate disposal facilities for these two types of waste.

<u>Domestic waste</u>

If the uranium mines practise recycling of all non-hazardous wastes such as paper, glass, plastic, wood, cardboard etc, then the remaining volume of domestic waste which needs to be disposed of at official municipal landfills will be very small. However, there will be a significant increase in the number of people living in the coastal towns who will add to the municipal waste stream.

<u>Special waste</u>

High volumes of special waste in the form of discarded machinery, building rubble and scrap metal are produced by mines. Much of this waste is stored in salvage yards where it is re-used on site or recycled through scrap metal dealers. Disposal sites for domestic and special waste exist in Swakopmund, Walvis Bay, Arandis and Usakos. These sites were designed to support the disposal of both these types of waste from the towns only and have not made provision for increased volumes of waste as a result of mines specifically. Walvis Bay is expected to have sufficient capacity to meet expected increases for the next 20 years but does not have a quantified estimate of waste volumes from the mines. The Swakopmund landfill is approximately 150,000m^2 in area, has sufficient capacity for the next 10 years and can expand at minimal cost and effort when required. Usakos has a landfill site which is currently uncontrolled and unfenced. No waste separation takes place at this site and there is a concern that even current volumes cannot be adequately contained.

Best practice requires that waste should be managed according to the waste management hierarchy of avoidance, reduction, recycling, treatment and disposal. This implies that low volumes are expected to be disposed of in landfills. Mines have on-site landfills for the low volumes of domestic waste, and salvage yards where special waste such as material off-cuts, and scrap metal are stored for re-use or reclamation by scrap dealers. To comply with the proposed regulations of the draft Pollution Control and Waste Management Bill, any on-site landfill for domestic waste would need to be licensed, or alternatively, waste needs to be taken to the nearest licensed municipal landfill site.

<u>Hazardous waste</u>

The uranium mines produce different types of hazardous wastes, such as explosives (e.g. old detonators), flammable liquids and solids (oil, solvents, sulphur dust), oxidising (e.g. sulphuric acid), toxic and infectious substances (e.g. medical wastes from the mine clinics), radioactive materials (mining and process plant wastes, depleted radioactive sources etc), corrosive substances such as caustic soda, sodium bicarbonate, and miscellaneous dangerous substances such as fluorescent tubes, tyres, vehicle batteries, etc.

Much of this waste is recycled either back via the suppliers e.g. spent chemical containers and depleted radio-active sources, or through specialist waste recycling companies e.g. oil, batteries. The large volumes of low-grade radioactive mining waste such as low grade ore, depleted tailings and heap leach residues are disposed of on licensed sites at the mines. The management of these radioactive mine wastes is governed by a new, separate policy and legal regime – the Atomic Energy and Radiation Protection Act, 2005 and its Regulations for the Safety and Secure Management of Radioactive Waste (see Chapter 6). At present there are only two hazardous landfills in Namibia: at Kupferberg near Windhoek and at Walvis Bay. The City of Windhoek is reluctant to accept hazardous waste generated in other parts of the country and hazardous waste is only accepted by prior arrangement.

The Walvis Bay waste disposal site is owned and managed by the Water, Waste and Environmental Management Department of the Walvis Bay Municipality, and comprises hazardous and non-hazardous sections. The Walvis Bay site is the nearest hazardous landfill for the waste which will emanate from the uranium mines and related industries in the central Namib and thus is the most critical in terms of capacity constraints.

The Walvis Bay hazardous waste landfill, built in 2001/02, was designed and constructed as an H:h landfill with a triple lining, leachate collection drains and pollution control systems. The site accepts all classes of hazardous waste except radioactive waste. There are strict controls at the site including security fencing, a weighbridge and all waste consignments are inspected and recorded on entry by a Hazardous Waste Inspector in terms of source, volume and types of waste.

The Walvis Bay site has a total volume of 4,500 m^3. It is currently about 25% full, (i.e. there are 3,375 m^3 available), but it has been designed so that it can be expanded upwards.

7.2.2 Analysis of cumulative impacts

7.2.2.1 Impacts on Sense of Place

As a result of the Uranium Rush, and particularly under Scenarios 2 and 3, it is highly likely that an industrial area will develop just north of Swakopmund, and include chemical and fertiliser plants, a desalination plant, salt and other mines (some already there), more powerlines and extended railway infrastructure. There will be housing developments to the north and east, and at least three new shopping centres, additional schools, increased traffic, less parking, more noise and congestion. Perhaps the 'holiday' atmosphere of central Swakopmund can be maintained, but the ambience in outlying areas will be different.

Walvis Bay will continue to grow rapidly as an industrial hub, with port expansion, new power stations, increased heavy traffic, and housing extensions both eastwards and northwards, inevitable. The pressure for more areas for beachfront properties will intensify and it seems likely that the Walvis Bay-Swakopmund coast will become more developed. Also, it seems probable that high-rise apartments will be constructed in this area as space becomes limited.

The volume of traffic on all Erongo roads will increase, with areas of greatest concern being between Walvis Bay and Swakopmund – a stretch of road already notoriously dangerous, the B2 to Windhoek and the C28 gravel road (see Section 7.3 for greater analysis).

Towns such as Henties Bay and Wlotzkasbaken will probably remain holiday destinations, but additional erven will be developed at both localities and their seasonal populations will increase significantly. By contrast, Uis and Karibib may not change much because they are further away from the zone of influence.

It is hoped that new investments will be made in Arandis and Usakos. These are the two towns where the Uranium Rush could radically improve socio-economic conditions, through for example:

- An increase in population and employment;
- Improved spending power;
- More shops and services (banks, garages, internet cafes);
- Improved health care facilities (clinics, ambulance services);
- Industrial developments, e.g. the proposed soda ash plant at Arandis;
- Increase in SMEs and support service industries;
- Development of a transport hub at Arandis;
- Possible development of a recycling centre for the entire region at Arandis.

These developments and others are likely to transform towns like Arandis and Usakos and thus place their economies onto a more sustainable footing.

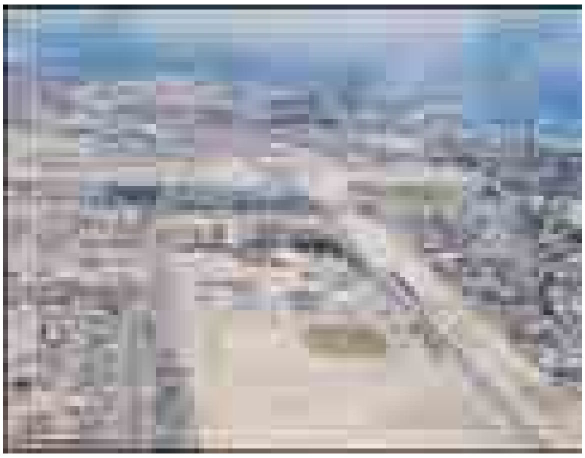


Plate 7.2.4: Urban expansion in Swakopmund (left) and construction of the jetty at the Wlotzkasbaken desalination plant (right). These examples of urban expansion are unavoidable consequences of the Uranium Rush, yet should be planned and designed for least negative impact (photo P.Tarr).

7.2.2.2 Impacts on crime in the central Namib

As mentioned above, the expected influx of labour to the uranium mines and the increase in revenue and disposable income for people in the area may lead to an increased incidence of crime in the following ways:

1. The populations of towns in the area are expected to increase. This is as a result of an influx of more than 3,000 direct mine employees under Scenario 1 (see Table 4.3 in Chapter 4), more than 6,000 employees under Scenario 2, and >7,000 employees in Scenario 3. With an average of four dependents per employee, a total increase of up to 28,000 people can be expected as a result of direct employment at uranium mines. In addition to this there is likely to be an influx of aspirant workers looking for employment opportunities in the area. Mining support industries, social services and retail businesses are likely to add to the population expansion as they increase their workforces to satisfy mining service industry requirements. The increased population is expected to cause a proportional increase in crime;

2. Unemployed job-seekers attracted to the area may become disillusioned if they do not find employment at the uranium mines, and may turn to crime;

3. The Uranium Rush will increase the amount of disposable income, assets and cash circulation and this is likely to attract organised crime into the region;

4. The increase in disposable income for mine employees may increase spending on social ills such as alcohol abuse and commercial sex (Trekkopje, 2008) for which recent trends are indicating an increase in incidence already.

In addition to an increase in crime, it is expected that the types of crimes committed may change. According to SADC (2004) most mining employees are males between the ages of 18 and 49 and are often migrant workers residing in isolated areas with few recreational activities, which encourages prostitution. This is especially true when workers are housed in hostels at the mines, rather than being integrated with their families in the local towns.

7.2.2.3 Impacts on the availability of affordable erven and houses in towns of the central Namib

The expected influx of people into the Erongo region will include those employed in the formal and informal sector, as well as job-seekers. Those who cannot buy a house will rent, exacerbating the existing shortage of houses for rent. Given that rental prices in towns like Swakopmund are already prohibitive for mine workers of the lower grades[3], they and the unemployed will seek properties in low-income areas. Consequently, there is likely to be an increase in demand for housing in the smaller towns such as Arandis and Usakos, where fewer serviced erven/houses are available. This in turn could also lead to an increase in land and house prices in those towns.

The main concerns are that the low-income market is already too highly priced for this group, their spending power (at individual level) is limited and the Uranium Rush will result in increased demand. A further problem is that erven prices are unaffordable. Even if land is made available at a subsidised price, escalating building costs are inevitable. Even locally available materials (e.g. building sand) will likely double in cost in the near future (currently N$120/$m^3$) because local sources (the lower Swakop River) are depleted/ unavailable, and more distant, alternative sources may require expensive transportation.

Housing shortages and escalating prices will likely lead to an increase in the number of informal housing developments[4] and increased demand for services from the municipalities. In the long term, current property development plans will have been implemented, and prices will stabilise.

Middle and high-income employees will likely prefer to live in Swakopmund and Walvis Bay, where housing shortages are expected in the short term. In the long term, there should be a stabilisation and greater availability of property for these categories, as property owners and developers make properties available.

7.2.2.4 Impacts on waste management

The mines and associated industries themselves will not contribute much to the domestic/special waste streams of the local towns, but the likely significant increase in population (as described above) will mean that there will be a concomitant rise in the amount of domestic waste. This will put pressure on existing landfills at all the towns, as well as on the ability of the municipalities to cope with the greater waste stream in terms of staff resources, waste removal vehicles etc.

No figures are available regarding the estimated quantities of hazardous wastes that may be generated by the mines directly and the amounts that may be generated by new or expanded related industries in the coastal area, and so it is unknown whether there is sufficient space available for the anticipated increase.

[3] For example, RUL grade 2-6 workers earn approximately N$6,069 – N$8,164, inclusive of housing allowance which ranges from N$2,230 – N$2,510; grade 10 and above earn N$13,967 – N$29,899 inclusive of housing allowance of N$3,479 – N$4,750

[4] These will be occupied by people who have been out-priced by the increase in the rental prices as well as those who have recently arrived in these towns.

7.2.3 Desired state

The desired state in terms of sense of place is that towns in the central Namib develop as a result of the economic impacts of uranium mining, but do not lose their particular character or attractiveness, causing quality of life to decline. This implies that Swakopmund and Henties Bay retain their 'holiday town' ambience through creative planning and provision of adequate services. Distribution of economic and social benefits should be reasonably even throughout, ensuring that Arandis and Usakos gain sufficient economic and social benefits to become sustainable towns. To this end, mine worker hostels on the mines should be actively discouraged, such as those being planned at Valencia.

Towns in the central Namib should remain safe, or even become safer as a result of the Uranium Rush. Stable or even reduced crime incidence should be seen in the town districts of the central Namib despite an increase in the population of the region as a result of the Uranium Rush.

Erven and houses in towns of the central Namib should be available and affordable. Every Namibian should have a fair opportunity to acquire serviced land in the Erongo Region, and have access to acceptable shelter in a suitable location at a cost and standard which is affordable to the individual on the one hand and to the country on the other.

Every effort must be made to re-use, recycle and minimise the expected domestic, industrial and hazardous waste streams. This needs to be encouraged through the availability of recycling sites e.g. at Arandis, financial and other incentives. However, there will still be waste that needs to be disposed of in a municipal landfill. This waste needs to be managed in a safe, responsible and legally-compliant manner, meaning that there needs to be sufficient capacity in the existing licensed waste disposal sites to accommodate the amount of waste that will be generated by the mines and urban residents without causing pollution to the air, soil or water.

7.2.4 Recommended avoidance / mitigation or enhancement measures

7.2.4.1 Impacts on Sense of Place

Town planning should include zoning restrictions which need to be upheld to ensure that inappropriate and conflicting land-use and development is not allowed. In addition, planning safeguards need to be in place and enforced to avoid fast tracking and circumnavigation of due process. The use of EIA as a planning tool cannot be overemphasised.

Basic social infrastructure (shops, schools, sports facilities, parks, police, health facilities, ablutions, waste removal, sewerage systems) must keep pace with urban expansion. Competent town planning should be supported by the mining companies to ensure that social infrastructure remains adequate regardless of the increases in population expected under Scenarios 2 and 3. This is especially true for the smaller towns of Arandis and Usakos.

7.2.4.2 Impacts on crime

Recent trends of involving communities in crime-fighting initiatives have proven to be successful; any community initiatives should be promoted and supported by mining companies associated with the Uranium Rush.

Uranium mining companies should, as part of their initial planning phase, include community policing and crime prevention into their security and social structures. This should be done in collaboration with the regional police, local authorities and political parties, to ensure integration with and strengthening of crime prevention activities in the area.

7.2.4.3 Impacts on availability of erven and houses

The following recommendations are made to ensure that a sufficient number of houses and erven are available for purchase and rent respectively.

Town planning (Integrated Development Planning)

Integrated Development Planning is a key principle that should be used to ensure that town planning pro-actively makes available serviced erven for property development in all the Erongo towns. Zoning plans need to be drawn up to ensure that development is planned in an orderly fashion and that conflicting land uses are avoided.

Private-public development partnerships

To mitigate the impacts of increased demand for property from Scenarios 2 and 3 of the Uranium Rush, private property owners may not have a major role to play. The onus is on parastatals such as the National Housing Enterprise (NHE), the government run Build Together programmes and the uranium industry to provide affordable housing for particularly the low-income group. They need to work together with municipalities to ensure that serviced land is made available at reasonable cost to limit the negative impacts of the Uranium Rush.

Affordability of house prices

Estate agents need to advise their clients in a responsible manner about the sale price of their houses – typically within 10% of the bank valuation, to ensure that prices of houses remain affordable. This is a very difficult mitigation measure to implement in a free-market system, however trends in houses not being sold within four months of being offered, and house prices exceeding bank valuations by more than 10% would indicate artificial inflation of prices. Mining companies should not be allowed to dictate prices by monopolising preferred suburbs. Instead, social conscience should be pursued by investing in less desirable suburbs or towns (e.g. Usakos and Arandis), thereby aiding in improving the housing market in these areas.

Quality of housing

Municipal building inspectors need to ensure that houses built are structurally sound through appropriate design and professional building. Particularly with high volume low-income housing development there is a temptation to skimp on building quality in order to gain time and improve profits. This will require frequent inspections by the relevant authorities.

Availability of building materials

Raw materials (e.g. sand, stone, water) need to be readily available for development without causing undue environmental damage. Sand mines and stone quarries should be identified and established in appropriate areas using effective planning and EIA processes. The mining of these materials needs to take place in a formalised fashion with EMPs in place.

7.2.4.4 Waste management

It is recommended that the municipalities should proactively determine (in conjunction with each mine) the potential waste quantities which may be generated over the next 20 years and make plans and budget for an increase in disposal capacity – for all categories of waste.

All waste site managers need to be properly trained and competent and the municipalities must have sufficiently qualified staff resources to manage their waste sites in a safe, responsible and legally compliant manner.

All new waste sites (whether at the mines or in towns) must undergo an EIA and receive a licence to operate.

A sustainable waste recycling depot needs to be opened in the central Namib e.g. in Arandis, servicing the uranium mines and residents, in order to reduce the volumes of waste needing disposal.

7.3 Cumulative Effects Analysis – Transport Infrastructure

This analysis of the cumulative impacts of the Uranium Rush on transport infrastructure encompasses the following components: roads, railways, Port of Walvis Bay and airports.

7.3.1 Introduction

7.3.1.1 Roads

The national road network connects the Erongo region to the rest of the country via Okahandja, Windhoek and Otjiwarongo. The trunk roads between Windhoek, Okahandja, Swakopmund, Walvis Bay and Omaruru are tarred. Other major connections are gravel or salt roads (see Figure 7.3.1).

The roads in the central Namib are pivotal in several respects i.e.:

- Regional and national economy – Walvis Bay harbour forms a vital transport node on various international and regional trade routes. The main road from Walvis Bay via Swakopmund to Usakos (B2) forms part of the strategically important Trans Kalahari and Trans Caprivi corridors.
- Mining – roads link Walvis Bay harbour with the mines providing essential linkages for the import of raw materials and the export of uranium oxide. The roads are also the only link between the mines and the towns (accommodation, hospitals, schools etc.).
- Tourism – the majority of tourist destinations in the central Namib are in fairly remote locations and can only be reached by road or air. Most of the tourist activities are thus dependent on good quality roads, particularly the C14 between Walvis Bay and Solitaire, the D1982 between Windhoek and Walvis Bay over the Us pass, the C28 between Windhoek and Swakopmund over the Bosua pass as well as the B2 between Usakos, Swakopmund and Walvis Bay.

It is clear from the above that some roads are currently catering for a range of different traffic users:

The B2 from Walvis Bay to Swakopmund is highly congested with heavy port traffic, commuter traffic between Swakopmund and Walvis Bay, and tourists. In 2008, total traffic volumes on this road were estimated to be almost 4,700 vehicles per day and numbers have been increasing by 5% per year over the last 9 years. This is a tar road, with some passing lanes, but the differential traffic speeds and foggy conditions make this road very dangerous.

The B2 from Swakopmund inland up to Arandis and Valencia also carries a high volume of mixed traffic: heavy-duty port traffic, heavy-duty mine-bound traffic to Rössing, Trekkopje and Valencia, mine commuter traffic (buses and cars), delivery vehicles, and commuter traffic between Windhoek and the coastal towns. Traffic counts for the section of road between Swakopmund and Arandis show that the average daily traffic volume (light and heavy vehicles) in 2007 was 1,842. The counts are directional (eastbound), and it can be assumed that on average, the westbound daily directional volumes are similar. This road is tarred but it is deteriorating badly due to the increasing volumes of heavy traffic, especially on the stretch up to Arandis. There are no passing lanes and visibility along the first 50 km from the coast is often poor due to the fog.

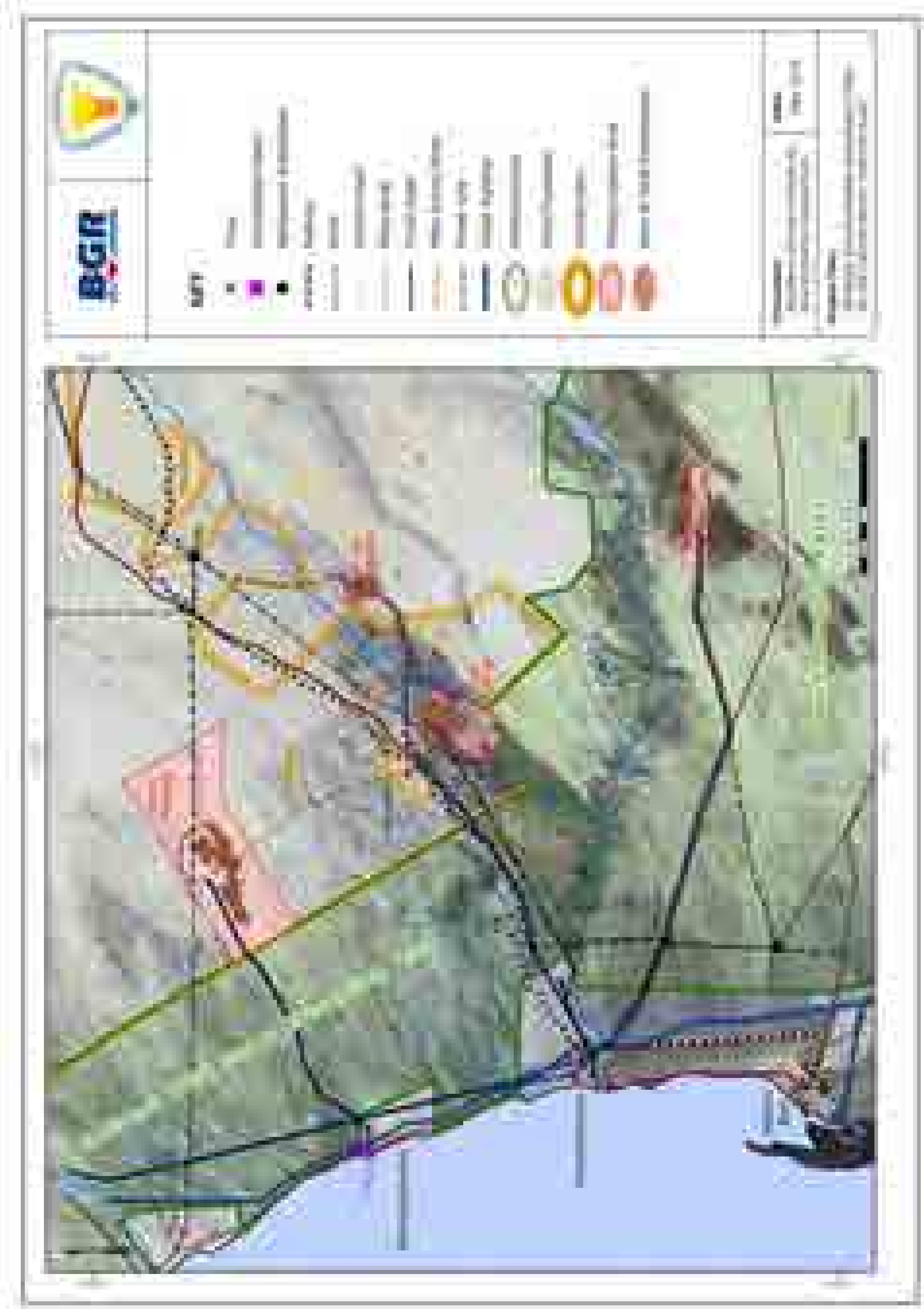


Figure 7.3.1: Scenario 1 – existing and planned infrastructure

The C28 from Swakopmund across the Namib-Naukluft Park to the Bosua Pass is busy from Swakopmund to the Langer Heinrich turnoff with a combination of heavy duty trucks making deliveries to and from Langer Heinrich, exploration drilling rigs and bakkies belonging to Bannerman, Reptile, Swakop Uranium and others, and tourists in self-drive and tour vehicles visiting the Moon Landscape and Welwitschia Flats. In 2008, an average of 177 vehicles per day was counted on this section of road. There is little through traffic to Windhoek. This road is a gravel road and therefore very dusty, but Langer Heinrich funded the tarring of 1 km long stretches to facilitate passing up to their turnoff. Although this road is on a scheduled grading and maintenance programme, the additional volumes of traffic from the Uranium Rush has meant that the road surface deteriorates quicker than it can be maintained, making it unpleasant and unsafe for tourists and other road users.

The C34 from Swakopmund north along the coast to Henties Bay is a salt road with an average of nearly 500 vehicles per day counted in 2008, due in part to an increase in heavy and light delivery traffic associated with the construction of the desalination plant at Wlotzkasbaken, uranium prospecting to the north, salt transport from Cape Cross, as well as tourists and recreational anglers.

It is clear from the above that the roads are struggling to cope with the current traffic volumes and some major construction work will be required in the next 3 years to accommodate the anticipated volumes of traffic during the construction of the mines and associated industrial developments. The projects currently envisaged by the Roads Authority (RA) over the medium term (5-10 years) are the following:

- Upgrade and surfacing of the C34 from Swakopmund – Henties Bay;
- Rehabilitation and widening of the B2 coastal road from Swakopmund – Walvis Bay;
- Upgrade and surfacing of the D1984 from Swakopmund to Walvis Bay (road behind the dunes) (Figure 7.3.1). This latter project is considered to be a priority in terms of this SEA. All heavy vehicles (except local traffic) should be directed to use this ‘new’ road, in order to relieve the congested and dangerous situation along the coastal road.

All of these projects will be subject to feasibility studies. A general guideline used to justify the surfacing of any particular road is when the daily traffic count exceeds 400 vehicles per day[1]. This however is only a guideline and depends on the composition of the traffic as well as the frequency of traffic peaks. At the moment, the RA does not anticipate any specific road upgrades to cater for the Uranium Rush. The strategy is to do regular traffic counts and to plan upgrading according to condition monitoring and the outcome of the traffic counts, i.e. reactive planning.

Unfortunately, it would appear that these upgrading projects may be too late for the peak construction period (2011-2013) and therefore there will be some significant cumulative impacts (see section 7.3.2).

7.3.1.2 Railways

The existing rail infrastructure traversing the project area consists of the single track linking Walvis Bay, Swakopmund to Usakos and then to Omaruru and Karibib respectively (Figure 7.3.1). This track

[1] Pers. Comm. Jean Nsengiyumwa, Roads Authority

is the only rail link from Walvis Bay to all inland destinations as well as several regional trade and freight corridors. The major function of this rail infrastructure is for the transfer of imported freight and fuel inland from Walvis Bay and export freight from inland to Walvis Bay.

A spur line connects the Rössing mine to the nearby mainline allowing the majority of freight to and from Rössing to be transferred by rail (Figure 7.3.1). The main commodities include sulphuric acid, fuel, manganese and uranium oxide (product). The proposed new mines will also need to import bulk raw materials, the composition of which will vary according to each mine's process plant requirements. At present all reagents and fuel are imported through Walvis Bay harbour, but a private entrepreneur, Gecko Chemicals is currently conducting feasibility studies into the construction of various chemical plants to produce the required reagents, such as sulphuric acid, caustic soda, soda ash and bicarbonate. Irrespective of whether Gecko goes ahead or not, various options are being investigated by the mining companies to transport the bulk products to the process plants. One of the options being investigated is the use of rail. The possible new rail links being considered are shown on Figures 7.3.2 and 7.3.3 and include:

- A 28 km rail link between the existing line (east of Swakopmund) to the proposed Gecko chemicals plant (near Wlotzkasbaken) (see Section 4.4.3);
- A roughly 22 km rail link from the Rössing spur line to Rössing South;
- A roughly 30 km rail link between the existing railway east of the dunes to Etango;
- The potential to extend the above eastwards to the possible future Tumas-Tubas plant (at a site not yet determined).

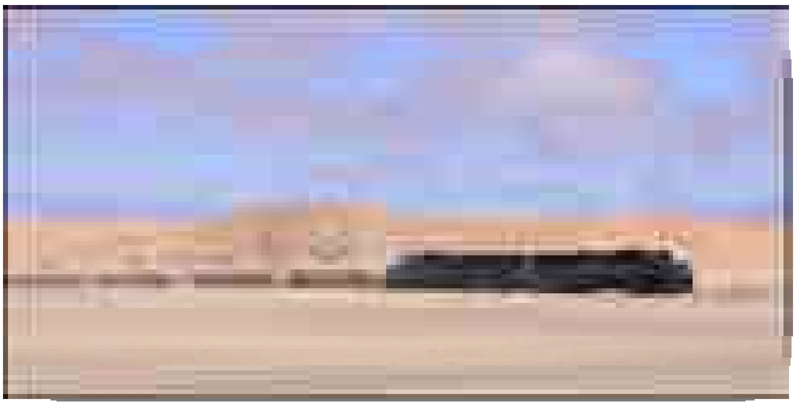


Plate 7.3.1: Train transporting chemicals in the central Namib (photo P.Tarr).

The potential for rail-road and rail-pipe freight transport is being investigated, especially to those mines lying close to the existing railways i.e. Trekkopje, Valencia and Rössing South from the main east bound line, and Etango and Langer Heinrich from the north-south line behind the dunes. This would entail the construction of new sidings, shunting areas and rail-road or rail-pipe transfer facilities. The cumulative impacts of this proposed infrastructure are discussed in section 7.3.2 below.

7.3.1.3 Port of Walvis Bay

Walvis Bay has the only deep-sea harbour in Namibia and is of strategic importance for the south-west African coastline and many land-locked countries in southern Africa. The harbour is regarded as 'port friendly' due to minimal climate-related delays, relatively calm seas, low congestion, and reasonable handling efficiency. Strong growth has been experienced in the volume of cargo passing through the Walvis Bay harbour, most of this destined for Botswana and Zambia.

Walvis Bay receives approximately 1,200 vessel calls each year and the port handles approximately 2.5 million tonnes of cargo per annum. The Port has experienced an increase of 37% in containers and a 13% growth in total freight tonnage over the last 5 years. The volume of chemicals imported for the mines as well as the volume of mined product (uranium) will increase proportionately with the accumulated production of all mines – indeed mine output could more than quadruple in the next 5-10 years (see Table 4.3 in Chapter 4). However, at present the volume of cargo associated with the uranium mines is relatively small compared to the total volume of cargo handled and shipped through the Port of Walvis Bay[2]. Even if the proposed Gecko Chemical plants supply the mines with process chemicals locally, there will be a demand for increased port capacity to import sulphur, coal and other bulk raw materials to meet the expected higher demands from the mining industry. This could have an impact on port activities, handling times and port infrastructure.

Another option being investigated by Gecko is the construction of a jetty between Swakopmund and Wlotzkasbaken. This jetty would only be for the import of bulk materials and would relieve congestion at Walvis Bay.

Nevertheless, NamPort is currently updating its Master Plan to cater for developments over the next 5-10 years, including the possibility of bulk coal imports for a coal-fired power station or a CNG terminal (see section 7.5). Possible projects include the deepening of the berths, turning basin and approach channels, as well as the expansion of the container terminal facilities to allow for larger container vessels at more berths. The need for this expansion is driven by the fact that the existing facility will reach its full capacity by 2011. The lack of availability of industrial land in the harbour (and Walvis Bay) is a major concern and any potential expansion will have to consider this limitation.

7.3.1.4 Airports

The main airport at the coast is the Walvis Bay International Airport and there are various other small public and private airstrips.

Since fresh fish is exported from Walvis Bay, the Walvis Bay airport has recently been upgraded to accommodate wide body aircraft flying directly to and from Europe. In addition, the airport is in the process of installing state-of-the-art, world class landing instrumentation that will enable flights to take off and land even during low cloud and foggy conditions, which frequently affect the airport.

The smaller airports (especially Swakopmund) service the tourism industry, which includes a growing number of tourists taking scenic flights over the desert and participating in extreme sports such as skydiving.

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[2] Pers. comm. Elzevir Gelderbloem, Namport.

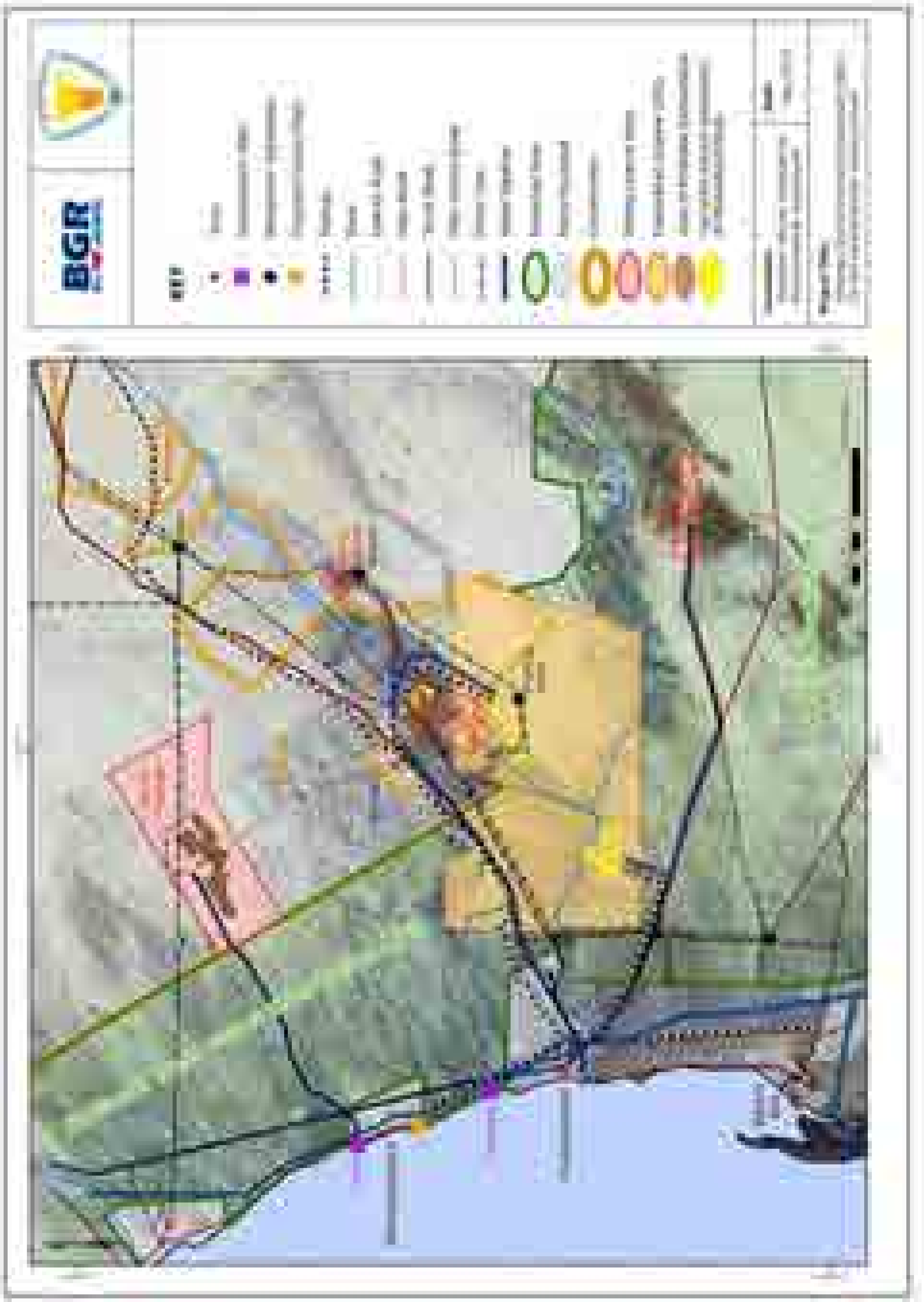


Figure 7.3.2: Scenario 2 Infrastructure (existing and planned)

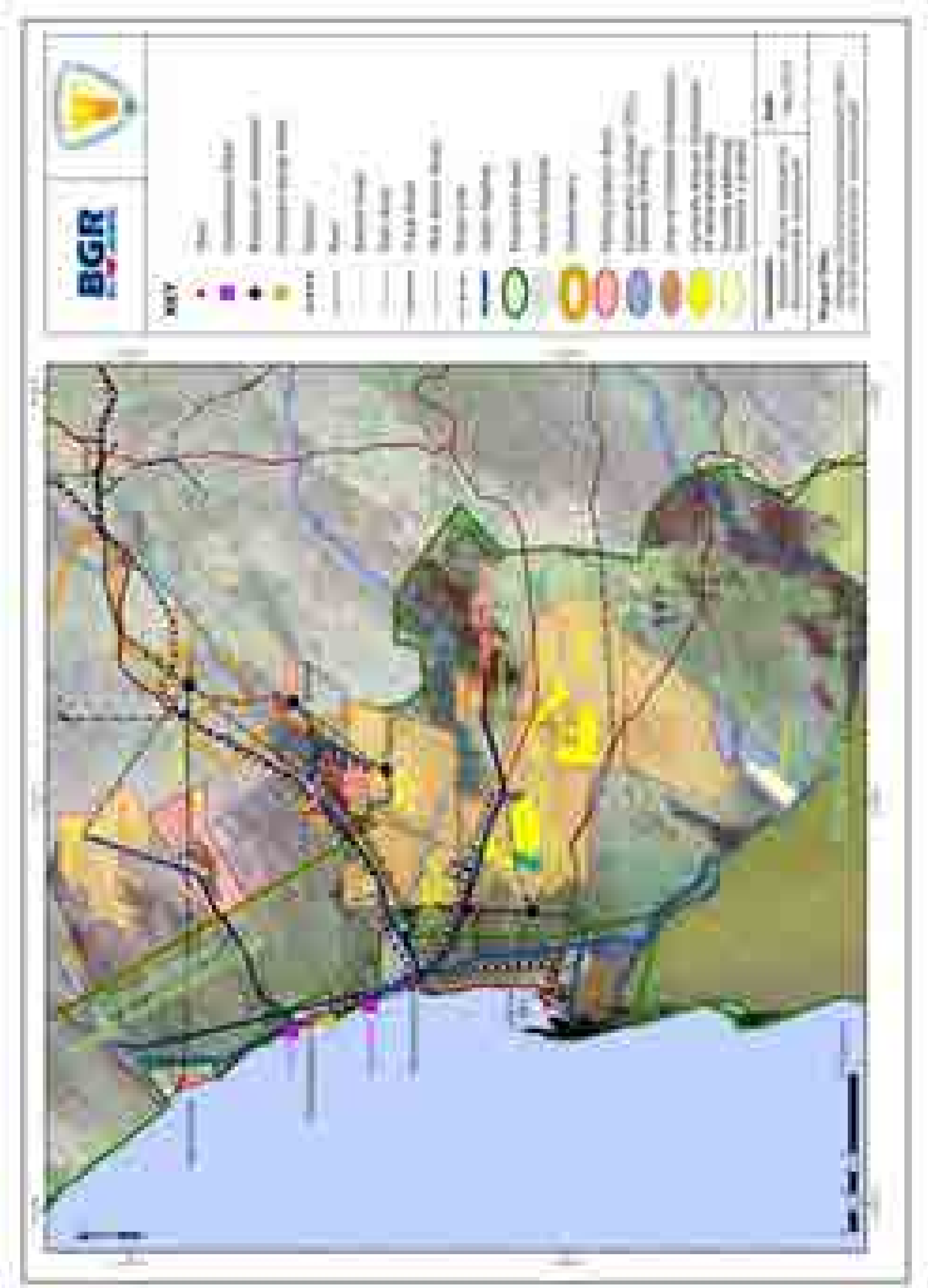


Figure 7.3.3: Scenario 3 Infrastructure (existing and planned)

The proportion of air passengers and cargo related to the uranium industry is fairly small relative to overall air traffic in the region, therefore the airport infrastructure is unlikely to be affected significantly by the Uranium Rush. Some of the smaller airstrips (e.g. near Arandis) may see some upgrades due to a potential increase in the number of mine-related private charters.

7.3.2 Analysis of cumulative impacts

The analysis of the cumulative effects of the Uranium Rush on the roads, railways, port and airports is described below and shown schematically in Figures 7.3.1, 7.3.2 and 7.3.3. It should be noted that the routes for all planned infrastructure are merely indicative at this stage to provide an idea of what impact the provision of infrastructure to the mines will cause.

7.3.2.1 Roads

The cumulative effects of the Uranium Rush on the roads essentially fall into two categories: increased volumes of traffic and demand for new road infrastructure.

Traffic volumes on the B2, C28 and C34 are expected to increase considerably as a result of the Uranium Rush, particularly under Scenarios 2 and 3, as shown in Figures 7.3.4, 7.3.5 and 7.3.6. These graphs compare current and projected normal growth in road traffic based on past trends and the cumulative increase of total construction and operations traffic. It can be seen in Table 7.3.1 that the highest increase in traffic volumes from the 2008 baseline will be on the C28, with a 72% and 80% rise in traffic numbers under Scenarios 2 and 3 respectively. As noted above, this road is unsurfaced and not built to withstand heavy loads and therefore it is likely to deteriorate very quickly. The volumes of traffic on the B2 between Swakopmund and Arandis may increase by 59% due to uranium-related traffic and normal traffic increases. However one of the biggest issues will relate to the number of buses during peak shift-change hours, given that there might be four mines using this road (Rössing, Valencia, Rössing South and Trekkopje).

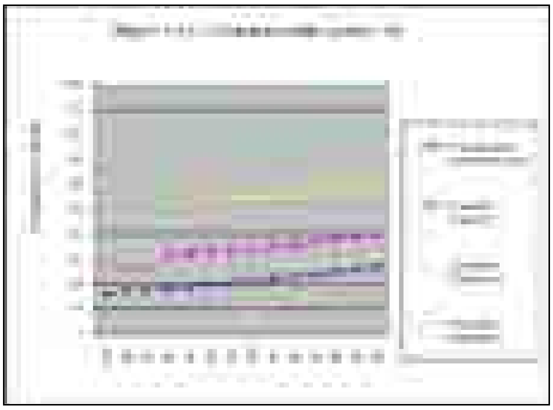
Plate 7.3.2: Commuter buses on the B2 (photo Rössing).

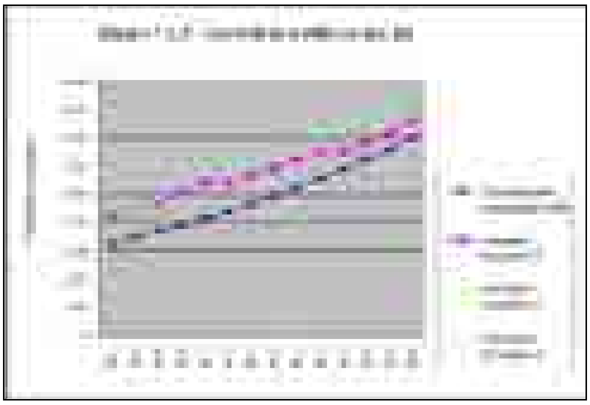
Table 7.3.1: Percentage increase in traffic numbers (all traffic including uranium-mine construction and operations traffic) per road and per scenario

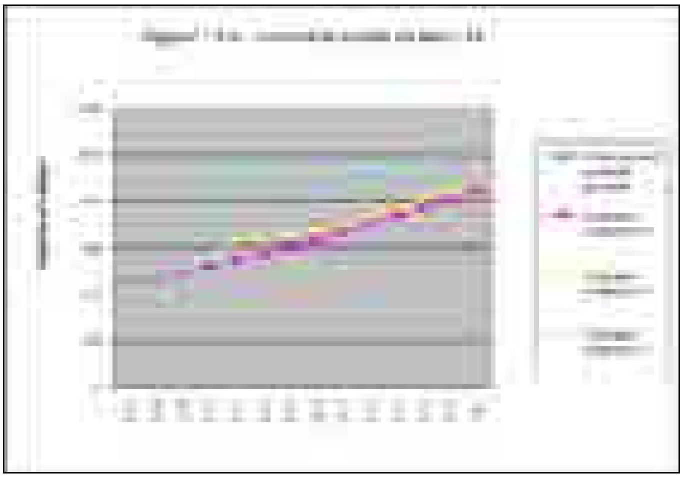
Scenario	B2 (Swakopmund to Arandis)[3]	C28 (Swakopmund to Langer Heinrich turnoff)[4]	C34 (Swakopmund to Wlotzkasbaken)
Scenario 1	54%	58%	44%
Scenario 2	59%	72%	47%
Scenario 3	59%	80%	56%

The main cumulative impacts arising from this increase in traffic are:

- Higher wear on the roads, necessitating more maintenance, especially on the gravel roads; if the maintenance is not sufficient to handle the increased traffic, roads will degrade (potholes and erosion along the edges of the tarred surface) and become very dangerous;
- Higher loads on the roads which were not built for such weights. This also results in road deterioration;







[3] Assuming that access to Rössing South will be from the B2
[4] Assuming that access to Rössing South will be from the B2

- More dangerous driving conditions. Since the majority of roads in Namibia are built for single lane traffic, these roads have to cater for all types of traffic i.e. passenger vehicles, light delivery vehicles, busses, heavy duty trucks etc often travelling at different speeds. With limited visibility under foggy or dusty conditions, passing can become very risky. Under certain circumstances, even vehicles passing in opposite directions can be risky;
- Greater need for traffic control and policing;
- Greater need for emergency response vehicles, ambulances etc.;
- Congestion causing delays for road users, which can also negatively impact on the competitiveness of the various trade corridors.

Plate 7.3.3: Heavy traffic, and particularly heavy loads, cause greater wear and tear on Namibia's roads and more hazardous driving conditions (photo J.Pallett).

The construction of new roads will contribute substantially to the cumulative impacts of the Uranium Rush in the following ways:

An estimated 106 km of new roads will be required to provide access to the new mines under Scenario 2 and approximately 113 km will be required for Scenario 3 (so long as the Tumas-Tubas and Marenica plants are located close to the C28 and D1918 respectively). If it is assumed that the average width of disturbance for the construction of a 2 lane surfaced road is 30 m, then the total area of disturbance will amount to some 3.2 km^2 for Scenario 2 and 3.4 km^2 for scenario 3. This area, as a total of the region is insignificant, but the more important impact will relate to habitat fragmentation, rather than habitat loss as shown on Figures 7.3.2 and 7.3.3. The cumulative impacts on habitat are discussed in section 7.7, but recommendations to minimise these impacts are provided in section 7.3.4 below.

Additional cumulative impacts arising from increased traffic and new roads include: dust, noise, risk of pollution and an increased accident risk.

7.3.2.2 Railways

The potential increase in rail traffic on existing lines will have a few cumulative impacts. These would include:

- Localised and intermittent noise from an increased number of trains on existing lines;
- Increased potential for spillages of diesel and oil (from train locomotives);
- Increased risk of accidents resulting in major chemical spills;
- Congestion in shunting and loading yards causing delays.

Far more serious would be the cumulative effects of new railway lines, trains, sidings and product transfer points in the desert environment generally and in the NNP specifically. These impacts could include:

- An additional 80-110 km of new railway line, of which some 30-60 km would be in the NNP if new lines are constructed to Etango and Tumas-Tubas from the existing line;
- Additional fragmentation of habitat because railway lines require gradual gradients and cannot necessarily follow other infrastructure in a corridor;
- If the average width of disturbance for railway construction and an access road is say 15m, then some 12-14 km^2 of land will be disturbed, much of which will be in the NNP. As with the roads, the greater impact will be on habitat fragmentation and destruction, especially as it is difficult to run railway lines alongside existing roads due to the special horizontal and vertical alignments required (see Figures 7.3.2 to 7.3.3);
- The trains on the new lines will introduce intermittent noise and vibration into the environment, which can be heard and felt over many kilometres, especially at night. This would add to the loss of sense of place in the NNP already being caused by new mines, roads, pipelines and powerlines;
- The extension of railways into the region will increase the risks of hydrocarbon pollution from diesel locomotives (largely due to poor maintenance) and the risk of spills of process plant chemicals. This risk is greatly increased wherever the railway crosses a river e.g. the Swakop River south of Swakopmund (existing line) and the Khan River (possible route to Rössing South);
- It is conceivable that there could be up to three product transfer points (excluding offloading facilities at the mines and loading facilities at the port or at the Gecko Chemicals plant): at Arandis (for transfer to Trekkopje), near Valencia, and at a point south of the Swakop River bridge on the existing north-south line east of the dunes. These transfer stations will require separate sidings, storage facilities, loading/offloading equipment, control rooms and offices, access roads, as well as pump and pipe infrastructure if the chemicals will be transferred to the mines by pipeline. This will contribute to the overall loss of sense of place, add to the area of disturbance and will substantially add to the risk of soil and groundwater pollution;
- The potential for increased rail transport will require additional locomotives and specialised rolling stock, which may not be readily available to TransNamib.

7.3.2.3 Port of Walvis Bay

Although the Uranium Rush may not add substantially to the current volume of cargo handled by the Port of Walvis Bay, it could contribute to port congestion and increased competition for space – more so if the Gecko Chemicals plant does not materialise and less so if Gecko does produce the required process plant chemicals locally. The impacts would be much less if Gecko decides to construct a bulk goods jetty north of Swakopmund. The quantum of the cumulative impact has not been calculated.

Increasing congestion will require NamPort to expand the harbour facilities if it wants to continue to attract shipping for local and continental customers. This will have several negative impacts on the environment, which are being documented in a separate EIA for the expansion project (CSIR, 2009).

There is also the possibility that if the port cannot efficiently handle bulk materials, Gecko Chemicals might construct a new jetty near its proposed chemical plant near Wlotzkasbaken (see section 4.4.3). This would certainly add to the cumulative development impacts along the coast north of Swakopmund – adding to the impacts associated with possibly two separate desalination plants, the chemical plant and all associated infrastructural developments. The individual impacts of the desalination plants are being considered in separate EIAs and Gecko would also commission an EIA if the jetty became a desirable and feasible option. However, at this early stage, the cumulative impacts of all these existing and potential structures on the marine environment cannot be evaluated.

7.3.2.4 Airports and air travel

There may be an increase in the number of scheduled commercial flights in and out of Walvis Bay to cater for the increased demand from the Uranium Rush. More flights to major destinations could be a major benefit to local coastal residents, however the negative impacts would include more noise along the main flight paths.

The other potential impact of the Uranium Rush on the air travel industry is that either scenic flight tourism may decrease because of the negative visual impacts of the mines and infrastructure, or new routes will be found e.g. to Spitzkoppe to avoid flying over the Trekkopje mine.

7.3.3 Desired state

The environmental quality objective relating to transportation is to ensure that key infrastructure in the central Namib is adequate and well maintained, thus enabling economic development, public convenience and safety, whilst minimising impacts on habitats and ecosystem functioning.

7.3.4 Recommendations

In order to minimise the cumulative impacts described above and to fulfil the desired aims and objectives, the following are recommended.

7.3.4.1 Roads

- The D1984 road to the east of the dunes must be upgraded to a two-lane tar road as soon as possible;
- All heavy traffic (except local deliveries to Langstrand and the coastal developments between Swakopmund and Walvis Bay) must be directed onto the upgraded D1984;

- The B2 between Swakopmund and Arandis must be upgraded to a 4-lane highway as soon as possible to facilitate traffic flow and increase road safety;
- The unsurfaced sections of the C28 up to the Etango turnoff should be tarred;
- Access to the Rössing South mine should be from the B2 (i.e. from the north) and not from the south (Figure 7.3.2);
- The road to the Welwitshia Flats should be restricted to tourist traffic only once the new Rössing South access road is in place;
- Certain tourist roads in the NNP should be restricted to tourist traffic only;
- The traffic police should stringently and regularly check vehicle weights at the existing weigh bridge in Walvis Bay to monitor vehicle loading;
- Additional traffic police will be required to maintain law and order on the roads;
- Additional ambulances and emergency response vehicles need to be purchased and be on standby to cope with road traffic accidents and chemical spills;
- Access roads to the mines should follow the shortest feasible route from the nearest existing road to minimise new disturbance (see Figures 7.3.2 and 7.3.3);
- Mine access roads need to be tarred to minimise dust and noise.

7.3.4.2 Railways

- A cost-benefit analysis needs to be conducted (which should include environmental 'costs' and 'benefits') to determine whether new railway links to the mines are desirable and/or feasible. Such lines would have to be privately built, owned and operated;
- If railways are desirable and/or feasible, the routes should, as far as possible, given vertical and horizontal alignment constraints, follow existing infrastructure such as roads and pipelines (see Figures 7.3.2 and 7.3.3);
- Careful thought will need to go into the siting of the rail-road or rail-pipe transfer facilities in order to reduce the visual and noise impacts and potential pollution impacts;
- State of the art loading and offloading facilities will need to be installed at the bulk material transfer points and comprehensive pollution control measures must be implemented;
- From the analysis of the road traffic impacts above, as many as 100 and 70 buses may be on the B2 and C28 respectively at peak hours under Scenario 3. This will have a major impact on road traffic at those hours and consideration must be given to the use of the railways for commuter transport. A new transport hub could be built at Arandis from where mine commuters will take buses to their respective mines – Rössing, Rössing South, Valencia and Trekkopje. Given the restrictions on the current Trans Namib line (unsuitable gauge and restricted speeds), it may be viable to construct a new light rail link between Swakopmund and Arandis, or even up to Trekkopje. As with the freight lines, such a venture would have to be a private or private-public partnership.

7.3.4.3 Port of Walvis Bay

Apart from the envisaged expansions, it is recommended that NamPort should consider involvement in the development of the bulk commodity jetty being planned by Gecko north of Swakopmund.

7.3.4.4 Airports and air travel

- The passenger terminal at the Walvis Bay airport may need to be expanded and upgraded to cope with increased numbers of passengers;
- Scenic flight tourism operators should alter their flight paths to avoid high levels of visual impact from the mines or, possibly offer aerial mine tours.

7.4 Cumulative Effects Analysis – Water

7.4.1 Introduction

7.4.1.1 Water supply and demand

The sources of water in the central Namib are fog, direct summer rainfall, surface water runoff during the rainy season in the rivers running from the interior of the country through the central Namib, groundwater and seawater. However, the origin of all water in the desert is due to some form of precipitation and the occurrence of this vital resource is determined by important factors such as climate, hydrology, topography and geology. Unfortunately the hydro-climate does not lend itself to produce an abundance of water, and the scarce water resources require innovative management to ensure that the development potential of the central Namib can be realised.

There are four main ephemeral rivers flowing through the central Namib: the Omaruru, Khan, Swakop and Kuiseb Rivers. All of these contain intermittent surface flows following rain, but most of the time, water 'flows' below the surface in the sediments of the river bed. The groundwater resources in the lower reaches of both the Omaruru and the Kuiseb Rivers provide most of the domestic and industrial water supplies at the coast. Groundwater resources in the alluvial aquifer of the Swakop River currently supply a small proportion of the total mining demand at Langer Heinrich mine[1], as well as irrigation water for farmers in the lower Swakop. All of the rivers represent linear oases through the desert and support a multitude of life forms.

All the coastal aquifers are recharged by runoff originating in the central highlands of Namibia where rainfall is higher and more reliable. The sustainable yield from the Kuiseb and Omdel schemes combined is 12Mm^3/a, but abstraction has been *temporarily* increased over the last 2 years to supply the increasing demand from the new uranium mines (Langer Heinrich and Trekkopje's construction demand). The current (2009) water demand at the coast from all users is 14.4 Mm^3/a, of which 4.6 Mm^3/a is from mining and 9.8 Mm^3/a is from domestic and non-mining industrial demand. This level of abstraction is patently not sustainable.

Unfortunately, the groundwater resources in the other two rivers (Khan and Swakop) are limited – exacerbated by the construction of the Swakopport and Von Bach dams in the upper reaches of the Swakop River in the 1970s. Studies have shown that the total groundwater recharge to the Swakop alluvial aquifer has dropped by 32% as a result of these dams (BIWAC, 2010).

Compounding this problem is the fact that the alluvial aquifers of both the Khan and Swakop Rivers are not homogenous, but separated into sections called compartments created by outcropping bedrock or narrowing of the river gorge. These compartments are mostly dominated by vertical flow (evapo-transpiration and recharge), rather than lateral flow. The stored water volumes in each compartment are therefore not replenished on a continual basis from upstream, but rather from occasional flood events.

The BIWAC (2010) study found that water levels in the Khan River tend to react more strongly to abstraction than in the Swakop River. The results of modelling[2] the Valencia compartment in the Khan suggested that this compartment cannot support long-term bulk abstraction by Valencia mine

[1] Note that Rössing Uranium Mine stopped abstracting water from the Khan River aquifer from 1st January 2010.
[2] See the BIWAC, 2010 report for full details of the models used.

and that abstraction should, therefore, be limited to the construction phase. On the other hand, the groundwater model suggested that the compartment from which Langer Heinrich abstracts water in the Swakop River, could provide the permitted amount of 500,000 m^3/a.

While these modest volumes can contribute towards water demand during construction and a limited amount to the operational demand, the available groundwater resources in the Khan and Swakop rivers do not start to meet the full demands of an operating mine, which typically requires >3 million cubic metres per annum.

It has been known for a long time that the only viable source of additional water at the coast to meet predicted future water demand is the sea via desalination. These plants are extremely costly to build and operate and so in order to delay the eventual need for desalination as long as possible, the coastal municipalities and Rössing Uranium Mine initiated a successful water demand management campaign in cooperation with the Department of Water Affairs and Forestry (DWAF). However, all these measures have now reached their limits and it is clear that even with the best conservation practices, desalination is the only viable option to augment the existing water resources and to supply anticipated future water demand from the uranium mines in the central Namib.

Desalination requires both energy and technical capability, and the cost of the water would be prohibitively high for domestic use. Considering the demographics and socio-economic status of the Erongo Region and the central Namib in particular, the most justifiable way to satisfy the domestic water demand would be to supply residents with water from the cheaper groundwater resources of the Omdel and Kuiseb schemes and the more expensive desalinated seawater would be used to supply the mines. Once the mining water demand is satisfied from desalinated water, domestic demand under Scenario 1 (low growth scenario)[3] can be fully met from the groundwater resources at the sustainable abstraction rate i.e. less than 12 Mm^3/a (Figure 7.4.1).

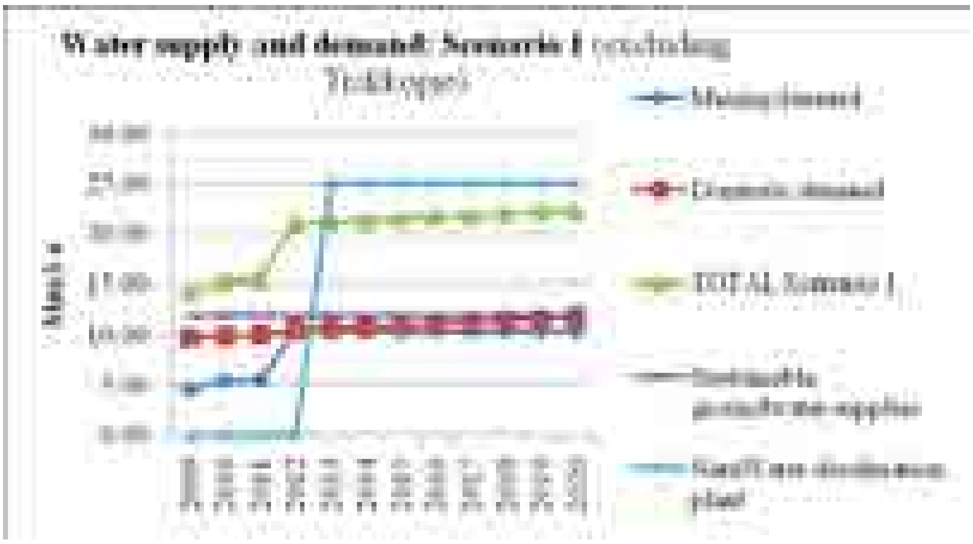


Figure 7.4.1: Domestic, mining and total water supply and demand for Scenario 1

[3] Domestic demand for Scenario 1 has been calculated at a low urban growth rate of 2.5% for Swakopmund and 0.8% for Walvis Bay.

Without *any further supply sources* being developed, domestic demand[4] under Scenarios 2 and 3 would exceed the sustainable groundwater yields by 2013 and 2011 respectively and is likely to rise to over 14 Mm^3/a and 18 Mm^3/a by 2020. While there may be some surplus from the NamWater and Areva desalination plants in the short-term, this will also not be enough to meet domestic demand from about 2013. The planned Gecko Chemicals plant will, however, produce a maximum of 4 Mm^3/a from its seawater desalination plant, which could be sold to NamWater, thus reducing demand on the aquifers – hence the 'dip' in the domestic demand line in Figures 7.4.2 and 7.4.3[5]. The Gecko plant is expected to be up and running by 2013, and could augment supplies from that date. This extra 4 Mm^3/a will mean that domestic demand under Scenario 2 can be met up to 2020 and beyond, but under the high growth Scenario 3, shortages in water supply may be experienced from 2016, unless other resources are developed (Figure 7.4.3).

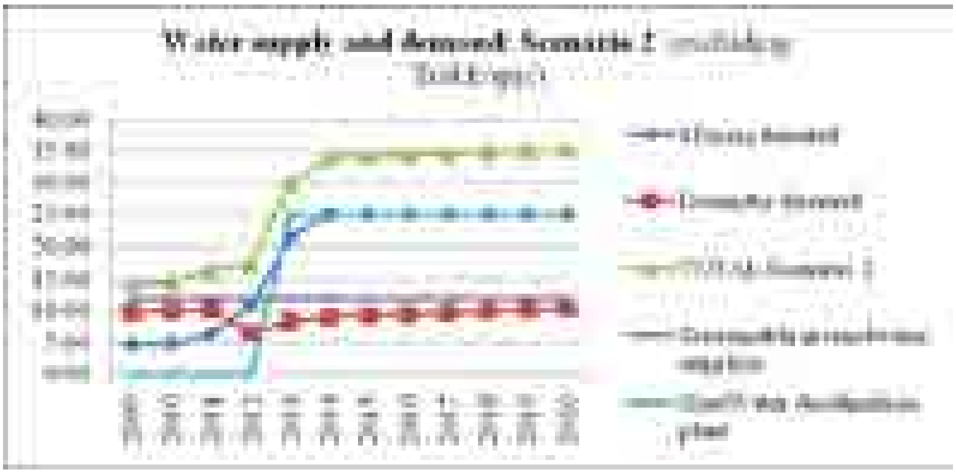


Figure 7.4.2: Domestic, mining and total water supply and demand for Scenario 2

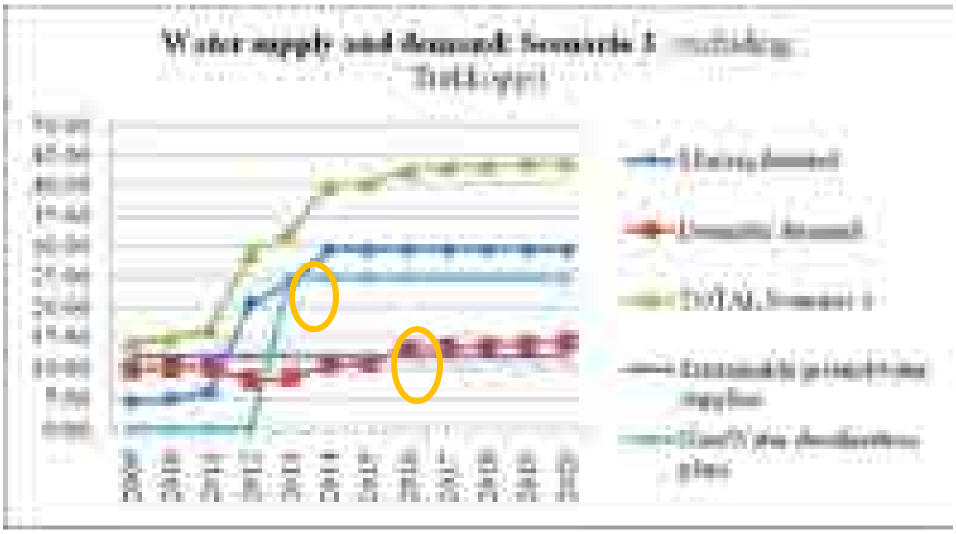


Figure 7.4.3: Domestic, mining and total water supply and demand for Scenario 3

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[4] Domestic demand for Scenario 2 has been calculated on a medium urban growth rate of 3% for Swakopmund and 1.15% for Walvis Bay and for Scenario 3 at a growth rate of 3.5% for Swakopmund and 1.5% for Walvis Bay.
[5] This amount represents a maximum value and could be less depending on production demand. At a minimum, 2 Mm^3/a could be fed into the supply system.

These figures clearly show the urgent need for a second desalination plant. NamWater is currently conducting investigations into the development of a desalination plant at Mile 6, north of Swakopmund. The estimated cost of the project is N$1,800 million and it will have a minimum lifespan of 20 years. It was originally planned to be commissioned by 2010, but the programme is behind schedule and it is unlikely that the plant will be operational until 2013-14. The design capacity of the plant is 25 Mm^3/a of potable water. While such a plant would be able to cater for the estimated demand under Scenario 2, it would be insufficient to meet predicted demands under Scenario 3 (see Figure 7.4.3 above), and additional sources of water would need to be found.

Furthermore, the demand for water from the mines is likely to start increasing from 2011 (see Figures above), but the NamWater plant will not be in operation by that date. Therefore, NamWater will have to enter into negotiations with Areva to purchase surplus water from them (estimated to be about 6 Mm^3/a) until an additional plant is commissioned. Thus water supply is a critical factor in future mine development and a shortage of water could seriously delay or impede such development.

This means that the mines will have to try and minimise their water consumption by implementing a number of measures such as reduced consumption, re-use and recycling (see section 7.4.4 below) in order to stay within the supply capacity.

The limited water resources at the coast necessitated the development of an integrated, long distance, bulk water supply network, known as the Central Namib Water Supply System (CNWSS). Bulk water is supplied to consumers in the central Namib by NamWater from the alluvial aquifers in the lower Kuiseb and Omaruru rivers, via infrastructure that was developed in the 1970s. Some of the pipelines are showing signs of having reached the end of their useful life, but most of the reservoirs are generally in good condition.

Although cross catchment transfers are possible between the Kuiseb River and the Omdel supply scheme, Walvis Bay is at present supplied from the Kuiseb River alone. After the significant floods in 2009 which recharged the Kuiseb River aquifer, supply for Walvis Bay is secure for another 10 years. Rössing mine, Arandis, Swakopmund and Henties Bay are supplied by the Omdel aquifer.

The existing Central Namib Area Bulk Water Supply System is divided into the following schemes, as shown on Figure 7.4.4:

- The Omdel-Swakopmund Water Scheme;
- The Kuiseb Water Scheme;
- The Swakopmund-Rössing Water Scheme; and
- The Swakopmund-Langer Heinrich Water Scheme.

However, the proposed new mines will require additional or larger pipelines to deliver water to them, necessitating new pipelines, pump stations, access tracks, and power lines, which could result in considerable cumulative impacts if not carefully planned (see sections 7.4.2 and 7.4.4 below).

A final issue that needs to be considered in addressing water supply is the vulnerability to climate change. Although the real effect that climate change may have on the occurrence of groundwater in Namibia is not yet fully understood, it can be assumed that there will likely be reduced precipitation and increased evaporation (see section 5.1.4). This will have a negative impact on groundwater resources due to reduced groundwater recharge, which could increase pressure on aquifers in the region.

Figure 7.4.4: Layout of the existing Central Namib Area Bulk Water Supply System and proposed new developments. (Source: NamWater)

In summary therefore:

1. There is sufficient water from the existing NamWater groundwater schemes (Omdel and Kuiseb) to supply potable water to current domestic users in the coastal towns until 2020 and beyond under Scenario 1, as well as under Scenario 2, but in this case, only if the Gecko plant can sell its excess water to NamWater. However, under the high growth conditions suggested in Scenario 3, new water supplies will need to be found to meet domestic demand from about 2016;
2. There is not enough water from existing groundwater sources to supply the operational needs of the existing mines, let alone the proposed new mines;

3. There is not enough water in the primary alluvial aquifers of the Khan and Swakop Rivers to satisfy the water requirements of the mines for operations, but there may be enough to supply water for construction purposes in the short-term (within safe yield limits), without compromising existing water users (farmers in these valleys) and riverine ecosystems;
4. Therefore NamWater needs to build a desalination plant (or, more preferably 'piggy-back' on the Areva plant) as soon as possible to be ready to supply the new mines when they start operating from about 2012;
5. A network of new pipelines will be required to supply the new mines with water which must be planned in 'proposed infrastructure corridors'. A working group under the SEMP office in GSN, including input from NamWater, NamPower and MET should delineate optimal routes, based on the findings of this SEA;
6. Desalinated water is expensive and the cost of this water should not be borne by domestic users while there is still sufficient groundwater to meet domestic demand;
7. The high price of water from the desalination plant should be sufficient incentive for the mines to closely manage their water demand through reduction, re-use and recycling strategies (see section 7.4.4).

7.4.1.2 Water quality

As noted above, most domestic supplies are obtained from the alluvial aquifers of the Omaruru and Kuiseb Rivers. Even without treatment, this water is generally of good quality (see section 7.4.1.3 below). The rest of this section deals with water quality issues in the Khan and Swakop Rivers, neither of which are used for domestic consumption, but could be affected by the Uranium Rush.

In considering groundwater quality in this area, the two types of aquifers which are discussed are:

- The shallow, alluvial aquifers (primary aquifers) of the Khan and Swakop Rivers; and
- The deep, fractured, secondary aquifers.

In 2009, 78 locations on the Khan and Swakop Rivers were sampled by a joint water team of BGR, GSN, BIWAC and DWAF for this SEA and analysed for major cations and anions, dissolved uranium, and trace elements. The main findings of the water quality study can be summarised as follows:

- Alluvial groundwater in the upper Khan and Swakop River catchments is Ca-Mg-HCO_3 dominated **freshwater** of 'acceptable' (B) or 'excellent' (A) quality for drinking according to the classification of the Water Act (1956);[6]

- Downstream of the 15°35'E line of longitude, the Ca-HCO_3 dominated freshwater of the upper catchment changes into Na-Cl-dominated **saline groundwater** with electrical conductivities of up to 17,000 µS/cm (11,000 mg/l TDS) caused by evapotranspiration and groundwater evaporation, making it unsuitable for domestic use. Locally, freshwater lenses exist on top of saline groundwater;

[6] See definitions of water quality classes in s. 7.4.1.3.

- The **pH** of the alluvial groundwater is controlled by the natural buffering of the carbonate-bicarbonate environment and has a median of pH 7. Localised occurrences of sulphidic rock can cause high acidity in the fractured aquifers, as noted in one sample taken near Rössing from a known iron sulphide deposit, where the pH was found to be 4.3;

- Nitrate concentrations are largely elevated, but 90% of the *freshwater* samples have **nitrate** concentrations n excess of the Namibian Drinking Water Standard of 10 mg/l N (40 mg/l nitrate);

- Concentrations of potentially harmful or toxic elements such as **fluoride, arsenic, lead or cadmium** are – with the exception of one or two outliers associated with sulphide rocks – below the guideline values of the Namibian Water Act. The presence of sulphate and iron at a low pH at depth near Rössing does not have the mine process water signature and could therefore reflect poor quality fossil water in the fractured aquifers.

- **Uranium** was found in all 78 samples collected along the length of both rivers and is therefore a common trace element, as would be expected in a geological uranium 'province'. The study found that the *natural background* concentrations of uranium range between 2 µg/l and 528 µg/l in the alluvial groundwater, with a mean of 39 µg/l. These values are well above the WHO provisional Guideline Value for Drinking Water of 15 µg/l (WHO, 2004), but well within the Namibian Group A water quality limit of 1000 µg/l.[7] The natural concentrations are generally higher in the upper Khan River catchment compared to the upper Swakop River catchment. Saline water samples from the lower Swakop River catchment generally exhibit higher uranium concentrations than the respective samples from the headwater regions. See section 7.12 for a more in-depth discussion on the presence of uranium in groundwater.

The water team also took samples of mine process water at both the Rössing and Langer Heinrich mines and compared it to the water in the alluvial aquifers up and downstream of the mines. The analytical results of trace elements, radioisotopes and stable isotopes showed that neither Langer Heinrich nor Rössing has had a detectable influence on the groundwater quality in the main streams.

Modelling of the Swakop and Khan Rivers has shown that the alluvial water quality is influenced by lateral inflows of poorer quality water from the basement aquifers (BIWAC, 2010). Groundwater hosted in the *secondary,* fractured aquifers (fractures, faults, etc) is mostly of poor quality owing to little direct recharge. It is therefore naturally highly saline and acidic, with sulphate, sodium and chloride ions dominating and trace metals in solution. Where water comes into contact with uraniferous rocks, it can also have naturally elevated concentrations of radio-nuclides, as described above. Thus although the contribution to alluvial flow from the secondary aquifers is only 5-15%, the influence on quality is much more significant (BIWAC, 2010).

7.4.1.3 Potable water standards and users

The quality of potable water is governed by the 'Guidelines for the Evaluation of Drinking Water for Human Consumption with Regard to Chemical, Physical and Bacteriological Quality' (DWA, 1988). For practical reasons the guidelines have been divided into three basic groups of determinants,

[7] Note: as previously mentioned, neither the Khan nor Swakop Rivers is used for domestic water consumption.

namely: aesthetic/physical, inorganic and bacteriological. The concentration of and limits for each of these determinants define the group into which water will be classified. These groups are:

Group A: water with an excellent quality and bacteriologically safe to drink;

Group B: water with good quality which is suitable for human consumption;

Group C: water with a low health risk on account of inorganic or bacteriological pollution, which requires immediate remedial action before it is safe to drink;

Group D: water which has a high health risk and is unsuitable for human consumption.

The water in the Omdel scheme is classed as Group B and the water from the boreholes in the Kuiseb aquifers varies from excellent to good quality (Groups A and B). This water is further treated for domestic consumption by NamWater prior to distribution to the Municipalities. Samples taken by Kringel and Wagner from tap water in the coastal towns demonstrated that the quality is good and contains no uranium or other toxic elements.

However, as noted above, the water quality in the primary aquifers of the Swakop and Khan Rivers is compromised by salinity and locally, by naturally occurring uranium and other elements. It is variable in both a vertical and horizontal direction, and quality can range from Group A to D. The water in the secondary, fractured aquifers is usually classed as Group D on account of the high salinity.

There is a range of different users in the region who may be categorised as follows:

- Urban users (domestic and light industrial sectors) in the towns of Walvis Bay, Swakopmund, Henties Bay and Arandis who are supplied with potable (Group A or B water) by NamWater from the Omdel or Kuiseb aquifers;
- Domestic rural users i.e. the Topnaar communities along the Kuiseb, who are supplied with potable water by NamWater;
- Livestock farmers living on the commercial farms east of the Namib-Naukluft Park. The water obtained from the fractured aquifers is used for stock watering only, because it is unfit for human consumption (Group D). Water for domestic consumption on these farms has to be obtained from the alluvial aquifers of active and palaeo river channels;
- Commercial irrigation farmers living along the lower Swakop River. As indicated above the water in the alluvial aquifer of the lower Swakop River is highly variable, ranging from potable (Group A) to non-potable (Group D) depending on the location and depth of the boreholes;
- The natural ecosystems along the river beds and ephemeral washes which are sustained by groundwater – particularly the large trees; and
- The mines (Rössing and Langer Heinrich), which use poor quality groundwater (Group D) for non-potable water uses e.g. dust suppression.

It is clear from the above that most of the groundwater in the region is used for many purposes and many livelihoods and entire ecosystems are directly sustained by such use.

Plate 7.4.1: Downstream users of groundwater include small-scale irrigation projects. Even though these enterprises may be modest in terms of economic output, they are important for livelihoods and they supply high value products for the local market (photo J.Pallett).

7.4.2 Analysis of cumulative impacts

From the above discussion, it is clear that the two issues relating to water revolve around the quantity and quality of available water resources. If we assume that all the mines and related large industrial developments will be supplied with desalinated water, what are the remaining cumulative impacts?

Many of the known impacts on water resources caused by mining operations are extremely localised and it will be the responsibility of each mine to control these impacts through their own mine-specific EMPs. These issues usually include:

- Mine infrastructure such as roads, embankments, tailings dams etc can cause local flooding and interrupt natural flow paths;
- Local drawdown of the water table due to pit dewatering;
- Localised contamination of the ground from uncontrolled stormwater runoff;
- Spills and leaks in the plant and workshops.

However, there are four major potential cumulative effects that may result from the Uranium Rush:

- Pollution of the primary aquifers by seepage and spills;
- Over-abstraction of water from the primary aquifers;
- A proliferation of pipelines across the region; and
- Impacts on the marine environment from numerous desalination plants at the coast.

7.4.2.1 Pollution of the primary aquifers

From Figure 7.4.5 and Table 7.4.2 below, it can be seen that many of the mining and exploration companies abut onto or straddle one of the large west-flowing ephemeral rivers.

Table 7.4.2: Mines, EPLs and potentially affected primary river aquifers

River	Mine or EPL	Responsible company
Ugab	EPL 3328: Uis/Namib	Extract/Swakop Uranium
Omaruru (Omdel scheme)	EPL 3454: Erongo Granites EPL 3851 and 3850: Klein Spitzkoppe EPL 3569 and 3570: Cape Cross	Erongo Energy Ltd SWA Uranium Mines Xemplar Energy Corp.
Khan	EPL 3637: Ancash EPL 3638: Namibplaas EPL 3602 EPL 3138: Rössing South EPL 3345: Etango ML 149: Valencia ML 28: Rössing	Forsys Metals Forsys Metals Zhonghe Resources Namibia Extract Resources Bannerman Forsys Metals Rössing Uranium Ltd
Swakop	EPL 3346: Swakop River EPL 3500: Langer Heinrich extension EPL 3668: Gawib West EPL 3439: Ida Dome EPL 3138: Rössing South EPL 3345: Etango ML 140: Langer Heinrich Mine	Bannerman Paladin Energy Reptile (Toro Energy) Swakop Uranium Extract Resources Bannerman Paladin Energy
Kuiseb	EPL 3498: Aussinanis EPL 3670: Chungochoab EPL 3516 and 3518: Dome Project	Reptile Reptile (Toro Energy) Cheetah Minerals

Note: the mines which are most likely under Scenario 3 are highlighted in bold.

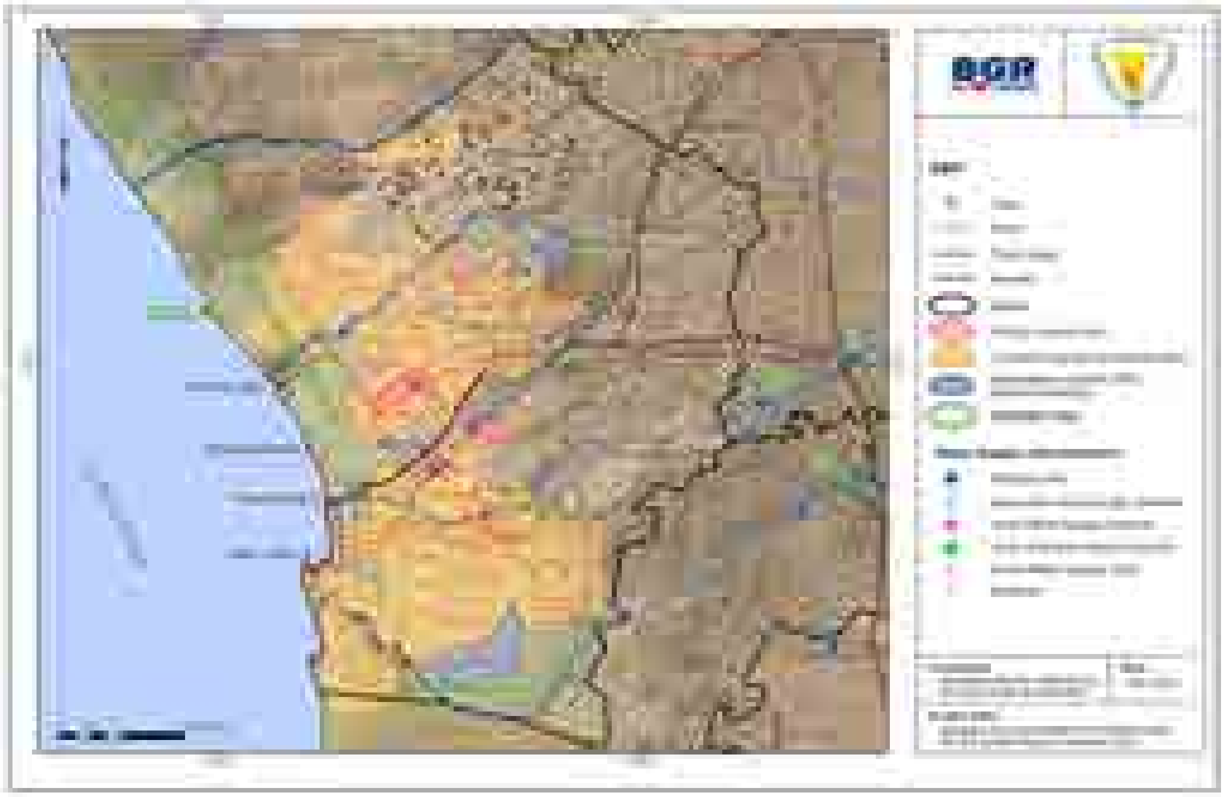


Figure 7.4.5: Uranium EPLs and Mining Licences in relation to dams, rivers, boreholes and water supply schemes

All of the current and possible future mines (highlighted in bold in the table) will have large-scale potential sources of pollution, namely: waste rock dumps, low-grade ore stockpiles, tailings dams, heap leach pads and heap leach residue disposal dumps, as well as process plant areas, effluent dams and ponds etc. With the exception of the waste rock dumps, best practice dictates that all these facilities should be lined. Indeed, Section 23(1) of the Water Act, 54 of 1956 states that it is "*…an offence to commit an act which could pollute any public or private water, including underground water, or sea water in such a way as to render it less fit for the purposes for which it is or could be ordinarily used by other persons …for legitimate purposes.*" Thus all new mines should be designed as 'zero effluent discharge' mines and those with existing water permits must ensure that the permit conditions are being rigorously monitored and enforced, both by themselves, the Department of Water Affairs and Forestry and MET.

The consequences of non-compliance of Scenario 3 mines would particularly affect the Khan and Swakop Rivers, with the main pollutants being sulphate, sodium, chloride, nitrate, uranium and other radio-nuclides and trace metals. The mines using the sulphuric acid leach process could cause the pH of the groundwater to drop since the effluent and tailings water can have a very low pH, whereas the mines using an alkaline leach process would cause an increase in the pH.

Should any of the EPLs along the Omaruru or Kuiseb be developed into mines, extra care will have to be taken to ensure that no pollution whatsoever reaches the primary aquifers, as these supply all domestic users in the coastal region.

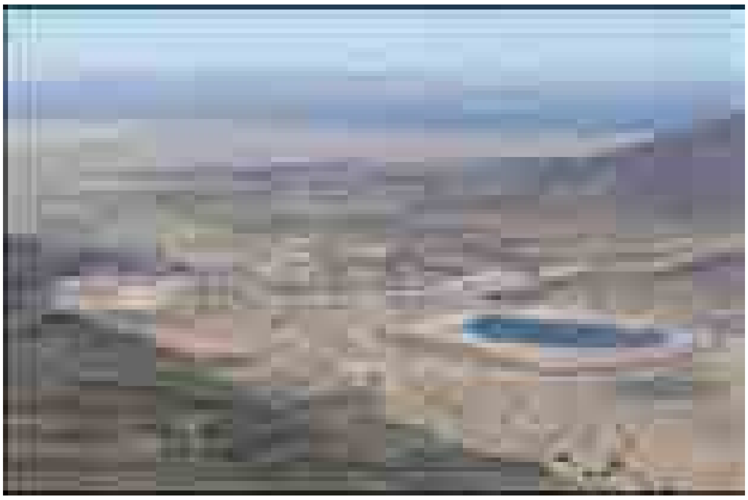


Plate 7.4.2: Tailings dams need to be carefully located, well designed and constructed, properly maintained and closed according to international best practice to avoid contamination of groundwater resources. The Langer Heinrich tailings dam is situated in a dry river channel, which could be hazardous in the event of a large flood (photo P.Tarr).

7.4.2.2 Over-abstraction

The second major cumulative impact relates to the incremental lowering of the water table in the groundwater compartments in the river beds. If each mine is allowed to extract its permitted maximum from the alluvium, this may result in a general decline in water levels throughout the compartment. This will affect the vegetation and all the dependent ecosystems along the affected river reaches, as well as the borehole yields of the farmers who abstract water from the river beds for irrigation and domestic consumption. This impact would last for as long as over-abstraction is allowed to continue and for some years afterwards until water table levels are naturally restored.

It is imperative therefore that the abstraction permits granted to the mines take into account the cumulative rates of abstraction to ensure that the permitted amount is within sustainable limits (see section 7.4.4).

7.4.2.3 Proliferation of pipelines

If the bulk water supply infrastructure is not carefully planned to allow for existing and potential new customers and demand volumes, there could be numerous pipelines across the desert, either in parallel ranks or taking the shortest route from the supply point to the customer. Furthermore, the presence of corrosive soils and shallow bedrock throughout the area means that pipelines have to be laid on the surface, rather than being buried. This has a major visual impact and also fragments wildlife habitat by impeding the movement of some species of animals, particularly ostrich, springbok, oryx and mountain zebra. Restricting the movement of wildlife in hyper-arid areas by isolating them from seasonal water and grazing will undermine their chances of survival. In order to reduce this cumulative impact, recommendations are made in section 7.4.4 below to optimise the sizing of the pipelines to restrict the number of parallel pipes and to restrict pipeline routes to designated corridors.

Plate 7.4.3: Pipelines are both a visual impact and a barrier to many forms of wildlife (photo J.Pallett).

Secondly, if it assumed that each pipeline construction corridor leads to a 10m wide zone of disturbance, some land will inevitably be disturbed. If the number of pipelines is restricted, as recommended, the lengths of pipeline and the associated areas of disturbance per scenario are shown in Table 7.4.3 below i.e. the best case scenario.

Table 7.4.3: Length and affected areas caused by new water pipelines

Scenario	Minimum length of new water pipelines (km)[8]	Minimum area of disturbance caused (km^2)[9]
Scenario 1	223	2.23
Scenario 2	250	2.50
Scenario 3	287	2.87

It should be noted that the area of disturbance includes the service road, but excludes the areas required for pump stations and powerlines. The figures shown therefore are minimum figures and if optimisation measures cannot be implemented, the cumulative impact could be far greater.

7.4.2.3 Impacts of desalination plants

It was beyond the scope of this study to evaluate the cumulative impacts of several desalination plants operating along the coast of the central Namib. However, possible impacts of these plants, together with other marine structures such as jetties, could affect normal sediment movement and scour and accretion processes by interfering with the long-shore currents. In addition, the brine discharge could locally affect marine life if the outlet structure is not carefully designed to ensure maximum mixing and dilution. As with all cumulative impacts, the effects of one plant may be deemed in the EIA to be insignificant, but if there are two or even three plants in the future, or if the capacity of the existing plants is increased, then the cumulative impacts could become significant with time.

[8] Assuming optimisation of water pipelines and not including possible reagent pipelines.
[9] Assuming a 10 m wide zone of disturbance, which allows space for an access road (single track) and an above-ground pipe to be constructed.

7.4.3 Desired state

The desired state for water supply in the central Namib under any of the mining scenarios is that there should be a sufficient, reliable supply of good quality water at an affordable price for all customers. However, the bulk water supply network must be optimised as far as practically possible to minimise the number of pipelines and associated infrastructure (pump stations, power lines etc).

Secondly, the quality of water used by existing water users must not be polluted in any way that renders the quality of water unfit for its current use.

7.4.4 Recommendations

In order to fulfil the desired outcomes, it is clear that:

- All mines must use desalinated water for mine operations, but an SEA needs to be conducted on various future scenarios for desalination as soon as possible, to ensure that the cumulative negative effects are not significant;
- Groundwater can be used in exploration and mine construction phases so long as that abstraction is based on a comprehensive hydrogeological investigation, including groundwater modelling of the affected compartment and all downstream compartments;
- Standards and protocols for pollution monitoring should be developed by the SEMP office in conjunction with DWAF, using the findings of the SEA water team. Future monitoring should take into consideration the vertical variation in groundwater quality, particularly in the saline downstream areas. Future monitoring should also take into account the likely mine process chemicals and ore body characteristics in determining the list of parameters to be monitored so that the signature of mine-related pollution can be readily detected. All future monitoring should also include annual sampling and analysis of important uranium daughter elements at selected stations;
- The monitoring data collected should be evaluated and used for regular reporting by the SEMP office;
- The monitoring data should also be maintained in a central database at the SEMP office and a hydrogeological information system should be developed to facilitate reporting, public information response to requests and the implementation of groundwater policies and management.

In order to prevent pollution, it is recommended that the following management controls should be built into every mine’s EMP and closure plan, and compliance needs to be closely monitored:

- Appropriate siting of tailings dams away from surface water courses and preferential groundwater flow paths;
- Application of best practice design and construction methods for seepage control and detection around tailings dams, heap leach pads, heap leach residue facilities and effluent ponds;
- Construct suitably sized and separate stormwater collection drains for ‘clean’ and ‘dirty’ stormwater;

- Conduct regular monitoring and reporting;
- Rehabilitate all disturbed areas as soon as they are decommissioned;
- Each mine (in conjunction with all suppliers) should develop a Code of Conduct to prevent spillage from vehicles transporting products and wastes along all roads (both public and mine site), including an emergency plan to deal with any such spillages.
- Funds for post closure pumping and maintenance.

In order to reduce the freshwater demand on each mine, it is recommended that each mine should develop a water demand management plan which aims to minimise the use of raw water, minimises water losses and maximises recycling and reuse of water wherever possible. Some suggested water saving measures include the following:

- Tar all access roads and in-plant service roads where possible to reduce the need for water for dust suppression;
- Use chemical binding agents on all haul roads and other un-surfaced roads to prevent dust rather than using water;
- Collect all 'dirty' plant runoff water and re-use it in the plant;
- Dewater tailings at source with appropriate technology. This will reduce water losses from the tailings dam through evaporation, seepage and entrainment, and the recovered water can be recycled through the plant. It will also reduce the hydrostatic head driving any pollution plume;
- Use groundwater collected in the pit to suppress dust during drilling operations and ore loading;
- Use water saving devices in all ablution facilities e.g. dual flush toilets, tap diffusers, automatic turn-off taps etc;
- Embark on a programme of raising awareness amongst the entire workforce regarding water conservation;
- Put automatic turn-off nozzles on all hoses;
- Recycle grey water (from the canteen and ablution blocks) and use for other purposes;
- Plant water-wise desert gardens (with indigenous species only);
- Install fog and rainwater harvesting systems where practical to augment supplies.

In order to minimise the cumulative footprint of the bulk water supply infrastructure, it is strongly recommended that where possible, supply schemes should comprise only one pipeline along a demarcated corridor – following other infrastructure e.g. roads, with a capacity to supply existing **and** future demands (Figures 7.3.1, 7.3.2 and 7.3.3). This will perhaps cost more in the short-term, but will have significant long-term cost savings due to economies of scale and the synergies that can be achieved, such as a reduced number of pump stations, fewer powerlines, less need for service roads, less maintenance etc.

7.5 Cumulative Effects Analysis – Energy

7.5.1 Introduction

7.5.1.1 Power supply – generation capacity

Namibia currently has only three power generation stations linked to the national grid:

1. The Ruacana hydro-power station on the Kunene River in the far north of the country. This station has an installed capacity of 240 MW, but it only has an average availability of 50%. This is due to the fact that the upstream dams which should control the releases to the power station are badly damaged. It is not known when or if this situation can be rectified.

2. The Van Eck coal-fired power station in Windhoek, which has an installed capacity of 120 MW. This power station operates on a stand-by basis due to the high costs of importing the coal to Windhoek and running the station.

3. The Paratus diesel generator in Walvis Bay. This can generate 24 MW, but also runs on a stand-by basis.

Thus Namibia has a maximum generating capacity of 384 MW.

The current national demand for electricity is ~550 MW, which leaves a deficit at peak demand of 166 MW. Furthermore, the predicted growth in demand is expected to average 3.5% per year, excluding the uranium rush. The balance is supplied from various sources within the Southern African Power Pool (SAPP) with the largest share traditionally coming from Eskom, South Africa. However, South Africa has had trouble meeting its own demand requirements since 2005 and its ability to assure a cheap, uninterrupted power supply to Namibia in future is doubtful. Furthermore a tariff increase of 25-26% per year for the next three years has recently been approved by the National Energy Regulator of South Africa, which is likely to be passed on to Namibian users in future.

The predicted demand from the uranium mines alone ranges from 120 MW under Scenario 1 (see section 4.5 for definition of scenarios), to 231 MW under Scenario 2, to a possible 278 MW under Scenario 3. If the industries i.e. one or two desalination plants and urban growth related to mine development are factored in, the total demand increases to at least 175 MW under Scenario 1, 333 MW under Scenario 2 and at least 380 MW under Scenario 3 (see Table 7.5.1). The predicted Uranium Rush step loads are shown in Figure 7.5.1.

It should be noted that the Gecko chemicals plant near Swakopmund will be designed to be energy neutral, since it will convert the waste heat from the acid plant to electricity on site.

Table 7.5.1: Predicted future power demand from the uranium mines and associated industries per scenario

Scenario	Power demand – mines (MW)	Power demand – related industries and urban growth (MW)	Total demand (MW)
Scenario 1	120	55	175
Scenario 2	231	102	333
Scenario 3	278	102	380

It is clear therefore, that NamPower is currently not in a position to meet the requirements of the new mines and associated infrastructure from *existing* sources and power purchase agreements. Thus NamPower is investigating a number of *additional* generation and power purchase agreements within the SAPP to meet power demand in the short-, medium- and long-term.

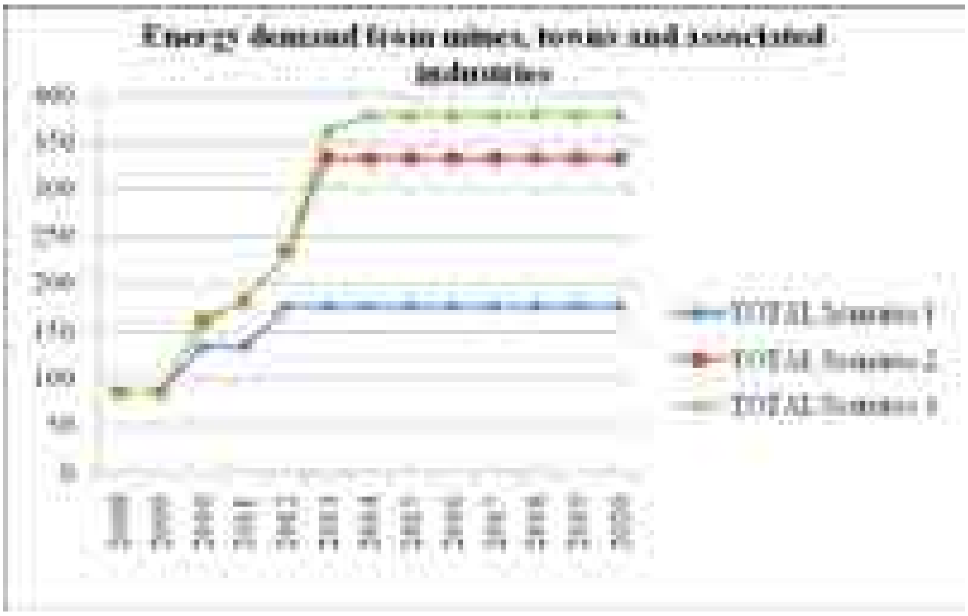


Figure 7.5.1: Cumulative energy requirements for the mines and associated industries by scenario

The various supply options are set out in Table 7.5.2 below.

Table 7.5.2: Possible future power supply options for the West Coast

Generation/ Contract	Size (MW)	Dispatch	Commissioning date
ZESA and ZESCO power purchase agreements	150-300	Via Caprivi Link	2010
Anixas Emergency Diesel	21-45	Emergency	Q4 2010
Ruacana 4th Turbine-Generator	80	Run of River	Q2 2012
Walvisbay ‘Slop’	70-270	Mid Merit	2013-2014
Kudu Gas CNG or Walvis Bay Coal	450 – (800) 200 - 800	Base Base	Q2 2013 Q1 2014
Baynes Hydro	360	Base or Mid Merit Small dam (1 year drought)	?
Wind	35	CF 35%	Q4 2011
Orange River Small Hydro	110	Run of River	2013 earliest

There are two possible alternatives to supply base load power on a long-term basis in the Erongo Region: generation of power by an Independent Power Producer from Compressed Natural Gas (CNG) imported to Walvis Bay from the Kudu Gas Field; or a coal-fired power station at Walvis Bay. NamPower has conducted several investigations into the coal-fired power station option, looking at several different locations and sizes.

For the purposes of scenario planning for this SEA, we have assumed that a 200 MW station would be sufficient to meet the demands of Scenario 1 mines; a 400 MW station would be needed for Scenario 2 and an 800 MW station would be required for Scenario 3.

A power station near Walvis Bay would have several advantages: it would be in close proximity to the port for the importation of coal or CNG; cooling water would be obtained from the ocean; and the power would be generated close to its major customers - the uranium mines, the desalination plants and other mine-related industries. It could also provide an opportunity for thermal desalination of seawater by using waste heat from the power plant, if it was situated near enough to a desalination plant. Thus long-term base load will be generated from a gas plant **or** coal thermal plant at Walvis Bay plus hydropower from Baynes (on the Kunene). In the interim, power to the coast will be available from imports through the Caprivi link from SAPP, the 4th turbine at Ruacana and in emergencies, expensive electricity could be sourced from the Anixas diesel plant.

If these additional sources of power materialise, NamPower will be able to supply the mines and related industries with sufficient power for any of the proposed mine development scenarios in the short-, medium- and long-term.

7.5.1.2 Power transmission

The supply of electricity is not just determined by the availability of generating capacity, but also by the electrical grid. The high voltage grid system needs to be able to transmit the voltages required and also needs to be configured to a) minimise transmission losses; b) maximise stability; and c) provide emergency power.

The existing transmission network supplying power to the coast consists of a 220 kV transmission line connecting the Omburo (at Omaruru) Substation via the Khan and Rössing Substations to Walmund Substation near Swakopmund. A ring system was created after the construction of the Van Eck – Kuiseb – Walmund 220 kV line in 2003. However, with the envisaged power demands from the uranium mines, NamPower is considering the necessity to reinforce this ring to be able to provide a stable and assured power supply to the mines. NamPower is thus considering a new line from the Khan Substation near Usakos via Valencia and Rössing South, to the Kuiseb Substation (see Figure 7.5.2).

The project currently being rolled out by NamPower is the construction of the transmission network from the Khan Substation to the desalination plant at Wlotzkasbaken, via the Trekkopje mine (Dolerite Substation). NamPower has also issued a tender for the construction of a transmission line from the Khan Substation to the proposed Rössing South Substation. While these projects are being implemented, both Rössing and Langer Heinrich Uranium Mines indicated that they also need higher power supply capacity in the near future.

Figure 7.5.2: Proposed Transmission Network in the Erongo Region

The condition of the existing 220 kV line between Rössing and Walmund (constructed in the early 1980s) is poor as it transverses a highly corrosive area. NamPower is therefore considering dismantling this line and building a new line in its place.

Future projects, dependent on the timing and power supply requirements of the proposed Etango and Tubas Mines as well as the upgrade of the power requirements of Langer Heinrich Uranium Mine, are as follows:

- 220 kV transmission line to connect the future Khan Substation to Kuiseb via the future Valencia and Rössing South Substations;
- Voltage support at Kuiseb Substation, to be operational on a permanent basis, through for example, the installation of an SVC (Static VAr Compensator) or similar dynamic voltage support technology;
- Replacement line from Kuiseb Substation to Langer Heinrich;
- New line from Kuiseb Substation to Etango, with a possible future extension to Tumas.

In addition to this, NamPower will also have to supply electricity to the proposed NamWater desalination plant north of Swakopmund (Figure 7.5.2). This will be a 132 kV transmission line of approximately 44 km from the proposed Dolerite Substation on the Trekkopje – Wlotzkasbaken scheme.

7.5.2 Analysis of cumulative impacts

Cumulative effects in the coastal region will arise from the presence of a diesel, and coal-fired or gas power station at Walvis Bay and the proposed network of transmission lines. These are discussed below.

7.5.2.1 New power station

From the above analysis, it is clear that there is an urgent need for a new source of base load power in the coastal zone of the Erongo Region. The *quickest* supply source to commission would be a diesel power station (as contemplated at Anixas), but these stations are very expensive to run and therefore it would only be operated during emergencies. The best option in terms of national power security and *cleanest* source of power would be a combined cycle gas turbine using CNG (transported from the Kudu gas field), but feasibility studies have only just commenced on this option.

A coal-fired power station would be the *cheapest* to operate, using a known technology, but it would have the greatest number of cumulative environmental and economic effects:

- One of the main pollutants emitted from a coal-fired power station is sulphur dioxide. Background sulphur levels in the Walvis Bay area are naturally quite high. The addition of SO_2 from the power station combined with expected SO_2 emissions from the proposed Gecko Chemical Plant need to be carefully monitored to ensure that they do not combine to cause negative effects on health and biodiversity.

- Another cumulative effect could be on aesthetics and sense of place, depending on the location of the power station. If it is located near the port, then the impact will be low, but if it is located in the designated Export Processing Zone (EPZ) east of the dune belt, it will have yet another impact on a favourite tourism destination – namely Dune 7. However, if the EPZ is developed for other industries – as is contemplated, the views from Dune 7 will be compromised anyway.

- A coal-fired power station will contribute to global warming at a time when steps are being taken around the world (including ironically, nuclear power - one of the drivers for this Uranium Rush) to reduce carbon emissions. The exact amounts that would be contributed from the power station will depend on a) the size of the station; and b) the measures and technologies put in place to minimise emissions of GHGs.

- In comparison to the mines, the power station, when in operation will employ fewer people: 60 will be required to run the 200 MW station, 116 for the 400 MW station and up to 204 for the 800 MW station – this compares to an average of about 800 for each mine. However, during construction, a large number of workers will be required at the same time as construction starts on 2-3 mines and the Mile 6 desalination plant, which will mean that the power station (coal or gas) will have to compete for labour and skills.

- A coal-fired power station is fully dependent on the availability of suitable coal and prone to price fluctuations on the world market.

- Dust emissions at the harbour.

- The construction stage (for any power station) is also likely to add to the congestion on the roads and the importation of coal through the port could stretch port facilities (see section 7.3).

7.5.2.2 Transmission lines

It is estimated that under Scenario 1, approximately 204 km of new lines will be added (including the line recently built to Langer Heinrich and the new ring feed line from Khan to Kuiseb). For Scenario 2, the total length of new powerlines will be roughly 228 km and for Scenario 3 this will increase to some 278 km.

The cumulative effects of the proposed new transmission network include:

- Visual impact. Even with the best route planning, the new power lines – in addition to the existing lines, will have a major cumulative impact on the wide open spaces and landscapes of the Namib-Naukluft Park in particular. As mentioned in section 7.6 on Recreation and Tourism, the sense of space and place is a key drawcard for tourists to the coast and desert. The wilderness qualities so valued by the tourists will be compromised by the presence of numerous power lines and substations. For example, NamPower have carefully routed the proposed Khan-Valencia-Rössing South-Kuiseb line to avoid the tourist views from Welwitschia Flats and the Moon Landscape by taking the line north from Rössing South to run parallel with the existing lines along the main B2 road.

- Several new substations are planned to supply the mines: at Valencia, Rössing South and Dolerite, as well as on the coast at the desalination plants. These structures have the potential to cause a major visual impact and need to be carefully located and designed.

- Another potential impact which is common to power lines is that construction causes tracks across the desert. While these are necessary for construction, they also ‘invite’ unauthorised access to remote parts of the Park. There are already several power lines through the park and additional lines will just add to this potential threat. The cumulative impact of disturbance caused by powerline construction is estimated to be between 4.0-5.5 km^2, depending on the scenario.[1]

- There will be an increased potential for bird collisions due to the number of new lines. The new ring feed line will cross both the Khan and Swakop Rivers and so it will need to be clearly marked with bird flappers in these locations (see Figures 7.5.2 and 7.3.2). In addition, new lines at the coast pose a hazard to migrating birds, particularly flamingos and several bird collision incidents have been recorded along the Trekkopje to Wlotzkasbaken line in recent months (Figure 7.5.2). The main bird groups that are susceptible to colliding with powerlines are bustards, korhaans, flamingos and vultures, all of which occur sporadically throughout this area and most of which are Red Data species. Individual EIAs will need to ensure that the lines are routed to avoid major bird flight paths and that the lines are adequately marked.

[1] This has been calculated on the assumption that the total width of disturbance during construction will be 20 m (pers. comm.. NamPower)

Plate 7.5.1: Powerlines degrade the sense of place of the desert and impact negatively on various bird species (photo J.Pallett).

7.5.3 Desired state

Acknowledging the need for additional power and the unavoidable impacts that this will cause, the desired outcome is that electricity will be available, reliable and affordable for all users in the Erongo Region, when it is required and with as small impact on the environment (primarily visual impact, birds and air quality) as possible.

However, it is also desirable that the demand for grid electricity should be managed so as to reduce the total demand and that the use of alternative sources of energy should be actively encouraged in all sectors.

7.5.4 Recommendations

In order to minimise the cumulative impacts described above, the following recommendations can be made:

- Power demand management should be actively encouraged in all sectors, including the mines, through incentives and subsidies. Measures that need to be considered include: use of solar water heaters; the introduction of passive heating and cooling in all building designs to create energy efficient buildings; use of 'waste' heat from boilers and other industrial plants to generate electricity on site; use of solar panels for borehole pumps and other installations that can be operated using this source of power; etc.;

- The proposed new power station must be fitted with the latest technology to reduce CO_2, SO_2 and NOx emissions to the atmosphere;

- The proposed new power station must be strategically located to minimise negative impacts and to maximise opportunities for synergies with other developments in the area;

- The new power station should be located such that it does not negatively affect tourism and view points;

- The port expansion, or new bulk goods jetty (see section 7.3) needs to be completed before the power station is commissioned to ensure the efficient and safe handling of bulk coal (or gas) imports;

- The proposed new power lines should preferably follow existing infrastructure routes such as roads, railways, pipelines and other power lines. Where this is not possible, the lines need to be carefully routed to avoid tourist routes, view points and bird flight paths;

- Where additional powerlines are contemplated to augment existing supplies e.g. to Langer Heinrich, the old lines should be removed and a new higher voltage line constructed so as to avoid ranks of parallel lines;

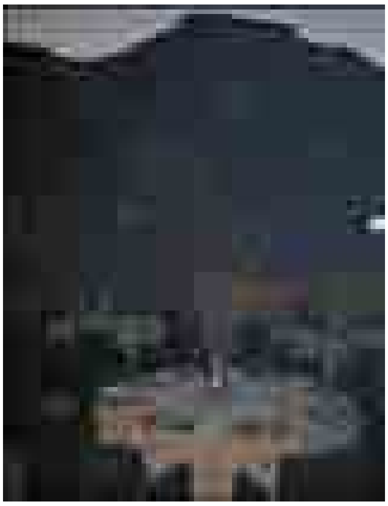
- Bird flappers and other flight diverters need to be placed on all power lines that cross river crossings and bird flyways, especially near the coast. Lines also need to be routed away from the lappet-faced vulture breeding areas at Ganab. These issues should all be addressed in detail in the EIAs for future transmission lines.

- Substations need to be located and designed so that they have a minimal impact on views and biodiversity, while maintaining minimum technical requirements.

7.6 Cumulative Effects Analysis - Recreation and Tourism

7.6.1. Introduction

Residents and tourists to the central Namibian coast define their quality of life as being enhanced by opportunities for sport, exploring the desert by vehicle, relaxing on the beach and living in tranquil towns, angling or adventure activities. Tourism products in the central Namib include adventure tourism (e.g. parachuting and quad biking), business tourism (e.g. workshops and conferences), consumptive tourism (e.g. hunting and fishing) and ecotourism (excursions into the desert). There is also the use of the desert landscapes for filming of documentaries, adverts and feature films[1].



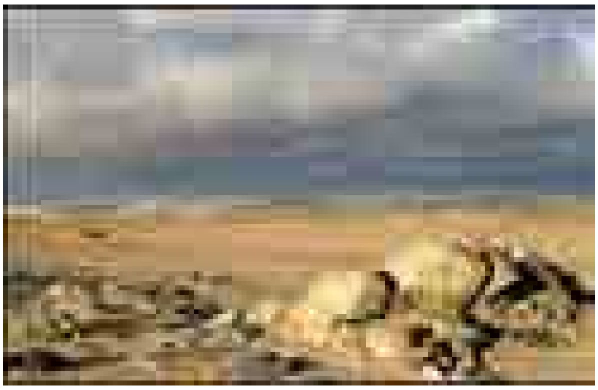


Plate 7.6.1: The central Namib is used for a range of tourism activities, including conference and special events, camping and enjoying the tranquil surroundings, adventure and sport activities (photos P.Tarr and NACOMA).

The tourism sector is of considerable importance to the Namibian economy. It provides over 18,000 direct jobs (5% of total employment), and N$ 1,600 million pa in revenue (3.7% of GDP). The sector has seen significant growth over the past fifteen years, with tourist arrivals increasing more than

[1] Filming is not strictly tourism, but is included as tourism in this SEA

threefold from 254,978 in 1993 to 833,345 in 2006 (NTB, 2007). The coastal region provides 16% of national bed occupancy (an indicator of tourism popularity). National bed occupancy was 53% in 2008 compared to 63% in Swakopmund and surrounds (HAN, 2008). In a survey conducted by NTB (2006-2007) the most popular destinations in Namibia were Swakopmund (30%), Etosha (27%) and Sossusvlei (16%).

The output for the coastal tourism accommodation sector was estimated at N$833.2 million in 2007 (Alberts and Barnes, 2008). They report that the number of international tourists visiting the coast for leisure and business (54% of the total) was estimated at 422,390. Among nature-based tourists, 22% were from overseas, 48% were from southern Africa, and 30% were domestic (Barnes *et al.* 1999). Areas used by the above activities are shown in Figure 7.6.1.

The Goanikontes – Moon Landscape and Welwitschia Flats are common routes for self-drive tourists, environmental tours, bus tours and even scenic flights. Ten of the 13 Swakopmund-based operators interviewed during this SEA offer this area in their tours, but there are no statistics on exactly how many visitors enter the area. One tourist operator specialises in high volume tours to the area from the Walvis Bay harbour (4,000 – 5,000 visitors annually), catering specifically for luxury cruise ships, which occasionally dock at Walvis Bay.

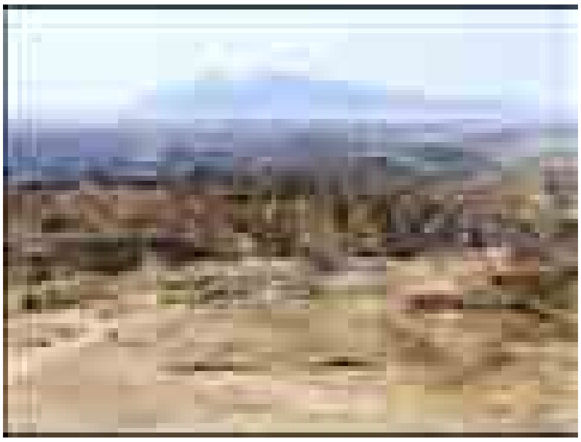


Plate 7.6.2: The Moon Landscape and Welwitschia Drive are routes frequented by almost all tourists who visit Swakopmund, showing off aspects of the Namib's superior tourism features within a short distance from the coastal town (photos P.Tarr and J.Pallett).

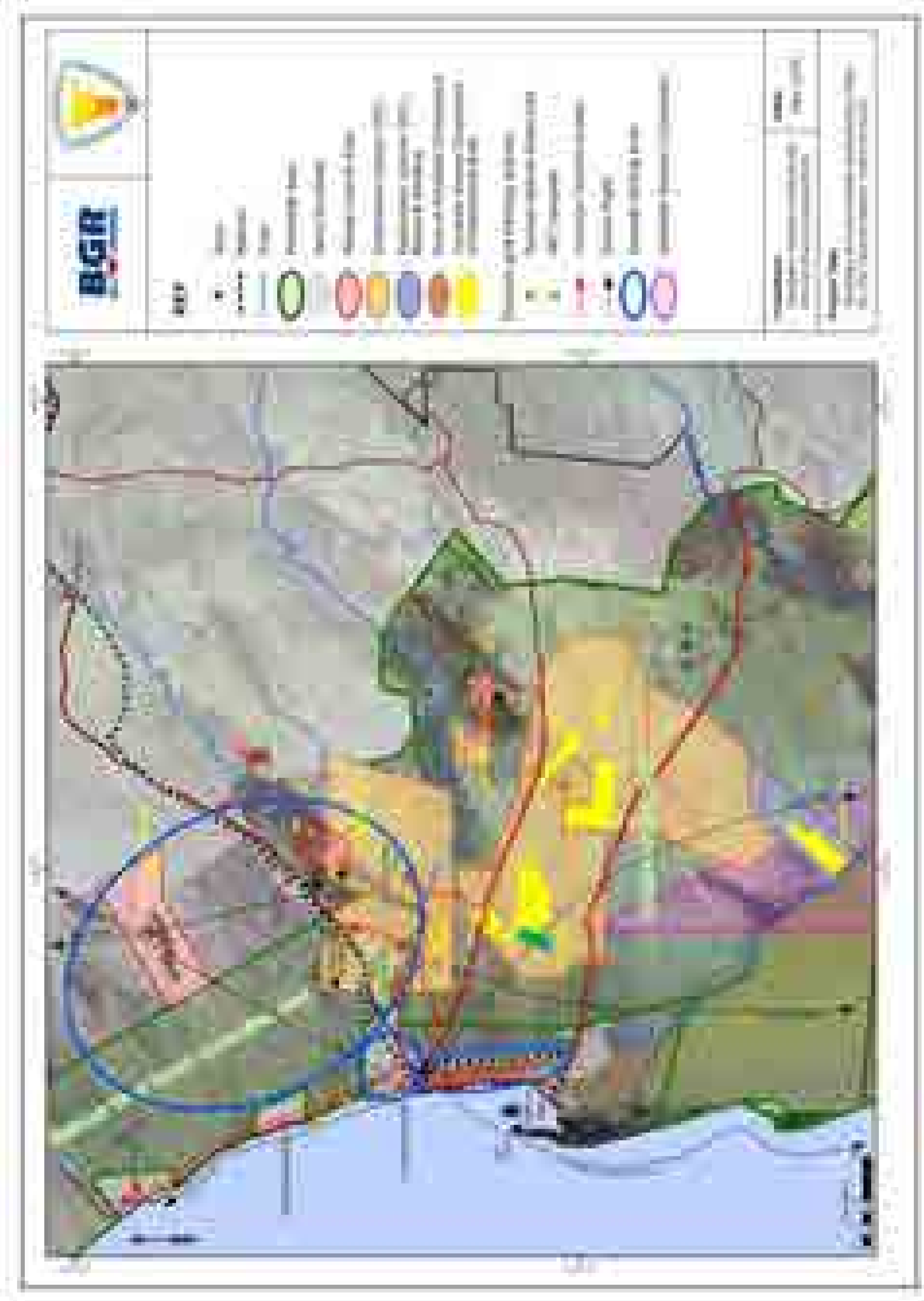


Figure 7.6.1: Map showing areas and routes used for recreation and tourism

7.6.2. Key issues

The most important tourism related concerns can be summarised as:

1. Concerns or perceptions over public health due to radiation exposure (this is addressed in section 7.13);

2. Diminished sense of place due to visual impacts and noise;

3. Actual or perceived loss of unique biodiversity; and

4. Reduced accessibility to sites of tourism importance.

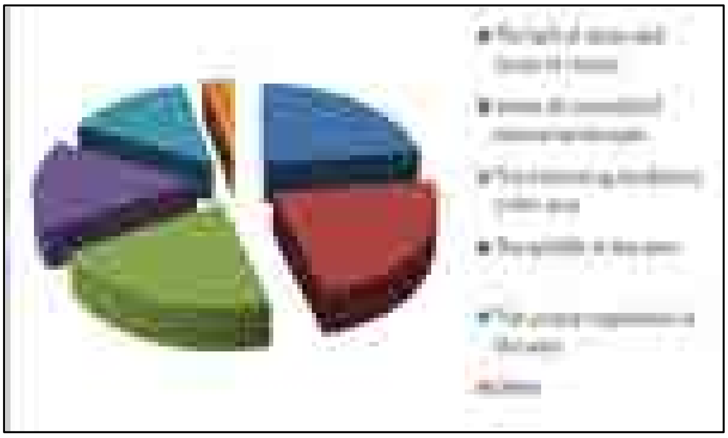


Figure 7.6.2: Tourism operators' perceptions of what makes the central Namib attractive to tourists[2]

Stakeholders interviewed within the tourism industry provided a useful assessment of what attributes are required to 'sell' the Namib to tourists (Figure 7.6.2).

Nine of the 13 tour operators interviewed as part of this SEA stated that landscape modifications from mining structures and related infrastructure would cause the most change to the desert landscape, and therefore impact negatively on its attractiveness to tourists. Also, increased mining is expected to reduce the accessibility of sites in the area for tourism and recreation activities. However, there will be opportunities for significantly increased business and workshop based tourism as well as the direct use of mines as an attraction, building on the popular Rössing tours that have been operating successfully for many years.

Stakeholders also expressed concern about the cumulative impacts of increased mining on the town of Swakopmund, which is marketed as a leisure and tourism destination. They stressed the need to maintain the aesthetically interesting architecture, holiday ambience and peaceful nature of the town. There was a concern over the influx of mining personnel, and the need for ancillary industries to be established in Swakopmund to support the Uranium Rush. It is expected to change the ambience to a more industrialised, busy centre.

[2] Sample size: 13 operators

A number of stakeholders were concerned about mining and exploration employees and contractors poaching wildlife. Sixty percent of tour operators rely on wildlife as a key component of a unique desert experience for tourists. They report a recent reduction in wildlife numbers in certain areas, and an increase in avoidance behaviour by wildlife species.

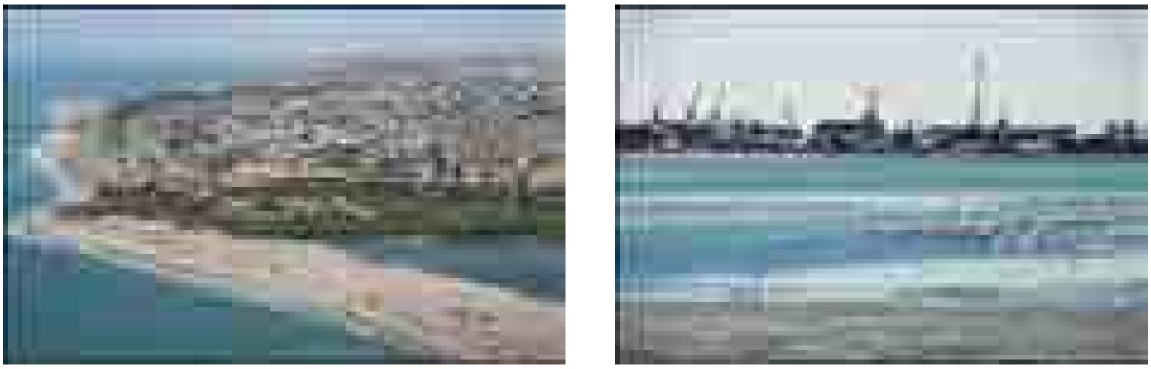


Plate 7.6.3: Swakopmund (left) is renowned as a quaint coastal resort town with a strong tourism appeal. Walvis Bay has more of an industrial character yet has also experienced growth in its tourism attractions which are largely focussed on the lagoon and nearby sand dunes (photos NACOMA).

7.6.3. <u>Assessment of direct, indirect and cumulative impacts</u>

In the context of public recreation and tourism, the main impacts likely to result from the Uranium Rush are listed as follows, and then discussed in more detail below:

- Visual impacts and noise, leading to compromised natural beauty and deteriorating sense of place;
- Loss of access to recreation and tourism destinations;
- Deterioration of roads; and
- Pressure on social and physical infrastructure as a result of escalating population influx.

The **natural beauty and ambience** of the desert will be compromised by the Uranium Rush, because prospecting and mining results in visually intrusive infrastructure, creates dust and noise, and will scar the Namib for decades or longer.

For this reason, the SEA commissioned a specialist study to assess the potential visual impacts of the Uranium Rush. The cumulative visual impacts (without and with mitigation) of multiple mines in the area were assessed using a Digital Elevation Model, and mapped. The following figures illustrate the possible visual impacts of the three Uranium Rush scenarios, assuming mitigation is applied (Figures 7.6.3 – 7.6.5).

The visual impacts of current mining are relatively low because Rössing Mine is situated in an area with high visual absorption capacity (Khan Valley) and as a result, the exposure of the more industrial structures, such as the processing plant, waste rock dumps and pit, have been concealed. Rössing is far from popular tourist destinations but nevertheless, there have been reports that mining activities can be heard at night from camping areas in the NNP.

Langer Heinrich Mine is located in a valley with the Langer Heinrich Mountain as a backdrop, and is thus barely visible from the C28. However, it is audible from the Bloedkoppie camp site and visible from the Bloedkoppie view point during both the day and night, thus diminishing the sense of place at this tourist spot.

The proposed Valencia mine is also located in the rugged topography of the Khan Valley, which will partially conceal features such as the open pit. The tailings dam, however, will be located on an open plain and will be visible at a distance from the B2. The Trekkopie mine does not have the advantage of topographic screening, since it is situated on open gravel plains. However, this area is not used for desert tour drives and the mine is located approximately 30 km from the B2. The mine will be visible to tourists on pleasure flights from Swakopmund to Spitzkoppe. It is likely that the waste rock will be dumped in the shallow pits as mining progresses laterally at both Trekkopie and Langer Heinrich, thus reducing visual impacts. Noise will be less of a problem at Trekkopje and Valencia mines because they are both remote from popular tourist destinations.

Other than from drilling activities, the Moon Landscape and Welwitschia Drive areas would not be visually impacted under Scenario 1.

For Scenario 2 there are significant impact differences between 'with' and 'without' mitigation. This is because Rössing South and Etango will both be deep pit mines with large waste rock dumps. These mines will visually influence the Welwitschia Flats from which three mines could be visible from a single location, significantly changing the area's sense of place. Given the Moon Landscape's very close proximity to the proposed Etango mine, there will also be a major deterioration to this area's sense of place. However, it may be possible to re-route tourist roads so that the mines are less visible from public access areas.

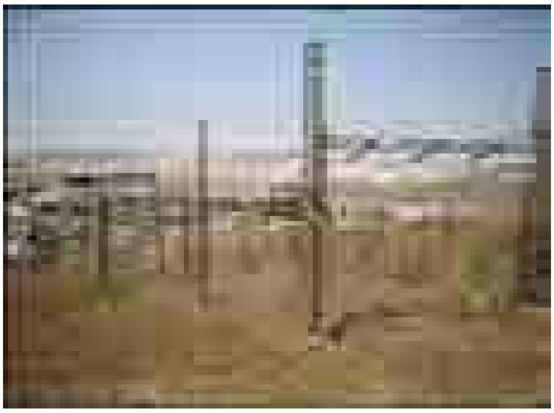


Plate 7.6.4: The visual, noise and sense of place impacts of a mine the size of Rössing are major. Rössing benefits from the fact that it is largely hidden from view along major tourism routes in the Namib (photos J.Pallett).

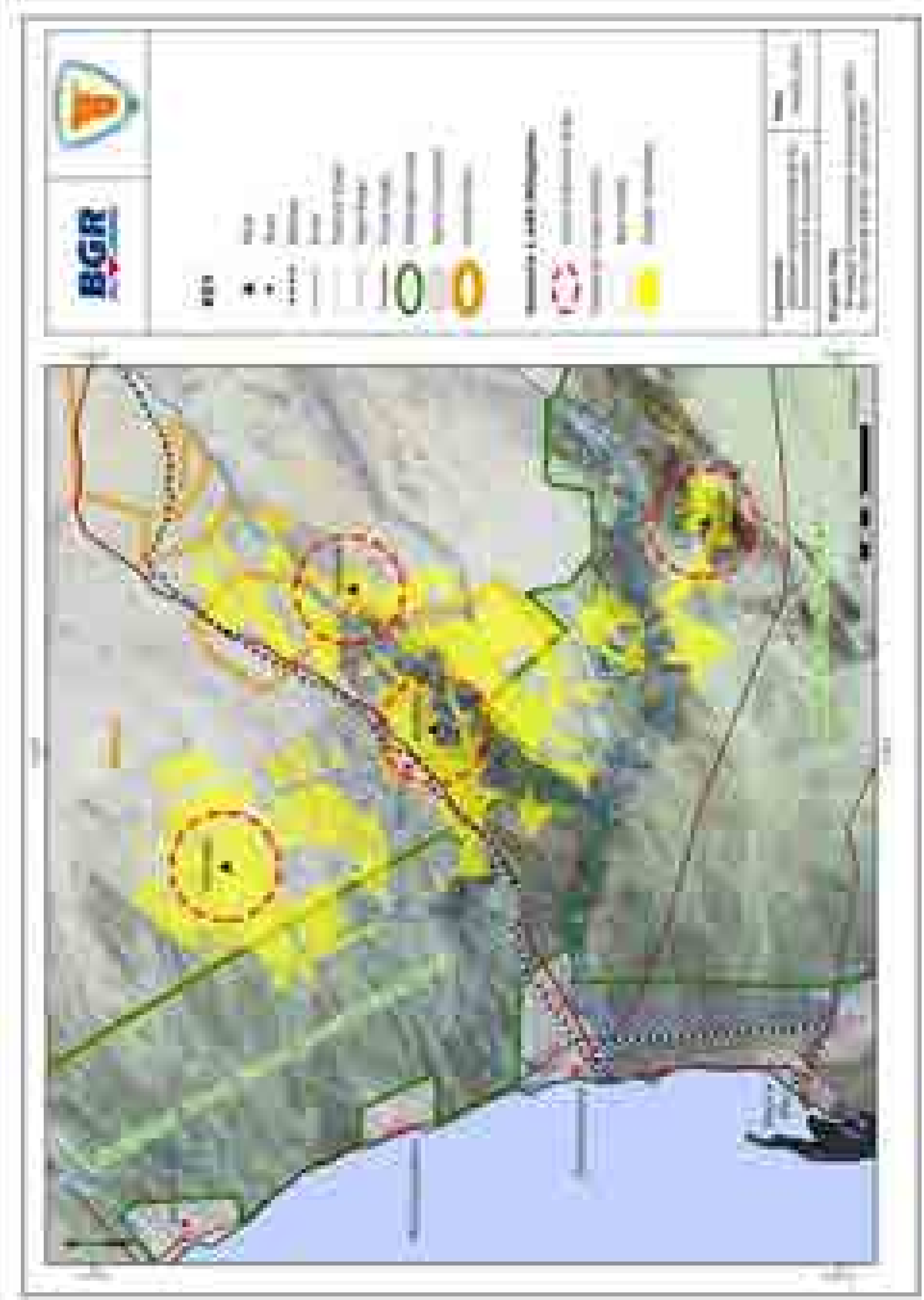


Figure 7.6.3 Predicted viewshed and visual influence of scenario 1 mines with mitigation

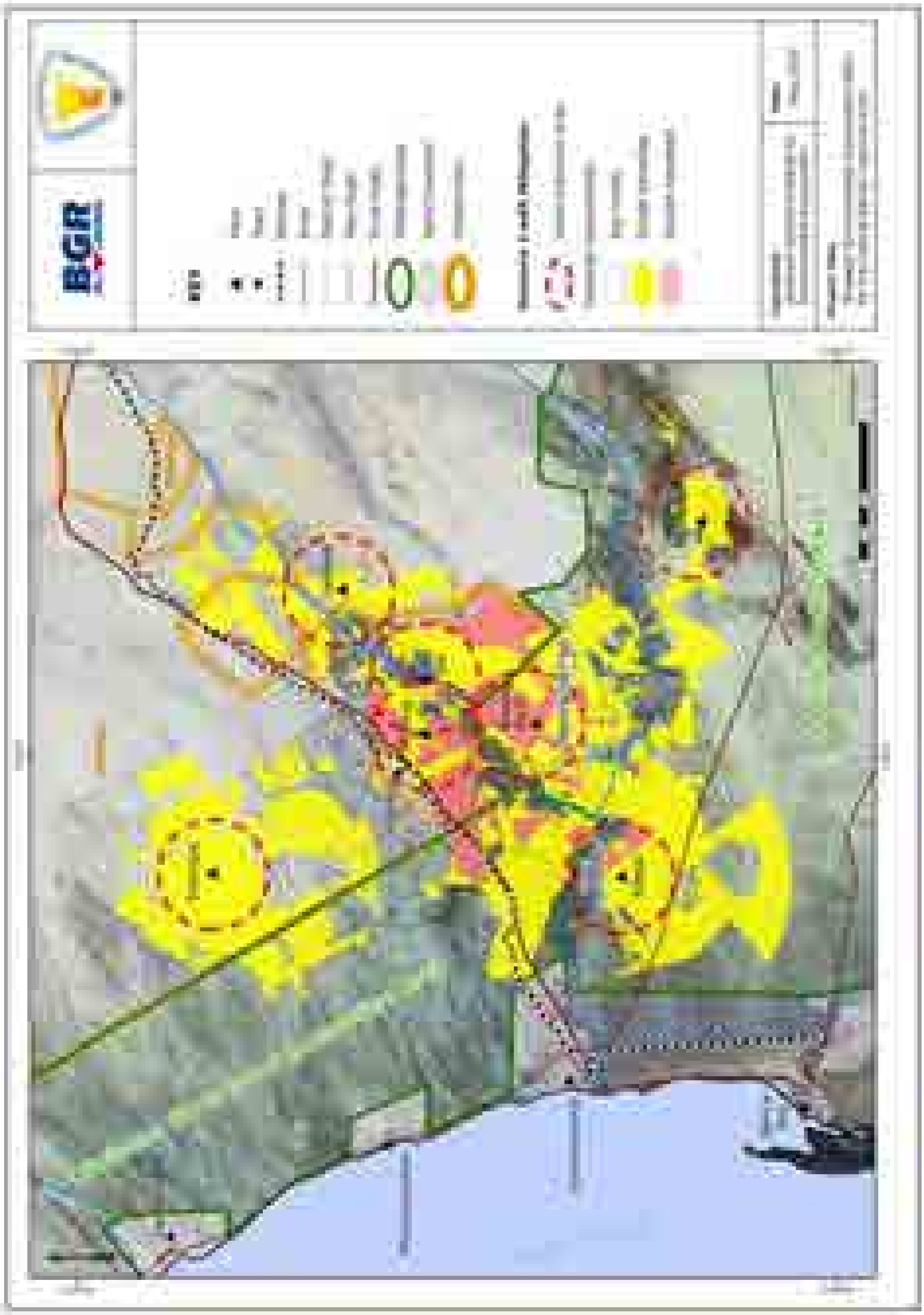


Figure 7.6.4 Predicted viewshed and visual influence of scenario 2 mines with mitigation

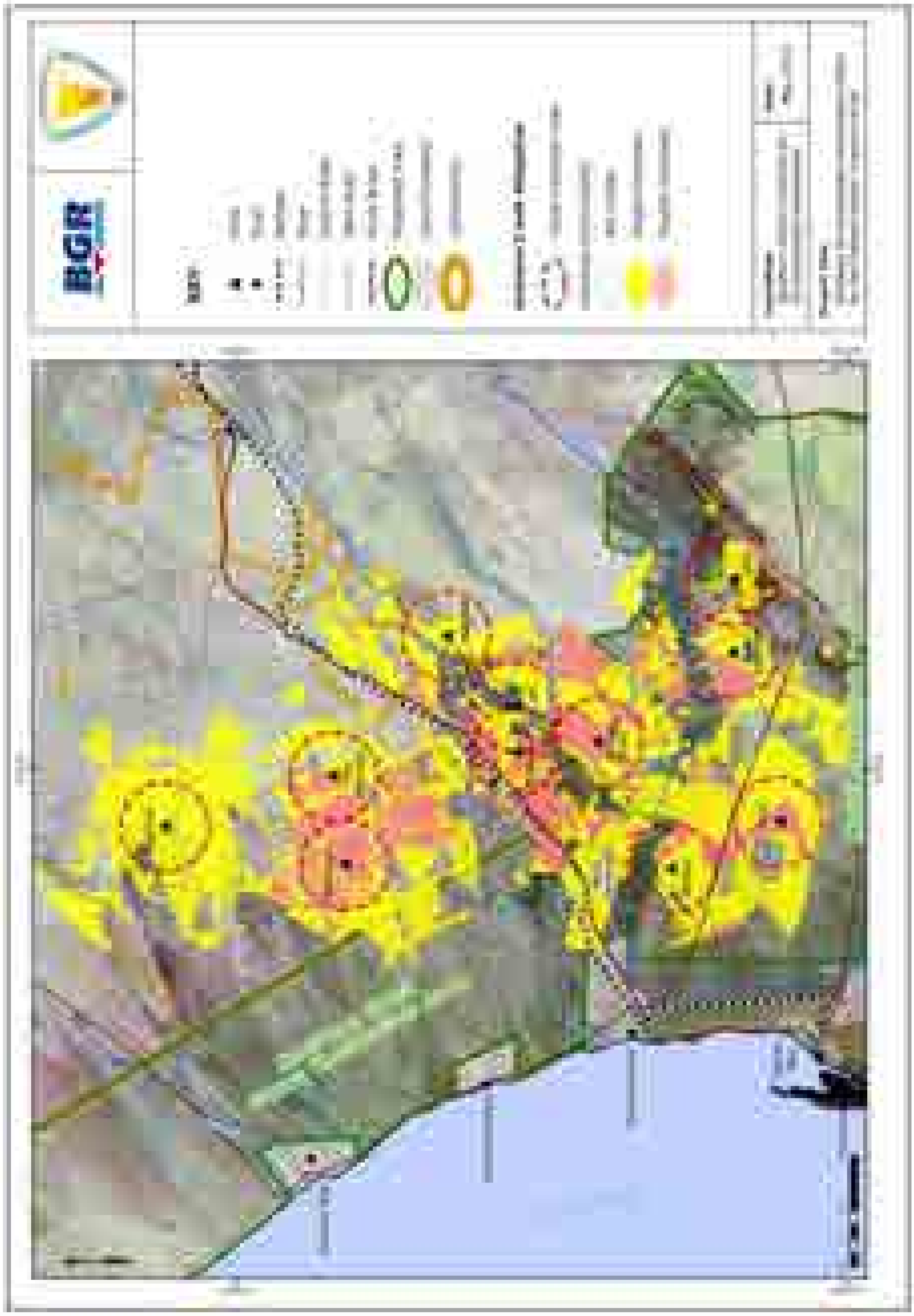


Figure 7.6.5 Predicted viewshed and visual influence of scenario 3 mines with mitigation

Mitigation requires back filling where possible, and landscape shaping of the remaining waste rock dumps as well as a reduction of height from 80 m to 40 m. This would significantly reduce the inter-visibility in the Welwitschia Flats access areas. Areas previously associated with the visibility of two mines would be restricted to partial visibility of one mine at a time. With careful positioning and height restriction of the Etango waste rock dumps, mining activities (other than blasting plumes) would not be visible from the Moon Landscape, however, the mine would still be audible to visitors. However the close proximity of the proposed Rössing South mine to the Welwitschia Flats would result in the potential impact of those areas within the visual intrusion buffer. The possibility should be investigated of creating a new tourist route to the Welwitschia Flats to the south of the proposed Rössing South mine, taking advantage of the topography to afford both visual and acoustic screening.

The existence of EPLs and mines, and their right to **exclude locals and visitors** from their areas, limits the places available for tourism and recreation, though some new tourism products could be developed (e.g. mine tours). Also, it may be possible to create new tourist and public roads, alternative viewpoints and campsites, so that there would be no net loss in terms of tourism and recreation opportunities.

Vehicles linked to prospecting and mining might **degrade gravel roads** in parks and other areas, making travel unpleasant and uncomfortable for locals and tourists, while **human influx** in coastal towns will place greater pressure on social and physical infrastructure, though the economic boost resulting from the Uranium Rush will also result in benefits, such as:

- Investments in new infrastructure (roads, seawater desalination plants, shops, hotels) that will be positive for locals and tourists;
- Increased business for local service providers (retailers, restaurants, adventure sports, etc.);
- Increased business and workshop tourism;
- Improvements to schools, clinics and other facilities which are needed to maintain investor interest; and
- Increased tax base and spending, which will contribute to the municipal budgets and thus increase the likelihood of improved service delivery and the provision of amenities.

Given that so many impacts relating to the Uranium Rush are interlinked, there are many cumulative impacts: for example, the proliferation of mining related infrastructure (e.g. powerlines, pipelines, roads and railways), added to the alienation for mining of areas previously used for public recreation and tourism, effectively means that one land use may displace the other (if not properly managed), resulting in opportunity costs for the tourism industry. Add to this:

- Increased crowding and industrialisation in coastal towns such as Swakopmund (which is essentially a tourist town) and subsequent avoidance of Swakopmund as a tourist destination;
- Real or perceived increased health risks because of radiation;
- Social impacts because of in-migration of job seekers (many of whom will not succeed in finding a job, resulting in them seeking other means – possibly crime to make ends meet), and an increased strain on infrastructure (ranging from parking, roads, sewerage, electricity, waste).

In addition to the direct impacts of the Uranium Rush discussed thus far, there will also be a host of impacts from other industries emerging to take advantage of the opportunities offered by the Uranium Rush. Examples are:

- New power station at Walvis Bay (either coal or gas, and diesel);
- New desalination plants (Wlotzkasbaken and Mile 6);
- Proposed acid and alkaline chemical plants at Arandis and north of Swakopmund, with associated salt and marble mining (Gecko Minerals and Gecko Chemicals) and emission of odour and fumes;
- Port expansion at Walvis Bay;
- Possible bulk materials jetty north of Swakopmund;
- Probable revitalization of the Export Processing Zone (EPZ) at Walvis Bay;
- Rapid urban development (Walvis Bay, Langstrand, Swakopmund); and
- Rapid growth in the light industrial and service sectors.

When one considers the combined impacts of the Uranium Rush and the other likely projects which are, to a large extent, linked to uranium prospecting and mining, one concludes that the cumulative impacts will likely result in a deterioration of most forms of tourism (notably desert tours and pleasure flights) and some forms of public recreation (notably desert excursions) if not addressed and mitigated during the planning and feasibility stages of all mining and related projects.

7.6.4. Desired state

MET's vision is "*a mature, sustainable and responsible tourism industry contributing significantly to the economic development of Namibia and the quality of life of all her people, primarily through job creation and economic growth*" (MET, 2008).

To achieve this vision, conducive conditions must be created for recreation and tourism. These are linked to a great number of the EQOs that have been developed as part of the Uranium Rush SEA, and include access to safe water, suitable infrastructure, a broad range of goods and services, accommodation and housing, access to the desert, low crime, good air quality, road safety, low noise levels, good governance, intact ecosystems and biodiversity, natural beauty and a conducive 'sense of place' (see Chapter 8). In many ways, sense of place encapsulates nearly all of the EQOs and is therefore at the heart of the Uranium Rush SEA.

7.6.5. Recommended avoidance, enhancement and mitigation measures

From a strategic point of view, avoiding and/or reducing negative impacts of the Uranium Rush on public recreation and tourism is required. In order to avoid or mitigate conflicts between these two key sectors, important tourism and recreation areas have been categorised as 'red' or 'yellow flag' areas (Figure 7.6.6). Application for mineral licences in both these categories of areas requires very careful consideration by the relevant government agencies (see Chapter 8).

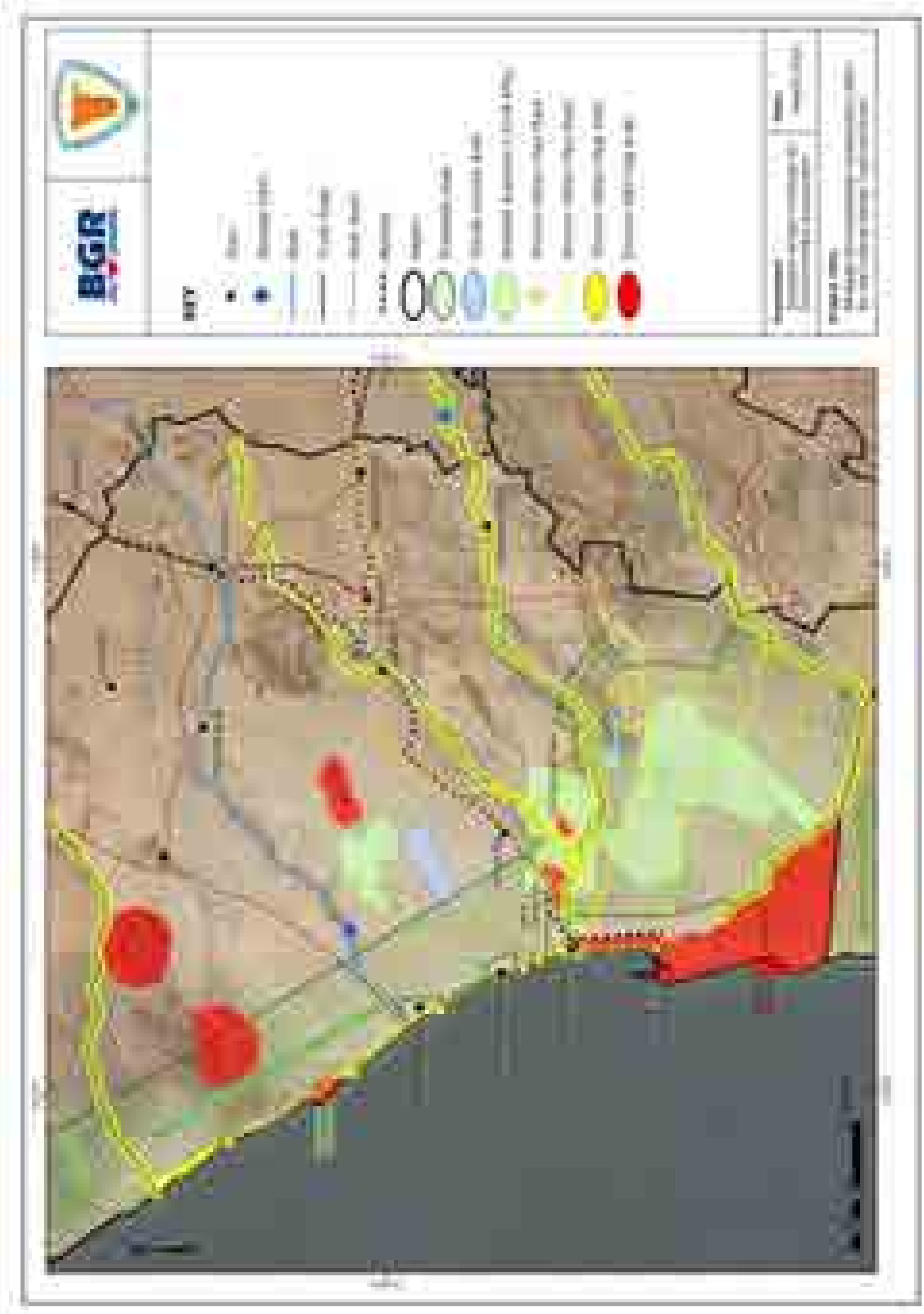


Figure 7.6.6: Red and Yellow Flag tourism areas

The proposed 'red' and 'yellow' flag areas are as follows:

Tourism Red Flag Areas: Unique areas of high importance for recreation[3] should be declared as 'red flag' areas for future prospecting or mining. In some areas such as Messum Crater, Spitzkoppe and Brandberg small scale mining has been present for years and is still being carried out today. Salt has been mined at Cape Cross for decades and there are plans to reactivate this mine (Chapter 4). The fact that mining has occurred, and continues in some of these areas should not negate the designation as a red/yellow flag area from a tourism perspective. The red flag areas include (see Figure 7.6.6):

1. Messum Crater;
2. Spitzkoppe;
3. Brandberg;
4. The dunefields;
5. Sandwich Harbour;
6. Moon Landscape;
7. Cape Cross, and
8. The Welwitschia Plains.

Tourism Yellow Flag Areas: These areas are popular amongst local and regional tourists. In some cases, it may be possible to provide a like-for-like alternative when a recreation or tourism area is 'alienated', so there is no net loss. These are 'yellow flag' areas:

1. The Swakop, Khan, Ugab and Kuiseb rivers;
2. The Erongo coastline from the low water mark to the main north-south coastal road;
3. All campsites within the Namib-Skeleton Coast National Park (NSCNP); and
4. Major tourist roads in the NSCNP.

To achieve relative harmony between recreation/tourism and mining and to minimise opportunity costs, there also needs to be institutional reform and the creation of partnerships. For example:

- All prospecting and mining to conform to Best Practice;
- Wherever possible, establish support infrastructure in defined 'corridors';
- Closer cooperation between MET and MME, so that new licences are carefully scrutinised before they are granted (see Chapter 8);
- In the management and development plans for the coastal parks, it is specified that each park will have a multi-stakeholder Consultative Forum, which is designed to support GRN in running the parks. Perhaps this forum could advise on future prospecting and mining licences, as well as assist with monitoring of prospecting and mining;

[3] These are places which have national importance and significance from a tourism and landscape perspective.

- Create a functioning SEMP office to provide input into the decision making process, opportunities for stakeholder dialogue and monitoring (see Chapter 8).

Capacity building is required, especially to enable MME and MET staff to interact confidently with prospecting and mining companies and personnel – current skills in this regard are inadequate. However, GRN might consider/could be encouraged to outsource EIA guide and review, as well as post implementation monitoring, to professional service providers. The costs of this outsourcing must be borne by the proponent (e.g. mining company). This is in line with the Polluter Pays Principle and the Environmental Management Act of 2007.

In spite of the many threats posed by mining to public recreation and tourism, there are opportunities for synergy between the companies that are part of the Uranium Rush, and between mining and other industries in the Erongo Region. In the context of public recreation and tourism these include:

- Supporting coastal conservation efforts (see section 7.7);
- Supporting public awareness campaigns about the desert and the importance of conservation (as above);
- Establishing new roads to various tourist attractions (e.g. Welwitschia Flats);
- Establishing new, replacement tourist attractions (e.g. an alternative 'Moon Landscape');
- Assisting local and national authorities with maintaining key infrastructure, including maintaining gravel roads in the NSCNP;
- Assisting local authorities to maintain public open spaces;
- Assisting local authorities and the police in combating crime (see section 7.2);
- Boosting local economies, with the resultant socio-economic spin-offs;
- EPL and Mining Licence holders may have to make compromises and develop offsets as part of their social 'licence' to mine, especially in a national park and important tourism area.