PROPOSED HYDROPOWER STATION ON THE FARM RIEMVASMAAK (REMAINDER OF FARM NO. 497 AND PORTION OF FARM NO. 498) ON THE ORANGE RIVER, NORTHERN CAPE

ECONOMIC IMPACT ASSESSMENT

Specialist Study Report

Prepared for:
Hydro SA (Pty) Ltd.
PO Box 428
Tableview
7439

Prepared by:
Imani Development (SA) (Pty) Ltd.
PO Box 1066
Umhlanga Rocks
4320

Contents

ABBREVIATIONS AND ACRONYMS

ACER	ACER (Africa) Environmental Consultants
AFNP	Augrabies Falls National Park
bn	Billion
CES	Coastal and Environmental Services
DEA	Department of Environmental Affairs
DM	District Municipality
DOE	Department of Energy
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GWh	Gigawatt
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IDSA	Imani Development South Africa (Pty) Ltd.
IPP	Independent Power Producer
Km	Kilometre
kV	Kilovolts
LM	Local Municipality
MW	Megawatt
m^3	Metres cubed
mn	Million
ORWC	Orange River Wine Cellars Cooperative Limited
REIPPP	Renewable Energy Independent Power Producers' Programme
RFP	Request for Proposal
RVM	Riemvasmaak Hydroelectric Project
RCT	Riemvasmaak Community Trust
SAM	Social Accounting Matrix
SATI	South African Table Grape Industry
SANParks	South African National Parks
StatsSA	Statistics South Africa
VAT	Value Added Tax

EXECUTIVE SUMMARY

INTRODUCTION

Scope of Project

RVM1 Hydro Electric Power (Pty) Ltd has identified the Riemvasmaak Hydroelectric Project (RVM) on the Orange River in the Northern Cape. The scope of work was to conduct an independent cost-benefit analysis.

METHODOLOGY

Both qualitative and quantitative data analysis techniques were applied (using primary and secondary data sources) in this specialist study.

Data Collection

Data were collected through a combination of desk research and fieldwork. A field visit to the study area was conducted between 9-13 March 2015.

Macroeconomic Impact Assessment

A Social Accounting Matrix (SAM) is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents that exist within an economy during a given period of time, usually one calendar year.

A SAM is a powerful tool that can be used to conduct various macroeconomic analyses such as calculating sectoral multipliers. Macroeconomic modelling calculates the impact that a specific event such as an investment project would have on a variety of economic indicators. Two of the most frequently measured indicators are GDP and employment creation.

GDP reflects the magnitude of the value added in the economy as a result of capital spending on investment projects.

Labour is a key component of the production process. Macroeconomic impact analysis determines the number of new jobs that will be created by the construction and operation of a particular project. The jobs created during the construction phase of a project will be mostly temporary, while those created during the operational phase will be mostly permanent.

Assumptions and Limitations and Gaps in Knowledge

Assumptions:

- The information and data provided by the client are accurate (especially with regard to the rate of water abstraction from the Orange River and its effect on the Falls and farmers).
- The cost data for the financial model are accurate.

Limitations and gaps in knowledge:

- Only a preliminary engineering study was available to complement the financial model. A more detailed study will be done only should the IPP be a preferred bidder.
- The lack of cooperation from SANParks.
- The lack of disaggregated economic data on the study area especially for agriculture and tourism (output, numbers, values).

- The lack of data for the production of 1kWh of power from small hydro schemes in South Africa.

THE ECONOMY OF THE AREA

The RVM hydropower project is located in the Kai!Garib Local Municipality.

Structure of the Economy

In the Kai!Garib municipal economy, just over one-half of the GDP is accounted for by the agricultural sector. It appears from the IDP that this covers both agriculture and agro-industry.

Sectoral Analysis

Agriculture

The agricultural sector is dominated by fruit, livestock and game farming. The main activity is the production of table grapes but there has been an increase in citrus growing while lucerne, dates and nuts are also grown.

There is a paucity of disaggregated production data, the last Agricultural Census having being undertaken in 2007. The reports from this Census are at a provincial level. Among private-sector agricultural bodies, the available statistics are mainly at the provincial level or the Orange River regional level, depending on the source.

The production of grapes has led to the construction of packing stores and cool rooms on major farms as well as in Kakamas. The industry as a whole has transformed the economy of the area since the 1960s.

Manufacturing

The importance of the manufacturing sector might be understated: it appears that agro-industry is included under the agricultural sector rather than under manufacturing.

Tourism

Although new investment continues to be attracted to this sector, the Siyanda IDP pointed out that the volume of tourists was insufficient to act as a driver of the economy. Nonetheless, it was the fastest-growing component of the economy between 2007-11. The Kai!Garib IDP states that there is substantial growth potential in the sector.

Retail and Services

This sector has grown but its potential is limited by the small size of the market. The size of the Kakamas retail and wholesale sector in terms of annual turnover was estimated by a leading enterprise at about R750 million.

Transport and Communications

The growth of irrigated agriculture in the LM has led to the establishment of a substantial local trucking and logistics sector.

Summary

The economy of the Kai!Garib LM is small in relation to the national economy and might be about 17% of the provincial economy. It is dominated by agriculture and agro-industry which have substantial linkages with other sectors such as trade,

transport, logistics, construction, utilities and financial services. The agricultural sector is highly dependent on the availability of water from the Orange River. A promising opportunity for economic diversification lies in the field of power generation using the area's endowment of renewable energy sources such as sun, wind and water.

COSTS

Capital

The projected capital costs of construction are R1.042bn for the plant excluding VAT and finance charges.

Operating

The projected operating costs comprise fixed and variable costs and working capital which is recovered in the final year of the financial model (2037).

BENEFITS AND IMPACTS

Agriculture:

Concerns

According to a spokesman for water users in agriculture, the farmers closest to the weir site had a number of concerns relating to the project.

- The impact of the weir on spray irrigation in the immediate vicinity as well as on the islands in the river.
- The impact on drainage on the islands.

However, these concerns have been alleviated as the envisaged height of the weir has been reduced by 2 metres. The only concerns mentioned by these farmers related to the dust problem and the standard of the road that would be used for the project. The logistics associated with the project was seen as the major issue. Nonetheless, all these farmers interviewed were positive about the project, feeling that it would be beneficial for the local economy. The farmers were sufficiently far upstream of the weir and thus would not be affected.

Impact of Dust on Grapes

Dust is an inherent problem in a semi-arid area. This is commonly mitigated through watering (using water tankers or a sprinkler system). The latter generally seems to be regarded by farmers in the area as a successful way of mitigating the impact of dust. Nonetheless, it is certain that an increase in the number of vehicles on the road during construction will produce greater volumes of dust.

Condition of Road

The dust problem is linked to the condition of the road that would be used for the RVM hydropower project. This road (the one that serves the Schroeder Farmers' Association between Kakamas and the Augrabies Falls on the north side of the Orange River) needs to be regravelled, and better maintained by the road authorities if it were to carry construction traffic (including heavy vehicles) for the RVM hydropower project, otherwise the farmers will be faced with higher transport costs.

Tourism

There are eight private/guest lodges in the area between the village of Augrabies and Dundi Lodge just west of the turnoff to the Augrabies Falls National Park. Two

lodge managers with lengthy local experience were interviewed and taken as representative of the views of private operators.

None of the interviewees believe that the RVM hydropower project would have an adverse impact on tourism in the area, particularly in the operational period. The establishments were in favour of the project because of the business it would generate for them during the construction phase. There would be a spin-off for the lodges from the flow of specialists and service personnel who would visit the site during construction.

A rough calculation indicates that total turnover for the lodges and guest houses could amount to approximately R23.765 million during the construction phase. The benefit to the economy from this expenditure is represented by the additional profit accruing to the lodges. The additional profit from this expenditure could amount to about R2.38 million over the three years of the construction phase.

Repeated requests to SANParks for information regarding its views on the project were ignored.

The economic consultants do not believe that there are any impacts either positive or negative that can be quantified for the purpose of the CBA.

Retail and Wholesale and Other Sectors
Other sectors of the local economy would naturally derive benefits as a result of the expenditure multiplier effects of the RVM hydropower project. These benefits are difficult to quantify for each sector and best lend themselves to treatment in a social accounting matrix (SAM) model (economic impact study).

The economic benefit from the project would be the increment to profits accruing from spending linked to the project (on supplies and by employees). At this stage of the planning for the project, no procurement expenditure details were available, and thus it is not possible for the Consultants to quantify what the additional profits linked to the project might be. Instead, this expenditure is included in the multiplier effects in the SAM model.

The Riemvasmaak Community
A meeting with the RVM Development Committee was held, and the RCT was contacted telephonically. It was clear from these interactions that the Trust and Committee are very strongly in favour of the RVM hydropower project.

The Trust handles the funds which accrue from projects on RVM land, the main ones being the hot springs 5km outside the village, two grape farms, and Melkbosrand Farm which is leased to SANParks. So far as funds accruing to the Trust from the RVM hydropower project are concerned, the RCT will receive:

- Rental income from the IPP since the community owns the land on which the facility will be located.
- Dividends from profits on the RVM hydropower project. As stated in the lease concluded with the RVM Trust, the local community will have a shareholding of between 10 - 15%, in order to provide it with sustainable, long-term income from the project.

The Administrator of the Trust stated that the projected average annual rental will be R13.1mn per annum and the expected average dividend incomes will be R26.6mn per annum.

Both the Committee and the Trust feel that, if the farms on RVM land are further developed, unemployment will be substantially eliminated as they will provide work for the youth in the age group 16-34 years among whom unemployment is a major social and economic problem. The Riemvasmaak Development Committee has requested that the RVM community be given preference in employment, but in fact all communities within a 50-km radius will also have access to work on the project. The IPP estimates that it will be able to provide about 150 - 200 jobs for local residents during the construction phase and a small number (perhaps 5 - 10) during the operational period.

In view of the RFP requirements that will have to be met by the IPP, the expectations of the Riemvasmaak Trust and Development Committee appear to be well-founded. There was real belief in the community that the project would yield benefits that would provide a secure and sustained economic future for Riemvasmaak.

Other Community Trust

As stated in Section 1.2.1, the Department of Energy, in its Request for Proposals (RFP) under the REIPPP, has stipulated that the local community must have a shareholding of between 2.5 and 5%. Therefore, and in addition to the RCT, a second trust – a broad-based black economic empowerment trust covering other previously disadvantaged communities, within a 50 km radius from the works, will be established, and this will also participate in the shareholding and hence receive dividend income (approximately 5% of profits).

Based on projected turnover of the RVM hydropower project, it is estimated that around R13mn per annum on average will be allocated to the Broad-based Community Trust. The income that the community will receive from the project can be used to stimulate new economic activities.

Expenditure on Community Development Projects

The RFP obliges the IPP to spend between 1-2.5% of its revenue on social, educational and healthcare causes in the community and on projects that promote business development. The income that the community will receive from the project can be used to stimulate new economic activities. Based on projected turnover of the RVM hydropower project, it is estimated that around R23mn per annum will be allocated to spend in the community[1]. This income flow to the community is guaranteed since the process is monitored strictly by the DOE's Monitoring and Evaluation Department, and IPPs are required to submit monthly Construction Reports and quarterly Economic Development Reports. Non-compliance would lead to the imposition of penalties or to termination, and would put the Power Purchase Agreement at risk.

[1] As stated in Section 3.3, the community is defined in the RFP as all towns and settlements within a 50-km radius of the facility.

Power Supply
One of the major benefits from the RVM hydropower project would be its contribution to a more assured baseload power supply (hydroelectricity is not only renewable but also baseload energy) for the population in the Kai!Garib Local Municipality. However, this would be the case only if the power generated were "ring-fenced", that is, it were supplied only to the local area. In reply to a question as to whether energy from the scheme would be ring-fenced, Eskom advised that it would not.

Thus, the presence of a local hydropower project would not guarantee immunity to local consumers from any load-shedding occurrences. Indeed, this has already been the experience from the Neusberg hydropower scheme on the Orange River between Kakamas and Keimoes.

Estimating the Benefits of Hydropower as Green Power
The economic benefits from the scheme would accrue at the national level in the form of any lower costs of energy production that might occur from a small hydropower scheme as opposed to existing sources of power.

The appropriate comparison would be between the costs of production per kWh from small hydropower plants and coal-fired power stations. Unfortunately, however, there are no comparable robust data on the cost of producing 1 kWh of power from coal and small hydro schemes in South Africa that could be used with confidence in a cost-benefit analysis. The REIPPP figures for hydro appear to range between R1.03-1.20/kWh which would put it in the upper range of coal-fired energy production costs. If the production costs of 1kWh of energy from hydro and coal were broadly similar, hydropower would be preferred because it is a form of clean energy, and this is reflected in carbon savings.

The economic benefits of the project that were then identified consist of revenue from the sale of energy back to the national grid and carbon saving from producing energy from a cleaner source.

Impacts Identified in Other Specialist Reports
A number of impacts of an economic nature were identified in other specialist reports. They are:

- In-migration of unskilled labour
- Increased opportunities for small enterprises and informal traders
- Temporary and permanent loss of land
- Temporary disruption of farming activities
- Noise and visual impacts

However, none of these were considered by respondents in the field interviews to be issues of concern.

Impacts Identified and Assessed
The following impacts with economic ramifications were identified during fieldwork and are assessed in Chapter 8:

- Increased dust - construction phase
- Road impacts - construction phase
- Increased tourism bed-nights - construction and operational phases
- Increased retail turnover - construction phase

- Increased employment - construction and operational phases
- Benefits for RCT - construction and operational phases
- Impacts on energy - operational phase

MACROECONOMIC IMPACT

The time requirements to undertake a full SAM stretch beyond the timelines for this analysis. Accordingly, the Consultants have used the Northern Cape SAM multipliers as constructed by the DBSA Information Analysis Unit and have applied it to Kai!Garib. The relevant multipliers are those for the energy sector. The multiplier for an investment project's impact on GDP and employment per R1 million investment are 0.31 and 0.92 respectively.

The multiplier effect shows that investment spending of R1 results in a multiple of that R1 in the overall output of the economy.

The impact on GDP in the Northern Cape of building this hydro station is R513mn.

The SAM for the Northern Cape also indicated that the impact on employment per R1mn investment results in 0.92 jobs being created. This indicates that, over the project's construction, the following total (direct and indirect) number of jobs will be created:

- Year 1: 336
- Year 2: 278
- Year 3: 345

ASSESSMENT OF IMPACT SIGNIFICANCE

Construction Phase Impacts	With Mitigation	Without Mitigation
Increased Dust	Low	Low
Road Impacts	Low	Moderate
Increased Tourism Bed-Nights	Moderate	N/A
Increased Retail/SME Turnover	Moderate	Moderate
Increased Employment	Moderate	Moderate
Benefits for RCT	Moderate	N/A
Operation Phase Impacts		
Increased Tourism Bed-Nights	Moderate	N/A
Increased Employment	Moderate	N/A
Benefits for RCT	Moderate	N/A
Impacts on Energy	Moderate	N/A

CONCLUSION

The economic impacts identified in this study are summarised below.

Economic Impacts

Sector	Impact
Agriculture	• Water availability – nil • Power availability – nil

	• Output – nil • Increased dust on grapes – needs mitigation • Increased heavy-vehicle traffic on Schroeder Road – needs mitigation
Tourism	• Estimated R2.38mn per annum in increased profits of accommodation establishments during three-year construction period. Multiplier effect of expenditure shown in SAM. • Number of visitors to Augrabies Falls National Park – nil
Retail/wholesale/other	• Multiplier effect of spending by project employees and project procurement shown in SAM.
Riemvasmaak Community Trust	• Estimated R13mn per annum in rental from IPP. • Dividends on profits from IPP (shareholding 10 - 15%) estimated at R26.6mn per annum.
BBBEE Trust	• Dividend income from shareholding in IPP estimated at R13mn per annum (shareholding 5%).
Local communities	• Development and social spending by IPP (1-2.5% of project revenue) estimated at R23mn per annum.
Power	• Nil – fed into Eskom grid. • Carbon savings – shown in CBA model.
Employment	• Construction phase – 150 - 200 jobs on the project • Operational phase – 5 - 10 permanent jobs over project lifetime (80 years) • Direct and indirect jobs – 336 in Year 1, 278 in Year 2 and 345 in Year 3 of construction phase.

This study has found that there are no fatal flaws or red flags from an economic perspective, i.e., from the point of view of society as a whole. The macroeconomic analysis revealed positive impacts on GDP, employment and incomes.

These impacts would be strengthened by measures such as skills development for local residents to enable them to secure permanent jobs during the operational phase, and to ensure that income from the project accruing to the Riemvasmaak Trust is utilised for productive and sustainable activities.

The project is small in size but would nevertheless make a positive contribution to the economy of the local municipality as well as to the provincial and national economies. Thus, it is recommended that it be implemented.

1. INTRODUCTION

1.1. Scope of Project

RVM1 Hydro Electric Power (Pty) Ltd is a South African company based in Stellenbosch that operates as an independent power producer, primarily taking advantage of the South African government's Renewable Energy Independent Power Producers' Programme (REIPPP). To this end, RVM1 Hydro Electric Power (Pty) Ltd has identified the RVM Hydro Electric Project (RVM) on the Orange River in the Northern Cape.

RVM is a run-of-river hydropower station, requiring no storage or consumption of water. The proposed hydropower station, if authorised by the Department of Environmental Affairs (DEA), will be tendered to the Department of Energy (DOE) and, if successful with the tender, implemented.

An environmental authorisation process via an Environmental Impact Assessment (EIA) was commissioned and scoping has been completed, with the Department of Environmental Affairs accepting the Scoping Report in October 2013.

This report is part of the Environmental Impact Assessment Report. RVM1 Hydro Electric Power (Pty) Ltd has identified the following specific Terms of Reference for the assignment. The Report must address:

1. The economic costs vs the benefits of the hydropower activity.
2. Potential impacts positive and negative on tourism in the area.
3. Economic viability of the facility to the surrounding area and how the community could benefit.

1.2. The Hydro Project

1.2.1. Context

South Africa has faced energy constraints since 2008 when load shedding was introduced for a period by Eskom to ensure that demand (consumption) was regulated in such a way as to align with available supply (production). In 2015, delays in the opening of new coal-fired power stations, together with maintenance requirements at the ageing existing plants, led to the imposition of a sustained load-shedding schedule nationwide during the first six months. This had a severe effect on economic growth. Uncertain supply conditions are expected to endure at least until the two new coal-fired power stations are operating at full capacity (around 2019-20).

In this context, the Department of Energy and Eskom are encouraging the entry of Independent Power Producers (IPPs) into the energy market. This includes small hydropower IPPs. Any energy supplied by IPPs reduces the pressure on Eskom. Hydropower, like solar and wind, is renewable energy but hydropower has the added significance of supplying baseload energy, the available supply of which is the key determinant of load-shedding episodes.

Apart from its contribution to its renewable and baseload energy supply, the RVM project also needs to be seen in the context of the REIPPP (Department of Energy, *Request for Qualification and Proposals for New Generating Capacity under the Renewable Energy Power Producers' Programme – Vol 5: Economic Development*

Requirements, updated for the fourth bid submission, 2014). These requirements are aimed at ensuring that IPPs contribute to national and local economic development. Their performance is measured by means of an economic development scorecard which covers: job creation, local content, ownership, management control, preferential procurement, enterprise development and socio-economic development. Of particular note are the following requirements:

- Job creation – emphasis on number of citizens from local communities as a percentage of total number employed on the scheme.
- Local content – procurement of South African goods and services, especially production of key components and equipment. Earmarked in the Request for Proposals (RFP) for South African manufacture in the case of hydropower plants are turbines, generators and hydro-mechanical plant such as penstock and steel gates.
- Community participation – the RFP stipulates (i.e., it is non-negotiable) that the local community (Broad-based Community Trust) must have a shareholding of approximately 5% in the project.
- Enterprise and socio-economic development – the IFP obliges IPPs to devote between 1-2.5% of their revenue to local projects, e.g., business development, education, healthcare.

The extent to which the RVM project is planned to comply with these RFP stipulations is referred to in Section 5.7.

1.2.2. Description

The proposed RVM Hydro Electric Project is located at the southern end of Riemvasmaak Farm (498/1) and Farm 497/0, approximately 3km northwest of the Augrabies Falls. These farms are owned by the Riemvasmaak Trust and the Department of Public Works respectively. Farm 497/0 forms part of a land claims restitution process.

The project includes a weir on the Orange River, located about 1500 m upstream of the Augrabies Falls. This weir will divert a portion of the river flow into the hydropower project. Given that the Augrabies Falls is a major tourist attraction in the area, there is significant concern amongst Interested and Affected Parties (I&APs) regarding the amount of water to be abstracted from the river and the effect that might have on the Falls and therefore the tourist industry in the region.

The hydropower facility is designed as a run-of-river scheme. Such schemes do not consume or store water: power is generated from the force of water flowing from a high elevation to a lower one using the natural flow of the water, and the flow of river water that is diverted is then passed through turbines and returned to the river. The proposed project will abstract a maximum of $38m^3/s$ of the river's flow approximately 1.5km upstream of the Falls, and then channel this flow to a hydropower station and through turbines before returning the water to the river some 7.5km downstream of the Falls.

The design of the weir will ensure that there will be no physical barrier preventing water flowing to the Falls. The assumption is that $30m^3/s$ will be adopted as the minimum flow. This equates to roughly the minimum flow the river experiences.

Normally, a weir crest of this type would be uniform in level across the full length. The RVM weir will have “slots” in the crest that govern how much water is allowed to pass the weir and how much is diverted into the hydroelectric project. The “low slot” will allow water to pass the weir before it can flow over the “hydro slot” and be diverted into the pipeline for the hydropower project. The level at which the “hydro slot” is set will be determined by the agreed minimum flow, and will coincide with the level at which water will pass through the “low slot” at the agreed minimum flow rate.

At a total river flow of $30m^3/s$, the flow in the “low slot” is $30m^3/s$ and there is zero flow through the “hydro slot”. Once the total river flow exceeds $30m^3/s$, a portion of the total flow will be diverted to the hydropower scheme up to a maximum of $38m^3/s$. This maximum flow into the scheme of $38m^3/s$ will only be achieved once the flow in the river is $100m^3/s$. When this flow is achieved, the flow through the “low slot” is $63m^3/s$, which then flows over the Falls. Since the flow into the hydropower project is capped at $38m^3/s$, it can never take all the water away from the Falls.

Flow duration curves have been developed by RVM1 Hydro Electric Power (Pty) Ltd to compare the flow over the Falls before and after implementation of the proposed RVM hydropower project. These curves show that:

- for 10% of the time (about 1 month per year), flows are less than $30m^3/s$, so the hydro project does not operate;
- for 50% of the time (about 6 months of the year), river flows are between $30m^3/s$ and $90m^3/s$, so the power station operates at less than its optimal capacity; and
- for 40% of the time (about 5 months of the year), the power station operates at full capacity, i.e., at $38m^3/s$. The proportion of flow diverted into the project decreases as total flow increases above $90m^3/s$.

Construction of the proposed weir therefore will not cause the water to stop flowing over the Falls. It will only divert a portion of the total river flow, and a minimum of $30m^3/s$ will always continue to flow over the Falls.

The project will have an installed capacity of 40 MW of renewable hydroelectric power that will generate about 235 GWh of energy per annum. It will consist of:

- a low weir (under 2.5m high) and grated offtake structure in the Orange River to divert water into the pipelines
- twin pipelines 4.6km long, 3.6m wide x 3.3m high below ground to transfer the water into the small headpond (surface area of about $12,000m^2$)
- an earth embankment to create a headpond
- intake structure fitted with main inlet valve
- a penstock below ground
- an underground powerhouse containing four turbines of up to 10MW capacity
- a 6.75km long tailrace tunnel (below ground) that takes the water back to a secondary channel of the Orange River before reaching the main river
- 24km of 132 kV transmission line infrastructure (8km buried and the remainder overhead).

1.3. Qualifications and Experience of the Practitioners

Imani Development South Africa (Pty) Ltd. (IDSA) was established in 1997 as part of the Imani Development International group of companies. IDSA operates throughout Southern Africa.

This report was compiled by Professor Gavin Maasdorp and Mr Frank Sturgess of IDSA's Durban office. Professor Maasdorp has extensive experience of economic impact assessment relating to infrastructure projects dating back to 1970. Since 2010 he and Mr Sturgess have undertaken such studies as a team, and have covered road, rail, airport and logistics hub projects, often as part of broader economic impact assessments.

Specialist EAP	Academic Qualification	Relevant Work Experience
Professor Gavin Maasdorp	MCom, PhD (Natal)	Professor Maasdorp has 45 years of experience as a consultant in Africa, the Caribbean and the Middle East for clients such as the World Bank, EC, African Development Bank, USAID, DFID, Development Bank of Southern Africa and national governments. In the field of energy he has undertaken feasibility studies of nuclear power stations, pumped storage and small hydropower schemes as well as the Thukela-Vaal Water Transfer Scheme. He has undertaken economic and social impact studies for wider environmental impact assessments.
Mr Frank Sturgess	B Bus Sc, MCom (UKZN)	He has five years of experience in feasibility and economic impact studies of transport projects in South Africa, Southern Africa and West Africa, applying quantitative models (cost-benefit analysis and social-accounting matrix) to sectoral and environmental impact assessments.
Ms Taryn Campbell	BA (Stellenbosch), MA (Warwick)	She has five years of experience in undertaking social and economic impact studies for projects in East and Southern Africa.

1.4. Report Structure

This specialist study report consists of eight chapters as follows:

- Chapter 1 – Introduction
    - Scope of work, brief background to the project, details of the practitioners, and structure of the report.
- Chapter 2 – Methodology
    - Description of the methodology including the manner in which the research and assessment were conducted, the quantitative techniques of analysis employed, the assumptions and limitations of the analysis, and the gaps in knowledge.

- Chapter 3 – The Economy of the Area
    - Description of the economy of the study area and its main sectors.
- Chapter 4 – Costs
    - Analysis of the capital and operating costs provided by the engineering specialists.
- Chapter 5 – Benefits and Impacts
    - Identification of benefits and assessment of impacts.
- Chapter 6 – Macroeconomic Impact Analysis
    - Modelling and quantification of macroeconomic impacts.
- Chapter 7 – Assessment of Impact Significance and Mitigation
    - Assessment of all identified impacts according to the methodology provided by CES, and mitigation measures.
- Chapter 8 – Conclusions and Recommendations
    - Final comments on the economic impact of the project.

2. METHODOLOGY

Both qualitative and quantitative data analysis techniques were applied (using primary and secondary data sources) in this specialist study.

2.1. Data Collection

Data for this study were collected through a combination of desk research and fieldwork.

Initial desk research consisted of an examination of other specialist reports provided by the client and available literature on hydropower schemes and the energy crisis in South Africa. A field visit to the study area was conducted between 9-13 March 2015. Appointments were based on a list of Interested and Affected Parties provided by the client. During this visit, primary data were collected during interviews with representatives of various farmers' associations, the water users' association, lodge managers, the manager of a leading retail and wholesale store in Kakamas, the Riemvasmaak Development Committee, officials of the Kai!Garib Local Municipality, and the manager of the Neusberg hydropower scheme. A site visit was paid to the Augrabies Falls National Park as well as to islands under irrigation in the Orange River and to grape producers in the Blouputs, Oseiland and Rooipad areas. A trip was undertaken to Riemvasmaak for a particularly informative meeting. These activities enabled the consultant to assess the state of the receiving environment.

Because a number of affected farmers were away at the time, a series of telephonic discussions were held with them. Others contacted by telephone were Eskom and a number of agricultural associations, cooperatives, and the Northern Cape Department of Agriculture as well as a raisin company. Attempts were made to arrange a meeting with SANParks but these failed as will be explained later. The same was the case with the Riemvasmaak Trust.

Secondary data sources consulted were:

- Municipal Integrated Development Plans for Kai!Garib Local Municipality and the Siyanda District Municipality.
- The websites of various agricultural producer associations and the Department of Agriculture, Forestry and Fisheries.
- The latest version of the socio-economic and tourism impact assessment for the RVM Hydroelectricity project.
- 2007 Agricultural Census – Statistics South Africa.
- 2011 Population Census – Statistics South Africa.

2.2. SAM

A Social Accounting Matrix (SAM) is a comprehensive, economy-wide database that contains information about the flow of resources that takes place between the different economic agents that exist within an economy (i.e. business enterprises, households, government, etc) during a given period of time, usually one calendar year.

When economic agents in an economy are involved in transactions, financial resources change hands. The SAM provides a complete database of all transactions that take place between these agents in a given period, thereby presenting a "snapshot" of the structure of the economy for that time period. Consequently, a SAM can provide a unifying structure within which the statistical authorities can compile and present the national accounts.

The most basic principle underlying a SAM is the concept of *circular flows* which relates to the particular angle from which an economic system is viewed and traced. The various productive sectors (i.e., the "activities") in the economy act as producers and sellers of goods and services (i.e. the "commodities") to institutions such as households, business enterprises and the government (the "purchasers" of the commodities). For their part, households, enterprises, and the government act as sellers of factor services to the various activities, who then become the purchasers of these factors (i.e., labour, capital, etc.).

In one direction, the circular flow involves tracing the flows of goods and services (i.e., the commodity markets). In the other direction, it traces the flows of funds (i.e., the factor markets). Transactions with the rest of the world can take place through both the commodity and factor markets.

Once a SAM has been developed, it becomes a powerful tool that can be used to conduct various macroeconomic analyses such as calculating sectoral multipliers. The multiplier concept is defined as the nature and extent of the impact/effect of an autonomous change in a specific economic quantity on another economic quantity or quantities. Samuelson (1970)[2] defines the multiplier concept as follows: "The multiplier is the number of which the change in investment must be multiplied in order to present us with the resulting change in income".

Macroeconomic modelling calculates the impact that a specific event such as an investment project would have on a variety of economic indicators. Two of the most frequently measured indicators are GDP and employment creation.

GDP reflects the magnitude of the value added in the economy as a result of capital spending on investment projects.

Labour is a key component of the production process. Macroeconomic impact analysis determines the number of new jobs that will be created by the construction and operation of a particular project. The jobs created during the construction phase of a project will be mostly temporary, while those created during the operational phase will be mostly permanent.

[2] Samuelson, P.A. 1970. *Economics,* McGraw-Hill Book Company.

2.3. Assumptions and Limitations, and Gaps in Knowledge

Assumptions

- The information and data provided by the client are accurate (especially with regard to the rate of water abstraction from the river and its effect on the Falls and farmers).
- The cost data for the financial model are accurate.

Limitations and gaps in knowledge

- Only a preliminary engineering study was available to complement the financial model. A more detailed study will be done only should the IPP be a preferred bidder.
- The lack of cooperation from SANParks.
- The lack of a response from the Riemvasmaak Trust.
- The lack of disaggregated economic data on the study area especially for agriculture and tourism (output, numbers, values).
- The lack of data for the production of 1kWh of power from small hydro schemes in South Africa.

3. THE ECONOMY OF THE AREA

The RVM hydropower project is located in the Kai!Garib Local Municipality (LM) which in turn is in the ZF Mgcawu District Municipality (DM).

3.1. Population

The Northern Cape Province covers almost one-third of the area of South Africa but is sparsely populated, containing only 1.146 million people in the 2011 census (Stats SA 2011). The Kai!Garib Local Municipality had a population of about 66,000, growing at an average annual rate of 2.1% . The average annual household income was about R72,000 which is only 60% of the national average of R120,000.

3.2. Structure of the Economy

The Orange River and a narrow band on either side of it form the spine of economic activity in the LM, containing all the significant urban settlements and the major economic activities. Only the areas of extensive farming and the town of Kenhardt are not within close proximity to the river.

The structure of the Kai!Garib municipal economy is shown in Table 3.1.

Table 3.1: Distribution of Municipal GDP by Economic Sector

Sector	**%**
Agriculture	51.8
Manufacturing	5.1
Mining	0.4
Construction	2.4
Transport and Communications	2.9
Utilities	2.6
Wholesale and Retail Trade	11.3
Financial Services	7.6
Commercial and Government Services	15.9
Total	**100.0**

Source: *Kai!Garib Integrated Development Plan* 2013-14.

The table illustrates that just over one-half of the GDP is accounted for by the agricultural sector. It appears from the IDP that this covers both agriculture and agro-industry since the text refers to the problems of wine and raisins as well as the cultivation of grapes.

The Kai!Garib IDP did not quote the Municipal GDP, the reason being that Statistics South Africa does not produce GDP figures for demarcations below the provincial level. The provincial GDP for the Northern Cape in 2013 was R71,142.0mn. The 2011 Population Census showed that Kai!Garib contained 17.4% of the Northern Cape's population; on a crude basis, applying a similar proportion to GDP would put the Kai!Garib GDP at about R12,378.0mn but this can be taken as nothing more than an indication. However, it does show that the district GDP is small in a national context.

3.3. Sectoral Analysis

3.3.1. Agriculture

The project is located in a summer rainfall area (September-March), the average annual precipitation being around 150mm. The Orange River is perennial, its flow being largely controlled from releases from the dams upstream. The Siyanda (now ZH Mgcawu) IDP warns that the quality of water in the river has been declining because of growing agricultural and industrial activities upstream from Upington and a lower inflow of high-quality water from Lesotho.

The agricultural sector is dominated by fruit, livestock and game farming. The main activity is the production of table grapes which are the first from the southern hemisphere to reach European markets, but there has been an increase in citrus growing while lucerne, dates and nuts are also grown. Viticulture and linkages are illustrated in the text below.

There is a paucity of disaggregated production data, the last Agricultural Census having being undertaken in 2007. The reports from this Census are at a provincial level with some disaggregation to a local municipality level. However, the coverage does not contain data on output (volume and value) or on each crop or type of farming, and therefore is of little or no use in an economic impact study.

Similarly, the Population Census of 2011 is not helpful either. The only interesting statistic it provides is that 23.5% of agricultural households in Kai!Garib are in receipt of incomes of between R4,801-307,200 per annum while 5.6% receive over R307,000 per annum. In the study area (which is defined as the area within a 50-km radius of the hydropower site and includes Riemvasmaak, the Augrabies Falls National Park, the villages of Augrabies, Marchand and Lutzburg, and the town of Kakamas), these would be the large-scale commercial farmers in grapes and citrus.

Among private-sector agricultural bodies, the available statistics are mainly at the provincial level or the Orange River regional level, depending on the source.

According to the Vin Pro *Harvest Report* (2012), the Northern Cape produces 49% of South Africa's table grapes while the Orange River region contains 5% of the total area under wine grapes and 3.5% of the total number of vines in the country. The Orange River region produced 118,000 tons of grapes in 2012, down 8% on the 2011 figure, but the 2013 crop was expected to grow by 20%.

Table grapes are exported, the United Kingdom and Europe remaining the major markets (79%) despite growth in the Far East. Wine grapes are sent to the Orange River Wine Cellars Cooperative Limited (ORWC) which is the second largest wine cooperative in the world and the largest in the southern hemisphere. It is headquartered in Upington but has a winery in Kakamas that is supplied by farmers in the area surrounding the RVM hydropower project. All in all, ORWC collects grapes from farmers along the river for a distance of 350km from Grobershoop in the East to Onseepkans in the west.

Vine-fruit products (raisins and sultanas) are important in the Northern Cape. In the study area there is one raisin factory in Marchand and a depot in Kakamas of SAD Vine Fruit (Pty) Limited, the largest dried vine-fruit packaging and processing plant in

South Africa with headquarters in Upington. In addition, there are two factories between Kakamas and Keimoes.

The production of grapes has also led to the construction of packing stores and coolrooms on major farms as well as in Kakamas. The industry as a whole has transformed the economy of the area since the 1960s.

According to data from the *Annual Statistics Booklet* of the South African Table Grape Industry (SATI), the industry association of table grape producers, the Orange River region produced 15.1 million equivalent 4.5 kg cartons for export in 2013/14. Over the 5-year period 2009/10-2013/14, the annual figure varied from a low of 13.9 million cartons to a high of 16.8 million cartons. There were 65 table grape producers in the region farming an area of 4,896 ha (up from 4,107 ha in 2008/09), and employing 1,274 permanent and 12,971 temporary labourers. The latter would be seasonal workers engaged during the picking season. The export market took 90% of total table grape production in 2013/14, the ten-year annual average being 87%. The relative share of the export and local markets each year depends on comparative prices which in turn are affected by exchange rate fluctuations. SATI data also show that the Orange River region accounted for 33% of the total area planted to table grapes in South Africa.

As in all agriculture, it goes without saying that annual figures fluctuate depending on natural conditions such as droughts and floods.

Citrus farming has also expanded in the Orange River region but is not a major factor in the Kai!Garib LM. Livestock farming occurs mainly to the south of the river where the rainfall is higher than to the north and which is more favourable for extensive farming.

Various organisations were approached with a request to provide disaggregated data at the study area level. The responses were either that the data were sensitive and could not be disclosed in order to protect confidentiality of returns by individual producers, or simply that they were not calculated at that level.

3.3.2. Manufacturing

According to the Siyanda IDP (p.21), manufacturing is in decline in the district "across the board". However, the importance of the sector in the LM economy as shown in Table 3.1 in Section 3.2 might be understated: as explained, it appears that agro-industry is included under the agricultural sector rather than under manufacturing.

Apart from agro-industry such as wineries and an abattoir in Kakamas, there is a brick factory on the road near Marchand and the usual array of small manufacturing workshops that characterise a town serving an agricultural community. The growth of such enterprises is tied up with the economic circumstances of the agricultural sector.

3.3.3. Tourism

Although new investment continues to be attracted to this sector, the Siyanda IDP pointed out that the volume of tourists was insufficient to act as a driver of the economy (p.21). Nonetheless, it was the fastest-growing component of the economy

between 2007-2011 (p.31). The Kai!Garib IDP states that there is substantial growth potential in the sector (p.18).

The vivid contrast between the green spine of the Orange River valley and the desert-type landscape to the north is remarkable and is unique in South Africa. The study area includes the major tourist attraction in the LM, namely, the Augrabies Falls which is situated in the Augrabies Falls National Park. It is the world's sixth largest waterfall and is located at the head of a deep, 18km-long gorge. The Park offers accommodation in the form of chalets, cottages, and camping and caravan sites. Day and night drives and nature trails are available to tourists, but the part of the Park adjacent to the RVM hydropower site is not open to visitors.

There is an unfortunate data gap regarding statistics in the LM and study area. There are three main lodges near the AFNP, the AFNP accommodation, a number of upmarket guest houses and a hotel and conference centre in Kakamas, and a number of guest farms and lodges (one with a ski school) between Kakamas and Augrabies. However, the data gap arises from the fact that accommodation establishments are not required to submit statistical returns to any official industry body. The experience of tourism consultants is that bed occupancy rates are invariably overstated, and that an annual average figure of 50-60% is the norm in South Africa. There are no data as to the total number of beds in the area, but there is no reason to expect that the bed-occupancy rate should deviate significantly from the national norm.

3.3.4. Retail and Services

According to the Siyanda IDP (p.21), this sector has grown but its potential is limited by two factors:

1. the small size of the market
2. the proximity of Kimberley which takes business away from Upington.

For the Kakamas area, the first factor remains a constraint. So far as the second is concerned, it is Upington, not Kimberley, that takes some business away from Kakamas, particularly to its shopping mall. Kakamas wholesalers and retailers state that their market area extends 100km as far Pofadder in the south-west on the N14 and 25km as far as Friersdale on the N14 halfway to Keimoes. It includes Marchand, Augrabies, Blouputs, Onseepkans and Riemvasmaak.

Kakamas contains branches of KaapAgri, OK, Saverite and Pep Stores while a branch of Spar is under construction. A Chinese-owned supermarket opened in 2014. The sector is estimated by one operator as having grown at a rate of about 20% per annum, but growth is related to the price of grapes and is expected to be slower in 2014/15 because the price has fallen although this might be partly offset by the increased harvest size. The number of consumers swells significantly during the grape-picking season (September/October to February/March) when there is an influx of seasonal workers to the farms. The citrus season in the winter months does not attract as many seasonal workers as the vineyards.

The size of the Kakamas retail and wholesale sector in terms of annual turnover was estimated by a leading enterprise at about R750 million.

This sector also contains small traders, both formal and informal. The latter category, by definition, is unrecorded and hence no data exist for it. It was reported during fieldwork that both the formal and informal sectors have been infiltrated in recent years by Asian traders. This is in keeping with the trend in the rest of the country.

3.3.5. Transport and Communications

The growth of irrigated agriculture in the LM has led to the establishment of a substantial local trucking and logistics sector. The Wine Cellars, pack houses and coolrooms are served by fleets of trucks and trailers moving produce from the farms, one consequence being that traffic on the roads is often slow during the harvesting season.

3.4. Summary

The economy of the Kai!Garib LM is small in size and is dominated by agriculture and agro-industry which have substantial linkages with other sectors such as trade, transport, logistics, construction, utilities and financial services.

The agricultural sector is highly dependent on the availability of water from the Orange River, and the management of that water is therefore an important factor in future economic growth. The general view encountered in interviews was that the scope for the expansion of irrigated agriculture was limited because of water availability. Economic diversification is therefore required, and a promising opportunity for this lies in the field of power generation using the area's endowment of renewable energy sources such as sun, wind and water. The Kai!Garib LM IDP (p.25) states that the generation of sustainable energy, particularly from solar power, has attracted interest from investors.

4. COSTS

The economic costs in this project refer to the capital costs of construction and operating costs over the lifetime of the facility. The RVM Indicative Model is an Excel spreadsheet provided by RVM1 Hydro Electric Power (Pty) Ltd . It serves as a proxy for the financial flows to be expected in the construction, financing and operation of a hydroelectric plant. The indicative model is based on construction costs of R1.4bn including VAT and finance charges over three years, and operation over 20 years, giving a project life from 2015-2037. The information directly relevant to the economic model includes data on construction costs, revenue, fixed and variable expenses, working capital adjustments and taxes. The full Indicative Model can be accessed from RVM1 Hydro Electric Power (Pty) Ltd .

4.1. Capital

The capital costs of construction were estimated by the engineering specialists and provided by means of a preliminary financial model. The cost figure supplied to the Consultants is R1.042bn for the plant excluding VAT and finance charges. Construction would take place over a three-year period. Table 4.1 shows how costs have been allocated over this period. The cost allocation is based on the split in the financial model.

Table 4.1: CBA Construction Cost Adjustment (Rmn)

Financial year	Rmn
2015	364,933
2016	302,373
2017	375,360
Total	1,042,666

The construction costs in Table 4.1 above are adjusted by the shadow price factor of 0.94. This is higher than the 0.80 referred to in Section 2.2 as being the accepted value in South Africa. The reason is that the costs already exclude VAT and finance charges. The adjustments made to the figure provided by the engineers are for import duties. The total economic cost therefore amounts to R980mn spread over three years.

4.2. Operating

The operating costs comprise fixed and variable costs and working capital which is recovered in the final year (2037). All these costs are sourced from the Indicative Financial Model. These costs have been used to calculate the potential spending on development projects in the region.

5. BENEFITS AND IMPACTS

5.1. Agriculture

5.1.1. Concerns

According to a spokesman for water users in agriculture, the farmers closest to the weir site had a number of concerns relating to the project.

- The impact of the weir on spray irrigation in the immediate vicinity as well as on the islands in the river.
- The impact on drainage on the islands.

However, the original envisaged height of the weir was reduced by 2 metres, and thus these concerns have been alleviated.

The water abstracted from the weir would not affect the availability of water to farmers who are located upstream of the weir. The farmers at Blouputs (downstream from the Augrabies Gorge) would also not be affected as the water abstracted from the weir would be returned to the river upstream of these farms, hence making no difference to their water supply.

Field interviews with the agricultural sector revealed that the following farms are closest to the weir site and could be expected to be the most concerned about the project:

- Groot Vaalkopeiland
- Witklip
- Orange Falls
- Vaaldrif
- Omdraai
- Oseiland
- Rooipad

All these farmers were interviewed, and corroborated the views expressed above.

The farmer closest to the project site did not believe he would be affected since the section of his land adjoining the weir site is in fact unworked. All the other farmers are located further upstream from him, and the only concerns mentioned by these farmers related to the dust problem and the standard of the road that would be used for the project (see below). The logistics associated with the project was seen as the major issue.

Nonetheless, all these farmers interviewed were positive about the project, feeling that it would be beneficial for the local economy. The farmers were sufficiently far upstream of the weir not to be affected.

5.1.2. Impact of Dust on Grapes

Dust is an inherent problem in a semi-arid area. The prevailing wind is from the north-west and deposits dust on buildings and lands, while vehicles on dirt roads generate dust. Not only does dust inhibit the growth of the vines but, for table grapes, it is a particularly sensitive issue: there is only a six-week period from picking to them reaching the overseas consumer, and washing of grapes to remove dust therefore needs to be avoided. For wine grapes, dust would affect the fermentation

process with a negative impact on the end product. Thus, the maintenance of roads is particularly important.

The common method of countering the problem is either to use water tankers or a sprinkler system to wet the roads. The former is expensive and therefore the latter system has been commonly adopted as it is cheaper and more cost-effective. At Blouputs, for example, the pipes along the length of the road cost R20,000/km to lay (although this figure would vary according to pipe and pump size), while electricity costs are R20/day per km and maintenance labour R20/day per km. The road is sprayed three times per day for 30 minutes at a time, i.e., 1.5 hours/day, although in the peak season (August-January for table grapes) this is increased to 4-5 times per day because of the increased number of heavy vehicles. At Rooipad which produces wine and raisin grapes, the season expands to March-April. One farmer close to the weir site stated that it was necessary to use the sprinkler system only during the period between October-February and that dust was not a problem for the rest of the year.

The sprinkler system generally seems to be regarded as a successful way of mitigating the impact of dust. Nonetheless, it is certain that an increase in the number of vehicles on the road during construction will produce greater volumes of dust, and increased vigilance and monitoring will be required during the construction period.

Another grape farmer stated that the sprinkler system was more of a nuisance than an expense factor.

5.1.3. Condition of Road

The dust problem is linked to the condition of the road that would be used for the RVM hydropower project.

One of the farmers on the Schroeder road – a gravel road of about 35-40 km from Kakamas towards the Falls on the north side of the river and which is the route that would be used for the project – stated that there were five farms along the road which was so neglected by the Municipality that it had had lost its base. It needed to be regravelled. The road is at present used by farm-related traffic – farmers and farm workers, and vehicles transporting grapes and delivering supplies. If the road were to carry construction traffic (including heavy vehicles) for the RVM hydropower project, it was essential that it be improved and maintained. At present the farmers apparently do almost all of the maintenance on the road.

One suggestion from a farmer regarding access to a weir site by construction vehicles was that consideration should be given to constructing a short (approximately 3 km) road on the south side of the river rather than using the 40-km gravel road on the north side which was in very poor condition.

5.2. Tourism

Tourism has grown rapidly and has potential to play a greater role in the local economy, as was described in Chapter 3.

There are eight private/guest lodges in the area between the village of Augrabies and Dundi Lodge just west of the turnoff to the Augrabies Falls National Park. They

offer a total of 205 beds, and to this must be added 236 beds at the AFNP (excluding the camp site). Thus, there is accommodation in rooms for 441 guests in the area immediately adjacent to the Augrabies Falls.

Two lodge managers with lengthy local experience were interviewed and taken as representative of the views of private operators. Attempts to elicit views from SANParks failed (as explained in Chapter 1). In addition, a brief informal discussion was held with a restaurant manager associated with an upmarket lodge in Kakamas.

Interviews were held with two leading lodges in the vicinity of the Augrabies Falls National Park (AFNP). These lodges derive their business mainly from visitors to the Falls (between January-March), passing tourists en route to and from Namaqualand to view the spring flowers (in August-September), and the vehicle-testing activities of leading motor manufacturers. For the past 10-15 years these companies have used the M14 between Upington and Pofadder for testing new models.

None of the interviewees believe that the RVM hydropower project would have an adverse impact on tourism in the area, particularly in the operational period. These opinions are based on their perceptions of visual and noise intrusion. One general manager stated that the site would only be visible from the air and that visitors would not even be aware of the scheme's existence. It would hardly be a tourist attraction in its own right even if it were to be accessible on public roads. As long as the area under SANParks jurisdiction remains controlled, it would remain off the tourist map.

The establishments were in favour of the project because of the business it would generate for them during the construction phase. There would be a spin-off for the lodges from the flow of specialists and service personnel who would visit the site during construction.

Farmers and business persons interviewed during the course of the work also felt that the project would have no impact either way on tourism in the area.

Adjacent farmers interviewed did not believe that project would be problematical for the tourist industry provided the flow of water over the Falls is not affected. One farmer, however, did refer to the fact that both sides of the river consisted of conservation area but felt that, because there were so few large animals in the area, animal crossings of the river would not be affected.

There would, however, be a positive impact during construction when the semi-skilled, skilled and professional individuals involved in the project would be requiring accommodation. There was no information from the financial model on what the expenditure on accommodation and subsistence might be. A rough calculation could be as follows:

- 20% of employees in the construction phase would comprise individuals in the above category. The number involved would be approximately 50.
- Assume that they are present in the area for an average for two years of the three-year construction phase, say, 97 weeks each after annual leave is subtracted. This means 679 days each.
- Thus, 33,950 bed-nights would be sold by local accommodation establishments.

- At an average cost of R700 per day for accommodation and meals (as incurred by the consultant during his field visit), total turnover for the lodges and guest houses would amount to approximately R23.765 million during the construction phase. This assumes that these individuals would stay in private lodges/guest houses, not in hired houses for the project.
- The benefit to the economy from this expenditure is represented by the additional profit accruing to the lodges. Discussions with a specialist tourism consultant revealed that the average rate of profit in the hospitality industry is around 10%. The profit margin is very low for this industry, but the figure provided could be used as a broad average. On this basis, the additional profit from this expenditure could amount to about R2.38 million over the three years of the construction phase.

The main tourist attraction, however, remains the Augrabies Falls. SANParks offers accommodation (chalets, cottages, and caravan and camping sites) but has not opened the section of the AFNP north of the river, i.e., the area closest to the RVM project site, to the public. It therefore derives no revenue from this area.

According to information in respect of the 2014/15 financial year (April-March) supplied by SANParks staff at the AFNP, there are 50 chalets and 40 camp sites. The former had a unit occupancy rate of 46.1% and sold 16,700 bed-nights; the latter had a lower occupancy rate (27.9%) and sold 14,500 bed-nights. There were 43,800 day-visitors to the park, and total revenue from all activities was R12.56mn.

Repeated requests to SANParks for information regarding its views on the project were ignored. However, it appears that it is not in favour of the project. This might be related to its perceptions regarding visual intrusion and the impact thereof on visitor decisions.

A questionnaire circulated by the socio-economic specialist consultants (ACER, 2014) to visitors to the AFNP attempted to ascertain their perceptions. However, such questionnaire approaches are not helpful unless they are accompanied by full explanations (including maps and photographs); without those, it is impossible for visitors to obtain accurate information on which to base their perceptions.

Nevertheless, despite this underlying weakness in the survey, it is noteworthy that the great majority of respondents indicated that the scheme would not affect their decisions to pay return visits to the AFNP.

Thus, based on field interviews and the results of the ACER survey together with our examinations of other specialist reports, the economic consultants do not believe that there are any impacts either positive or negative that can be quantified for the purpose of the CBA.

5.3. Retail and Wholesale and Other Sectors

Other sectors of the local economy would naturally derive benefits as a result of the expenditure multiplier effects of the RVM hydropower project. These benefits are difficult to quantify for each sector and best lend themselves to treatment in a social accounting matrix (SAM) model (economic impact study) rather than in a cost-benefit analysis (economic feasibility study).

Apart from agriculture/agro-industry and tourism, the significant business sector in the local economy is retail and wholesale trade. As mentioned in Section 2.3.4, the total turnover in this sector was estimated at approximately R750 million per annum. According to a major firm, there is keen competition and price cutting but nevertheless a profit margin of about 12-14% would be expected. The economic benefit from the project would be the increment to profits accruing from spending linked to the project (on supplies and by employees). There is no information on such procurement expenditure in the financial model, and thus it is not possible to quantify what the additional profits linked to the project might be. Instead, this expenditure is included in the multiplier effects in the SAM model.

5.4. The Riemvasmaak Community

The Riemvasmaak community has had a difficult time since the 1970s when it was uprooted under the Group Areas Act. This resulted in significant dislocation of the community, and the effects are still felt 21 years after the land was regained under the restitution policy of the democratic government. The community faces high levels of unemployment and poverty, low levels of education and limited economic opportunities. No secondary/high schools are located in the Augrabies and Riemvasmaak communities, and access to adequate healthcare is poor.

The community is exposed to social ills such as alcohol and substance abuse, a high incidence of teenage pregnancy, and increased levels of HIV/AIDS and TB infections. The situation is well described in the socio-economic specialist study and therefore is not detailed here. That report highlights a number of potential benefit-sharing options identified by members of the community. These are:

- Support for existing projects.
- Education.
- Training and skills.
- Construction of public spaces and sports fields.
- Provision of services.

5.4.1 Expected Channels for Community Benefits

The potential beneficial economic and social impact of the RVM hydropower project on the Riemvasmaak community and surrounds is high. It is stipulated in the IPP Procurement Process that the project is required to meet a number of key economic development requirements which includes socio-economic development spending, local ownership and preferential access to employment and procurement. There are five channels through which the community is expected to benefit from the project. These are discussed below.

5.4.1.1. RVM Development Committee and Trust

The RVM Development Committee is an elected body and its focus is on identifying projects, discussing them with the community, and then handing them over to the Riemvasmaak Trust for implementation. The Trust handles the funds which accrue from projects on RVM land, the main ones being the hot springs 5km outside the village, two grape farms, and Melkbosrand Farm which is leased to SANParks.

During fieldwork, a meeting with the RVM Development Committee was held. The focus was on the views of the Committee and the community regarding the project.

The RVM Trust was contacted telephonically. It was clear from these interactions that the Trust and Committee are very strongly in favour of the RVM hydropower project.

So far as funds accruing to the Trust from the RVM hydropower project are concerned, the RVM Trust will receive:

- Rental income from the IPP since the community owns the land on which the facility will be located. The Administrator of the Trust stated that the projected annual rental was R13.1mn per annum.
- The RVM Trust will receive dividends from profits (between 10 -15%) on the RVM hydropower project. It is estimated that this could amount to R26.6mn per annum. The RVM Trust will purchase ownership in a private capacity. The issue of expected dividend incomes together with the establishment of a development forum will await the project being given the go-ahead by the REIPPP.

The identification of projects to be developed by this income stream was still in progress at the time of consultation but, in the meantime, the Administrator of the Trust was able to state that one important project could be the development of export grape production. The 10ha of vineyards on Vredesvallei Farm (across the Orange River from Blouputs) has reached the end of its productive life, and it was planned to put about 80ha under vineyards: this would comprise the replanting of the Vredesvallei land plus an extension of the cultivation at Vaaldrif Farm (the farm closest to the project) and the development of other parts of RVM land that might be identified as being suitable for grape production.

The Committee stated that it has a development coordination plan which is still incomplete. It mentioned the following as possible initiatives for funding:

- A Tourism Master Plan – the major tourism attraction on RVM land is the hot springs which receives a steady flow of visitors (no figures were available) throughout the year and provides four full-time jobs.
- The preparation of proposals for an Enterprise Development Plan.
- Education – there is a shortage of teachers at the primary school.
- Healthcare – there is a new clinic but no doctor or nurse, only a local assistant nurse. An ambulance is required to transport residents whenever necessary.
- Facilities for the aged and for sport.
- A geological report has shown that there are possibilities for small miners.
- Since RVM is a large farm, there might be possibilities for livestock development and meat production, but a specialist report is needed for such a project.

Both the Committee and the Trust feel that, if the farms are further developed, unemployment will be substantially eliminated as they will provide work for the youth who will be keen to accept any jobs on offer. The Administrator of the Trust stated that there was real belief in the community that the project would yield benefits that would provide a secure and sustained economic future for Riemvasmaak.

The Committee is aware that the project is opposed by some environmental groups (including SANParks), and is also aware of the potential negative impact of dust on

the vineyards. It believes that these problems can be overcome if strong mitigation measures are implemented.

5.4.1.2. Community Trust

As stated in Section 1.2.1, the Department of Energy, in its Request for Proposals (RFP) under the REIPPP, has stipulated that the local community must have a shareholding in order to provide it with sustainable, long-term income from the project. As stated in Section 3.3, the community is defined in the RFP as all towns and settlements within a 50-km radius of the facility. Shareholding is to be held via a Community Trust with dividend payments occurring bi-annually. This Community Trust is separate to and independent of the RVM Development Trust (5.4.1.1).

This Community Trust will be established within six months of the start of operations of the RVM hydropower project. Through support from the Development Bank of South Africa or the Industrial Development Corporation, the Community Trust will be able to purchase a shareholding of approximately 5% in the plant. It is estimated that this could generate an income of R13mn per annum. Dividends received will be used to service the loan (approximately 90%) and for community development projects (approximately 10%).

5.4.1.3. Expenditure on Community Development Projects

The RFP obliges the IPP to spend between 1.0-2.5% of its revenue on social, educational and healthcare causes in the community and on projects that promote business development. The income that the community will receive from the project can be used to stimulate new economic activities. Based on the projected turnover of the RVM hydropower project, it is estimated that around R23mn per annum will be allocated to spend in the community[3]. This income flow to the community is guaranteed since the process is monitored strictly by the DOE's Monitoring and Evaluation Department, and IPPs are required to submit monthly Construction Reports and quarterly Economic Development Reports. Non-compliance would lead to the imposition of penalties or to termination, and would put the Power Purchase Agreement at risk.

The potential positive developmental results that this required spending can have on a community are demonstrated by the Kakamas Hydro Electric Power (Pty) Ltd. ("KHEP") project based at the Neusberg weir approximately 12km from the town of Kakamas. The KHEP commenced production and electricity generation in February 2015. This action triggered the commencement of socio-economic and economic development spending within the broader community. To date (September 2015) more than R1mn has been spent on various community-based upliftment projects. These included: support to Assumpta Primary School Girls' Under 12 netball team's participation in the National Netball Championships, donation of cots and a cold storage fridge to Guardian Angel Nursery School, the development and stocking of a computer room at the Pikkiebult Pre-primary School, monthly support of R10,000 to the Ruach Centre for Senior Citizens, refurbishment of the Trauma Counselling

[3] As stated in Section 3.3, the community is defined in the RFP as all towns and settlements within a 50-km radius of the facility.

Centre at the local police station, and the establishment of local enterprise Maaritjie's se Skoonmaak Dienste[4].

The potential areas that could benefit from this expenditure in the Riemvasmaak community are discussed in section 5.4.4.

5.4.1.4. Procurement

The IPP requires an approximate 75% procurement of South African goods and services for the project. Few imported components and equipment are required for the construction of the project, and there is a high "civils" component which will use local firms, materials and staff. In addition, 75% of the manual labour will be sourced from the community.

5.4.1.5 Employment

Since unemployment in the age group 16-34 years is a major social and economic problem in the community, the Trust, Development Committee and RVM community support the hydropower project. The RFP stipulates that a substantial proportion of the jobs created on REIPPP projects must accrue to the local community. The Riemvasmaak Development Committee has requested that the RVM community be given preference in employment, but in fact all communities within the 50-km radius mentioned above will also have access to work on the project. The IPP estimates that it will be able to provide between 150 and 200 jobs for local residents during the construction phase and a small number (between 5 and 10) during the operational period[5]. According to RVM1 Hydro Electric Power (Pty) Ltd, it is anticipated that around 80% of the required workforce will be unskilled. The remainder will range from semi-skilled through skilled to supervisory/professional/managerial.

5.4.2 Management of Community Development Funds

There are three main sources of direct income for community development projects: rental and dividends to the RVM Trust, dividends to the Community Trust, and the stipulated percentage of revenue devoted to development expenditure in the community. These are explained in Sections 5.4.1.1, 5.4.1.2 and 5.4.1.3 above. Over the 20-year life of the power purchase agreement (PPA), this amounts to the following nominal expenditures:

- Financial benefits to the RVM Trust – rental income (R 262mn) and dividend flow (R472mn), while a residual value at the end of the PPA would remain.
- Financial benefits to the Broad based Community Trust through dividend flow (R260 mn) as well as the residual value at the end of the PPA.
- Financial benefits to the broader community (50km radius) through socio-economic development (SED) spending by the project company (R461 mn).

If this money is managed well and invested in income-generating projects, employment creation and skills development initiatives, it could transform the socio-economic realities of the Augrabies and Riemvasmaak communities. As mentioned, the community is defined in the RFP as all towns and settlements within a 50-km

[4] KHEP Socio-Economic Development Report, September 2015, HydroSA.

[5] Environmental Impact Report, RVM 1 Hydro Electric Power (Pty) Ltd - 40 MW Hydroelectric Scheme on Orange River, October 2015, CESNET, accessed on 15.10.2015 http://www.cesnet.co.za/rvm.html

radius of the facility. It will be important to ensure that benefits accrue to all members of the community. The KHEP project falls within the 50km radius. An opportunity exists to synergise efforts with development initiatives resulting from the KHEP.

Coordination and collaboration between the various stakeholders who manage the different income channels will be vital to ensure that efficiency, effectiveness and high impact of expenditure is achieved. This could be secured through the establishment of a Steering Committee comprised of stakeholders from each of the three main channels. This Steering Committee should meet regularly (possibly quarterly) to coordinate and manage development activities.

In order to achieve a high impact on project spending, the Steering Committee should commission a study that examines the various development opportunities, costs, and impact potential. Following this, an integrated plan for community development should be drafted which should outline a programme for development spending as well as a framework for monitoring and evaluating project outputs, outcomes and impacts. This process should involve wide stakeholder consultation so as to ensure that all voices are heard and that the projects are in line with community priorities, thus potentially also playing a role in strengthening support for the RVM Hydropower project.

5.4.3 Options for Community Development Expenditure

A number of options for development spending are outlined below. These were highlighted as priority areas by the stakeholders consulted during this assignment.

5.4.3.1 Improved Education and Skills Development

Lack of employment opportunities is one of the biggest challenges facing the community. This is as a result of relatively low economic growth rates in the area as well as poor levels of education. The lack of access to high schools (there is no high school in the towns of Augrabies and Riemvasmaak) are major challenges facing education and, in turn, socio-economic development in the area. Pupils therefore need to attend high school in Kakamas (approximately 60km away), which is invariably a significant financial burden on parents and is often not a feasible option. In 2011, only 15.5% of the population over the age of 20 had a secondary school education[6], and high school drop-out rates are high. There is scope for:

- Support to existing local schools to upgrade facilities so as to accommodate high school grades.
- Educational programmes and support to parents to keep children in school.
- Co-investment in the development of a secondary/high school.
- A tertiary education fund for talented students in the community.
- Vocational skills training courses/training in line with economic activity in the area (e.g., hospitality, welding, construction, driving, etc.).

[6] Environmental Impact Report, RVM 1 Hydro Electric Power (Pty) Ltd - 40 MW Hydroelectric Scheme on Orange River, October 2015, CESNET, accessed on 15.10.2015 http://www.cesnet.co.za/rvm.html

5.4.3.2 Healthcare Services

Access to healthcare in the Riemvasmaak and Augrabies communities remains dire in comparison to South Africa as a whole. The limited medical facilities that do exist (one permanent and one satellite clinic) lack qualified healthcare practitioners and adequate health equipment and facilities[7]. Key health-related issues in the community include high levels of teenage pregnancies and increasing rates of HIV/AIDs and TB infections. Furthermore, access to water and sanitation remains a challenge that places an increasing burden on the healthcare system. There is scope to:

- Support the staffing of qualified health professionals at the clinics.
- Improve the state of medical equipment and stocking of medical supplies.
- Support the training of health professionals in the community.
- Conduct educational campaigns in the community (though schools, community) on issues of teenage pregnancy and HIV/AIDs.
- Improve the state of sanitation and water access (through infrastructure development).
- Conduct awareness campaigns on sanitation and hygiene.

5.4.3.3 The Augrabies Falls National Park (AFNP) - SANParks

The AFNP lies within the 50km radius that is set to benefit from the various income streams generated for the community by the RVM hydropower project. The AFNP is a significant tourist attraction in the region, mainly because of the 56m waterfall. A key concern expressed by SANParks over the construction of the RVM hydropower project is that the reduced amount of water reaching the Falls when the river is flowing above 30m³/s will have a negative impact on the number of tourists to the park. It was found, however, that the slight reduction in the volume of water channelled to the Falls will not be likely to have an impact on tourist levels as the number of visitors to the Park is not solely determined by the volume of water over the Falls and will thus not result in a decrease of tourism-related revenues for AFNP[8]. There is scope for community development funds to:

- Support AFNP conservation efforts,
- Conduct conservation education training at schools
- Support land conservation initiatives

5.4.3.4 Agriculture

Agriculture contributes just over one-half of the total GDP of the Kai!Garib Local Municipality. It is thus an important income and employment generator for the community. Through consultations with the RVM Development Committee and other community stakeholders, it was evident that there is an interest in developing agricultural projects such as grape and citrus production in the area. Livestock production was also mentioned as a potential activity. Increased agricultural activity will improve opportunities for employment and will increase economic activity in the area. Furthermore, investing in value-added activities in the community will have a significant impact on the local economy. It is recommended that a feasibility study

[7] Environmental Impact Report, RVM 1 Hydro Electric Power (Pty) Ltd - 40 MW Hydroelectric Scheme on Orange River, October 2015, CESNET, accessed on 15.10.2015 http://www.cesnet.co.za/rvm.html
[8] Environmental Impact Report, RVM 1 Hydro Electric Power (Pty) Ltd - 40 MW Hydroelectric Scheme on Orange River, October 2015, CESNET, accessed on 15.10.2015 http://www.cesnet.co.za/rvm.html

and value chain analysis be conducted in order to determine where investment should be directed and where potential impact is the greatest. Management of the fruit farms would be a particularly important aspect in their success.

5.4.3.5 Enterprise Development

Establishment and growth of small and medium enterprises is a key pillar of community development and job creation. There is the potential to build spin-off enterprises from the tourism, agriculture and manufacturing sectors. The RVM hydropower project offers local entrepreneurs opportunities such as cleaning services, catering services, tours of the site, and goods supply, particularly during the construction phase. Potential activities to consider include:

- Business skills training and mentoring support.
- Seed funding for start-ups.
- Support to develop bankable business plans.
- Creation of an enterprise/tourism hub.

5.4.3.6 Safe Public Spaces and Sports Facilities

The need for the construction of public spaces and sports fields was highlighted as a key priority for community members[9]. Construction of these would need to take into account ease of access for children, the elderly, and other vulnerable groups; safety aspects; and the preferred recreational activities/sports of the community. There is scope to:

- Construct/upgrade sports facilities.
- Construct/upgrade parks or community halls.
- Support sports teams through sponsoring equipment or sports days.
- Support community activities.

Furthermore, a potential activity is the decontamination of the area. The South African National Defence Force (SANDF) established a military base near Riemvasmaak in the early 1970s. There are reports that remains from the military base (grenades, ammunition, shrapnel) can still be found in the area, threatening the safety of children and animals in those areas.

5.4.4 Recommendations for Management of Community Development Funds

The following recommendations are put forward to the RVM Community and RVM Hydropower project for the effective and efficient management of the funds accruing to the community through: rental and dividends to the RVM Trust (5.4.1.1), dividends to the Community Trust (5.4.1.2), and the stipulated percentage of revenue devoted to development expenditure in the community (5.4.1.3). These recommendations should be implemented at the start of the RVM Hydropower project.

[9] Specialist Report, Socio-Economic and Tourism Report, Environmental Impact Report, RVM 1 Hydro Electric Power (Pty) Ltd - 40 MW Hydroelectric Scheme on Orange River, October 2015, ACER, accessed on 15.10.2015 http://www.cesnet.co.za/rvm.html

1. Establish a Steering Committee (SC) comprised of representatives from the three main income streams (outlined above) and community representatives. This SC should guide the implementation of the development spending programme and ensure coordination and collaboration between projects.
2. Commission a Community Development Impact Analysis which outlines the community priorities, develops criteria for project selection and timescales for implementation, and estimates the costs to potential projects.
3. Draw up a Community Development Roadmap that guides project implementation, roles and responsibilities.
4. Development and implement a Monitoring and Evaluation System which tracks project progress and monitors project relevance, effectiveness, efficiency, impact and sustainability.

5.5 Power Supply

Power outages are a major factor in South Africa at present and are expected to continue to be a problem for the next five years or even longer according to official statements by the government and Eskom. A common local perception encountered during fieldwork was that one of the major benefits from the RVM hydropower project would be its contribution to a more assured power supply for the population in the Kai!Garib Local Municipality. The various economic sectors as well as residents in the municipality have, in common with the rest of the country, experienced load-shedding episodes. There has been no published attempt to quantify the cost of power outages in South Africa, but there is some anecdotal evidence specific to individual firms that is reported randomly in the media from time to time. The cost to the economy in any period will of course depend on the frequency of implementation of the various stages of load shedding.

Many firms and farmers in the area have installed their own generators and incurred other expenses to ensure a back-up power supply in the event of load-shedding. A power outage breaks the cold chain and affects the products. Most farmers have found that it is better to switch off the coolroom and switch on the generator in advance of a power outage (i.e., if the time can be accurately known).

For the viticulture industry the cost of power outages would depend on the time of year. During the picking season for grapes when produce has reached the coolrooms, ice chests and compressors have been known to be destroyed by a sudden cut-off of the power supply. This would damage the quality of the fruit in the coolroom, and one estimate obtained during fieldwork was that the loss could be about R2.2 million, comprising the value of the fruit in the coolroom at the time and the cost of new compressors. Similarly, irrigation pumps and computers can also be damaged by a sudden outage. A reliable power supply is particularly important during harvesting as exports have to reach Cape Town on time in order to catch the ship to overseas markets.

For the retail and wholesale sector, the loss in turnover from a power outage would depend on the nature of the customers. Local customers would merely postpone their purchase until the power was restored but passing traffic (such as tourists) would represent a loss in turnover that would not be recouped. The major trader in the area had not done a detailed examination of the costs of load-shedding: the

episodes were too sporadic and unpredictable, and thus such an exercise had not been deemed worthwhile.

A lodge manager stated that its generator, at a purchase price of R500,000-600,000, had not proved cost-effective to operate and that solar power was being investigated as an alternative. Eskom electricity was cheaper than the costs of operating a generator. Running costs of generators are high because of the price of diesel; this makes the power from the generator more expensive than from Eskom.

This was also the experience of some farmers. An alternative to a farmer purchasing his own generator is to hire one from a local firm. However, this would require at least a three-month contract.

One of the benefits identified in existing RVM project literature is that the scheme will result in a more reliable and assured supply of power to consumers in the area. However, this would be the case only if the power generated were “ring-fenced”, that is, it were supplied only to the local area.

In reply to a question as to whether energy from the scheme would be ring-fenced, Eskom advised that it would not. Instead, the energy would be connected into the closest Eskom connection point which is feasible. In this case, a 132kV connection would be required to connect the hydro plant into the existing network. The energy generated would then be dispersed into the network from this injection point to the closest HV/MV sub-stations. The national grid would then supply the area in conformity with its load-shedding schedule.

Thus, the presence of a local hydropower project would not guarantee immunity to local consumers from any load-shedding occurrences. Indeed, this has already been the experience from the Neusberg hydropower scheme on the Orange River between Kakamas and Keimoes.

5.6 Estimating the Benefits of Hydropower as Green Power

The economic benefits from the scheme would accrue at the national level in the form of any lower costs of energy production that might occur from a small hydropower scheme as opposed to existing sources of power. Coal is the dominant source of power in South Africa, coal-fired power stations supplying over 80% of the country’s electricity requirements. Thus, the appropriate comparison would be between the costs of production per kWh from small hydropower plants and coal-fired power stations. This is also a valid comparison on the grounds of clean energy: coal is the technology with the highest carbon emissions whereas hydropower has low emissions and is a so-called green technology. Every kWh produced by hydropower would mean that 1 fewer kWh would need to be produced by coal-fired power stations when demand and supply are in balance.

A number of industry specialist consultants and an Eskom representative were contacted to determine the costs of producing 1kWh of energy from coal and small hydropower projects. It is apparent that there is no industry consensus or average that is used. Much of the information relates to prices in the bid rounds for the REIPPP process, and not all the comparisons include small hydropower projects. So far as coal is concerned, numerous figures have been quoted based on the size of

the operation and a number of other factors. Costs have ranged from R0.55 to R1.20/kWh. Thus, it would be difficult to compare the costs as the results would be speculative at best in the absence of any definitive figures. Moreover, the REIPPP figures for hydro appear to range between R1.03-1.20/kWh which would put it in the upper range of coal-fired energy production costs. If the production costs of 1kWh of energy from hydro and coal were broadly similar, hydropower would be preferred because it is a form of clean energy, and this is reflected in carbon savings.

The Consultants examined the issue of carbon emissions. The economic benefits of the project that were then identified consist of revenue from the sale of energy back to the national grid and carbon saving from producing energy from a cleaner source.

Carbon emissions are a contentious issue and, depending on the source of information, their cost varies greatly. It is clear, though, that hydropower is a cleaner source of energy than burning fossil fuels. In order to account for this benefit, conservative figures have been used for the baseline analysis and improved figures have been used under the sensitivity analysis.

In order to calculate the cost of carbon emissions, two pieces of information are required:

1. The amount of carbon emitted per kWh of energy produced.
2. The cost of carbon.

The first piece of information is less contentious. Depending on the efficiency of the coal plant, the amount of carbon emitted ranges between 260-1001 grams per kWh. As a baseline figure, the Consultants have used 700g/kWh which is an average of the 1001g/kWh cited in *State and Trends of Carbon Pricing* published by the World Bank Group, 2014; 960g/kWh cited by Eskom (Source: Eskom Holdings, *World Energy Outlook*, 2010); and 260g/kWh cited in the *Journal of Energy Policy* 31 (2003) pp1315-1326 (also cited as a low figure in *State and Trends of Carbon Pricing, World Bank Group*, 2014).

In order to arrive at a figure for the cost per ton of carbon emitted, the Consultants have been conservative in the baseline calculation, using a figure of USD5. Various sources for the cost of carbon are:

- Reducing Emissions from Deforestation and Forest Degradation (REDD), which is under negotiation by the United Nations Framework Convention on Climate Change (UNFCCC) uses a figure of USD4.90 per ton.
- The proposed South African Carbon tax of about USD10 (ZAR120) per ton (WB *State and Trends of Carbon Pricing*, 2014).
- United States Environmental Protection Agency uses USD39 per ton(2015)
- Stanford University's School of Earth Science considers that the figure of USD39 is too low and should be as high as USD220 per ton (2015).

By comparison, other countries base their carbon pricing on *State and Trends of Carbon Pricing, 2014* (USD per ton of carbon emitted):

- Sweden: 168
- Japan (Tokyo): 95
- Switzerland: 68
- Finland: 48

- Netherlands: 31
- Australia: 22
- UK: 16
- California: 11
- France: 10
- China (Beijing): 9
- Mexico: 5
- China (Shanghai): 5

From the above, the following assumptions have been used in determining the cost of carbon emissions:

- All costs and revenues in constant (2015) prices.
- A discount rate of 10% with sensitivity analysis at the 8% and 12% level. This is based on rates commonly used in South African CBAs.
- The CBA is based on a 20-year cash flow recovery period.
- 235GW/annum energy production.
- USD5 per ton for carbon emission.
- 700g carbon emission/kWh.
- USD1:ZAR11.94 exchange rate (based on 28/03/15)

The cost of carbon emissions is R10,825mn per annum. Accordingly, the additional cost of producing energy by means of coal rather than hydro is R10,825mn when accounting for the cost of carbon emissions.

In order to show the outcome of improved benefits resulting from a higher cost of emissions and an increase volume of carbon emissions from energy, an additional scenario test was undertaken whereby the Consultants increased the cost of emissions from USD5 to USD39 to conform with the United States Environmental Protection Agency and the carbon emission per kWh produced was increased from 700g to 1001g to conform to Eskoms value. This resulted in a carbon cost of R84,438mn per annum. Using Eskoms proposed cost of R120 per ton of carbon results in a cost saving of approximately R21.6mn per annum (South Africa National Treasury: Carbon Tax Policy Paper, May 2013).

5.7 Conformity with REIPPP

In Section 1.2.2 the stipulations in the Department of Energy's RFP for the REIPPP were mentioned. These stipulations are non-negotiable. The RVM hydropower project is expected to conform to these stipulations as follows:

- Local content – approximately 75% of procurement on South African goods and services. Few imported components and equipment are required for the construction of the project, and there is a high civils component which will use local firms, materials and staff.
- Job creation – during the construction phase 150-200 individuals from local communities will be employed per month for the three-year period, followed by between 5-10 persons for the operational period over the lifetime of the project which is estimated at 80 years.
- Community shareholding – the RVM Community Trust will hold shares on behalf of the community. This Trust will receive rental income for the lease of RVM land over the lifetime of the period, and dividend income from projects over the operational period.

- Economic development and socio-economic projects – RVM1 Hydro Electric Power (Pty) Ltd is obliged to comply with the RFP stipulation of spending between 1-2.5% of revenue in these fields. The mechanism of Development Forums has been established to involve the IPP, the Community Trust, and local and district municipalities in regular interaction to ensure that a coherent programme of projects is planned and implemented without duplicating what other organisations are providing.

5.8 Impacts Identified in Other Specialist Reports

A number of impacts of an economic nature identified in other specialist reports did not feature as issues during the fieldwork. These are:

- In-migration of unskilled labour: Since the project is committed to employing local residents, it is not expected that there would be an influx of labour from other areas in search of work. It was felt that the project is too small to attract such an influx.
- Increased opportunities for small enterprises and informal traders: The project should provide some scope for enterprising local firms or individuals to supply services such as accommodation and catering during the construction phase, but these will be taken into account in the multiplier effects considered in Chapter 6.
- Temporary and permanent loss of land: The project will have a small permanent footprint in terms of its land usage, but no farmers felt that this was significant.
- Temporary disruption of farming activities: This was not seen as an issue during discussions with farmers.
- Noise and visual impacts: These did not feature as concerns for lodge managers or farmers adjacent to the project site who were interviewed.

5.9 Impacts Identified and Assessed

The following impacts have been identified and will be assessed in Chapter 7:

- Increased dust - construction phase
- Road impacts - construction phase
- Increased tourism bed-nights - construction and operational phases
- Increased retail turnover - construction phase
- Increased employment - construction and operational phases
- Benefits for RCT - construction and operational phases
- Impacts on energy - operational phase

6 MACROECONOMIC IMPACT

The period required to undertake a full SAM stretches beyond the timelines for this analysis. Thus, the Consultants have used the Northern Cape SAM multipliers as constructed by the DBSA Information Analysis Unit, and have applied them to Kai!Garib. The relevant multipliers are those for the energy sector. The multipliers for an investment project's impact on GDP and employment per R1 million investment are 0.31 and 0.92 respectively. This indicates that R1 million invested results in an increase of GDP and employment of R310,000 and 0.92 jobs respectively.

The contribution from the civil works to the total output shows the importance of capital-intensive projects to the economy as a whole. Evaluating the multiplier effect is expected to provide a picture of how significant the investment in the hydropower project is to the entire economy. The multiplier effect primarily takes place in the short run and is an important driver of economic expansion, showing that investment spending of R1 results in a multiple of that R1 in the overall output of the economy.

The South African construction multiplier is R3.02 per R1 investment (source: previous construction studies undertaken by the Consultant). This shows that each R1 of investment in construction projects results in an additional R3.02 to the overall economy.

The three-year investment of R1,042 billion in the project will have a present value of R893 million when using a real rate of discount of 10% per annum. This present value will increase to an eventual one-off regional gross income of R2,697 billion. After deduction of the original investment amount, the present value of the net increase in one-off regional income is expected to equal R1,655 billion.

However, the SAM for the Northern Cape (based on the 2011 financial year) indicates that the multiplier for energy is only 0.31, indicating that R1 investment results in an impact on GDP of R0.31 (source: DBSA Information Analysis Unit). On this basis, the impact on GDP in the Northern Cape of the hydropower project may only be R513mn as opposed to the R1,655bn calculated in the previous paragraph.

The SAM for the Northern Cape also showed that the impact on employment per R1mn investment results in 0.92 jobs being created. This indicates that, over the project's construction, the following total (direct and indirect) number of jobs will be created:

- Year 1: 336
- Year 2: 278
- Year 3: 345

Based on the 2011 Population Census, there are 31,000 persons economically active (employed or unemployed but looking for work) in Kai!Garib. Of these, 10% are unemployed, leaving 27,900 employed (Kai!Garib Municipality Integrated Development Plan, 2014). Thus, the impact of the jobs created during construction will be of limited value in the overall context of Kai!Garib, but the project will nevertheless provide useful additional employment and incomes.

7 ASSESSMENT OF IMPACT SIGNIFICANCE

Specialists are required to provide their reports in a specific layout and structure, so that a uniform specialist report volume can be produced. To ensure a direct comparison between various specialist studies across a range of disciplines, standard rating scales have been defined for assessing and where possible quantifying the significance of impacts.

7.1 Methodology

Five factors need to be considered when assessing the significance of impacts, namely:

1. Relationship of the impact to **temporal** scales - the temporal scale defines the significance of the impact at various time scales as an indication of the duration of the impact.
2. Relationship of the impact to **spatial** scales - the spatial scale defines the physical extent of the impact.
3. The severity of the impact - the **severity/beneficial** scale is used in order to scientifically evaluate the severity of negative impacts, or how beneficial positive impacts would be on a particular affected party. ***Magnitude*** is an often-used synonym.

The severity of impacts can be evaluated with and without mitigation in order to demonstrate how serious the impact is when nothing is done about it. The word 'mitigation' means not just 'compensation' but also the ideas of containment and remedy. For beneficial impacts, optimisation means anything that can enhance the benefits. However, mitigation or optimisation must be practical, technically feasible and economically viable.

The **likelihood** of the impact occurring - the likelihood of impacts taking place as a result of project actions - differ between potential impacts. There is no doubt that some impacts would occur (e.g., increased dust), but other impacts are not as likely to occur and may or may not result from the proposed development.

Each criterion is ranked with scores assigned as presented in Table 7.1 to determine the overall **significance** of an activity. The criterion is then considered in two categories, viz., effect of the activity and the likelihood of the impact. The total scores recorded for the effect and likelihood are then read off the matrix presented in Table 7.2 to determine the overall significance of the impact, which is either negative or positive.

Table 7.1: Ranking of Evaluation Criteria

EFFECT	**Temporal Scale**			**Score**
	Short term	Less than 5 years		1
	Medium term	Between 5-20 years		2
	Long term	Between 20 and 40 years (a generation) and from a human perspective also permanent		3
	Permanent	Over 40 years and resulting in a permanent and lasting change that will always be there		4
	Spatial Scale			
	Localised	At localised scale and a few hectares in extent		1
	Study Area	The proposed site and its immediate environs		2
	Regional	District and Provincial level		3
	National	Country		3
	International	Internationally		4
	Severity	**Severity**	**Benefit**	
	Slight	Slight impacts on the affected system(s) or party(ies)	Slightly beneficial to the affected system(s) and party(ies)	1
	Moderate	Moderate impacts on the affected system(s) or party(ies)	Moderately beneficial to the affected system(s) and party(ies)	2
	Severe/ Beneficial	Severe impacts on the affected system(s) or party(ies)	A substantial benefit to the affected system(s) and party(ies)	4
	Very Severe/ Beneficial	Very severe change to the affected system(s) or party(ies)	A very substantial benefit to the affected system(s) and party(ies)	8
LIKELIHOOD	**Likelihood**			
	Unlikely	The likelihood of these impacts occurring is slight		1
	May Occur	The likelihood of these impacts occurring is possible		2
	Probable	The likelihood of these impacts occurring is probable		3
	Definite	The likelihood is that this impact will definitely occur		4

The first three scales above rate the effect which can range from a minimum of 3 (short term; localised; slight) to a maximum of 16 (permanent; international; very severe). Using the effect of the impact and its likelihood of taking place, the significance is obtained by reading the matrix below as shown in Table 7.2.

Table 7.2: Matrix to Determine the Significance of the Impact based on the Likelihood and Effect of the Impact.

Likelihood		Effect													
		3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	1	4	5	6	7	8	9	10	11	12	13	14	15	16	
	2	5	6	7	8	9	10	11	12	13	14	15	16		
	3	6	7	8	9	10	11	12	13	14	15	16			
	4	7	8	9	10	11	12	13	14	15	16				

The significance scale is an attempt to evaluate the importance of a particular impact. The evaluation of the significance of an impact relies heavily on the values of the person making the judgment. For this reason, impacts especially of a social nature need to reflect the values of the affected society.

The evaluation of the impacts as described above is used to prioritise which impacts require mitigation measures.

Negative impacts that are ranked as being of "**VERY HIGH**" and "**HIGH**" significance will be investigated further to determine how the impact can be minimised or what alternative activities or mitigation measures can be implemented. These impacts may also assist decision makers, i.e., many **HIGH** negative impacts may bring about a negative decision.

For impacts identified as having a negative impact of "**MODERATE**" significance, it is standard practice to investigate alternate activities and/or mitigation measures. The most effective and practical mitigations measures will then be proposed.

For impacts ranked as "LOW" significance, no investigations or alternatives will be considered. Possible management measures will be investigated to ensure that the impacts remain of low significance.

Table 7.3: Description of Environmental Significance Ratings and Associated Range of Scores

Significance rating	Description/definition	Guiding score
Low	An acceptable impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in either positive or negative medium to short-term effects on the social and/or natural environment.	4-8
Moderate	An important impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.	9-12
High	A serious impact, if not mitigated, may prevent the implementation of the project (if it is a negative impact). These impacts would be considered by society as constituting a major and usually a long-term change to the natural and/or social environment, and result in severe effects or beneficial effects.	13-16
Very High	A very serious impact which, if negative, may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are unmitigable and usually result in very severe effects, or very beneficial effects.	

The project impacts are identified according to which phase of the project they are applicable to as required by the National Environmental Management Act (NEMA) where applicable. An economic analysis of infrastructure projects confines itself to the construction and operation phases.

7.2 Construction Phase Impacts

Impact 1: Increased Dust

Cause and Comment
Increased traffic on road during construction.

Mitigation and Management
Sprinkler system; influence road authority to improve road surface and maintenance, preferably sealing the road.

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Localised	1	Moderate	2	Definite	4	8	Low
With Mitigation	Short term	1	Localised	1	Slight	1	Probable	3	6	Low

Impact 2: Road Impacts

Cause and Comment
Increased heavy vehicle traffic on already poor road.

Mitigation and Management
Road authority to improve road surface and maintenance, preferably sealing the road.

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Regional	3	Severe	4	Definite	4	12	Moderate
With Mitigation	Short term	1	Regional	3	Slight	1	Probable	3	8	Low

Impact 3: Increased Tourism Bed-Nights

Cause and Comment
Skilled and professional persons working on project will require accommodation.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Study area	2	Beneficial	4	Definite	4	11	Moderate
With Mitigation										N/A

Impact 4: Increased Retail/SME Turnover

Cause and Comment
Employment on project will lead to increased expenditure locally in retail sector including small and informal enterprises.

Mitigation and Management
Ensure that project services are contracted to local small enterprises wherever possible.

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Regional	3	Slight	1	Definite	4	9	Moderate
With Mitigation	Short term	1	Regional	3	Slight	1	Definite	4	9	Moderate

Impact 5: Increased Employment

Cause and Comment
Project will provide 150-200 jobs.

Mitigation and Management
Maximise employment of local residents.

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Regional	3	Slight	1	Definite	4	9	Moderate
With Mitigation	Short term	1	Regional	3	Slight	1	Definite	4	9	Moderate

Impact 6: Benefits for RCT, Broad-based Community Trust and Socio-economic Expenditure

Cause and Comment
Income from rental, dividends and community expenditure.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Short term	1	Study area	2	Moderate	2	Definite	4	9	Moderate
With Mitigation										N/A

7.3 Operation Phase Impacts

Impact 7: Increased Tourism Bed-Nights

Cause and Comment
Small amount of bed-nights required by skilled and professional persons servicing the project.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Medium	2	Regional	3	Slight	1	Definite	4	10	Moderate
With Mitigation										N/A

Impact 8: Increased Employment

Cause and Comment
Small number of jobs (5-10) permanently created on project.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Medium	2	Study area	2	Slight	1	Definite	4	9	Moderate
With Mitigation										N/A

Impact 6: Benefits for RCT, Broad-based Community Trust and Socio-economic Expenditure

Cause and Comment
Income from rental, dividends and community expenditure.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Permanent	4	Study area	2	Severe/Beneficial	4	Definite	4	14	High
With Mitigation										N/A

Impact 10: Impacts on Energy

Cause and Comment
Clean energy produced into national grid.

Mitigation and Management
N/A

Significance of Impact

Impact	Effect						**Risk or Likelihood**		**Total Score**	**Overall Significance**
	Temporal Scale		Spatial Scale		Severity of Impact					
Without Mitigation	Permanent	4	National	3	Slight	1	Definite	4	12	Moderate
With Mitigation										N/A

8 CONCLUSION

The economic impacts identified in this study are summarised in Table 8.1.

Table 8.1:Economic Impacts

Sector	Impact
Agriculture	• Water availability – nil • Power availability – nil • Output – nil • Increased dust on grapes – needs mitigation • Increased heavy-vehicle traffic on Schroeder Road – needs mitigation
Tourism	• Estimated R2.38mn per annum in increased profits of accommodation establishments during three-year construction period. Multiplier effect of expenditure shown in SAM. • Number of visitors to Augrabies Falls National Park – nil
Retail/wholesale/other	• Multiplier effect of spending by project employees and project procurement shown in SAM.
Riemvasmaak Community Trust	• Estimated R13.1mn per annum in rental from IPP. • Dividends on profits from IPP (shareholding 10 - 15%) amounting to R26.6mn per annum.
BBBEE Trust	• Dividend income from shareholding in IPP amounting to R13mn per annum (shareholding 5%).
Local communities	• Development and social spending by IPP (1-2.5% of project revenue) amounting to R23mn per annum.
Power	• Nil – fed into Eskom grid. • Carbon savings – shown in CBA model.
Employment	• Construction phase – 150-200 jobs on the project • Operational phase – up to 5 - 10 permanent jobs over project lifetime (80 years) • Indirect jobs – 336 in Year 1, 278 in Year 2 and 345 in Year 3 of construction phase.

This study has found that there are no fatal flaws or red flags from an economic perspective, i.e., from the point of view of society as a whole. The macroeconomic analysis revealed positive impacts on GDP, employment and incomes.

These impacts would be strengthened by measures such as skills development for local residents to enable them to secure permanent jobs during the operational phase, and to ensure that income from the project accruing to the Riemvasmaak Trust is utilised for productive and sustainable activities.

The project is small in size but would nevertheless make a positive contribution to the economy of the local municipality as well as to the provincial and national economies. Thus, it is recommended that it be implemented.

ANNEX 1 – LIST OF INTERVIEWS

NAME	GROUP/ORGANISATION
Mr J Wessels	Kaap Agri Kakamas
Mr B Vass	Riemvasmaak Development Committee
Ms P Basson	Riemvasmaak Development Committee
Mr M Basson	Riemvasmaak Development Committee
Ms M Roma	Riemvasmaak Development Committee
Mr R Matthews	Riemvasmaak Trust
Mr B van Zyl	Dundi Lodge
Mr G van Niekerk	Keikarries/Kakamas Water Users' Association
Mr A Gagiano	Blouputs Farmers' Association
Mr S Theron	Oseiland Farms/ Rooipad Farmers' Association
Mr DJ Strauss	Rooipad Farmers' Association
Ms G Cloete	Kai!Garib Local Municipality (Local Economic Development)
Ms R Jafta	Kai!Garib Local Municipality (Tourism)
Mr J Benade	Neusberg Hydro-SA
Mr W Benade	Augrabies Falls Lodge and Camp
Mr F Oosthuizen	Witklip and Orange Falls Farms
Mr W du Plessis	Omdraai Farms
Mr F H Burger	Schroeder Farmers' Association
Mr G Heese	Groot Vaalkopeiland Farm
Mr C Klindt	Vaaldrif Landgoed
Ms N Maritz	The Raisin Company, Marchand
Mr D Smit	Dried Fruit Technical Services
Mr J Lombard	South African Table Grape Industry
Ms B Floris-Samuels	SAWIS
Mr A van Zyl	Vinpro
Mr C Ferrandi	Agricultural consultant, Somerset West
Mr H Burger	Orange River Wine Cellars, Upington
Mr B Louw	Orange River Wine Cellars, Kakamas
Mr M van Vuuren	Grant Thornton (Tourism Specialist)
Mr R Buske	Eskom (Planning)
Professor P Lloyd	Energy Institute, Cape Peninsula University of Technology
Ms K Maasdorp	Spring Grove Dam
Mr R Matthews	Riemvasmaak Trust
Mr F van Rooyen	Augrabies Falls National Park
Ms L de Wet	Augrabies Falls National Park
Dr H Hendricks	SANParks
Ms E Lombard	Orange River Producers' Alliance
Ms G Weare	Citrus Growers' Association
Mr A Dippenaar	Deciduous Fruit Board

Correspondence

Professor A Eberhard, Graduate School of Business, University of Cape Town
Mr W Mullins, Conningarth Economic Consultants
Dr T Bischof-Niemz, Energy Centre, Council for Scientific and Industrial Research
Ms S Benade, Manager, Economic Research and Analysis, Northern Cape Provincial Treasury