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Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

NCWABENI OFF-CHANNEL STORAGE DAM: FEASIBILITY STUDY

Economic Feasibility

P WMA 11/T52/00/3211/3

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Executive Summary

During the project it became clear that the provision of water to the rural and urban poor in this area will have to be approached, not only from a socio-economic perspective but also from a socio-political reality to understand the dynamics of the need to provide water in this area.

Secondly, it was also necessary to determine the value of the water (opportunity cost[1]) that is to be distributed to the community.

In the conceptualising process of how to approach the task it became clear that it is necessary to discuss a number of issues that will impact on the value of the water (opportunity cost) that is to be used in the economic CBA *versus* the tariff to be used in the financial cost benefit analysis.

The following issues were identified and are discussed in the main report:

- Who pays for the Provision and Maintenance of Basic Infra Structure,
- Regulatory Environment;
- Theoretical Approach;
- Affordability;
- Monetary Value of Domestic/Municipal Water;
- Value of Environmental Water.

A number of studies were used to arrive at a value for the water to be used in the Cost Benefit Analysis. The following two were found to be the most appropriate and was used in the CBA:

- WRC Report No. 989/1/08: - CJ Williams, GA Veck, and MR Bill. – The Value of Water as an Economic Resource in the Greater Letaba River Catchment. The 2002 value is set at R5.72 per m^3, if converted to a 2012 value it comes to R10.56.
- WRC Report: TT 305/07 – A Manual for Cost Benefit Analysis in South Africa with Specific Reference to Water Resource Development. The 2007 value is set at R7.99 per m^3, if converted to a 2012 value it comes to R10.82.

The Ncwabeni Dam can also benefit the estuary of the river, especially in the winter months, as excess water will be available and the water can be utilised to keep the estuary open. The only value of water calculated under these circumstances was the work done by Turpie[2] and Joubert who derived a value of river water for the whole of the Kruger Park based on a travel cost methodology. Williams again used this to estimate the value of the water in the Letaba catchment. The value estimated by Williams was R 0.85 per m^3, converted to 2012 prices it comes to R1.68 per m^3. This value was used as the opportunity cost of the water released.

The capital and operational data with the projected water use over time was obtained from the rest of the project team and used in the CBA analysis.

[1] In the report, the term “value of water” is preferred, but has the same meaning as “opportunity cost”

[2] Institute of Natural Resources, University of Natal: Incorporating Economic consideration into the determination of the Environmental Reserve – Case Study: The tourism value of rivers in and adjacent to the Kruger National Park, and impacts of a change in river quality – 2001.

The results of the CBA are presented in the following table.

	Parameter	*Discount Rate 6%*	*Discount Rate 8%*
WRC Prices	***Net Present Value***	R181.8 mil.	R21.8 mil.
	IRR	8.36%	8.36%
	BCR	1.35	1.04
Letaba New Water Prices	***Net Present Value***	R167.96 mil.	R11.68 mil.
	IRR	8.19%	8.19%
	BCR	1.32	1.02

The results are positive for both values as well as the two different discount rates.

The macro-economic impact results for both the operational and construction phases show positive impacts on the local economy.

The two issues that play an important role in the final recommendation are:

- Affordability, and
- The possible impact should the project not be implemented, the so-called “no – go” option, seen from a regional perspective.

Although the project is economically feasible according to the above analysis, the situation around the financial affordability will have to be addressed. It is not only the poverty levels of the recipients of the water but also the possible financial situation of the local authority or Regional Water Service Supplier that must be taken into consideration.

The affordability by the local authority is addressed in the financial report, however, it is necessary that the option of treasury grants be raised against the backdrop of who pays for “basic infrastructure” if the locals and the local authority cannot afford the full capital complement.

In the above analysis the value of the water (opportunity cost) used in the analysis is above R10 per m^3, a value that produces acceptable Economic Cost Benefit Analysis parameters, this tariff would probably be outside the affordability levels of many of the local population, should the full capital cost be transferred to the tariff. It will therefore be necessary for the authorities to assist the local government with financing options or appoint the Regional Water Services Supplier to act as the implementing agent.

The “no – go” option also has implications, not only on a local but also on a regional basis. The need for water supplementation on the Lower South Coast, south of Port Shepstone has been discussed in the relevant project documents. The situation is becoming critical and it appears as if no further population or economic growth can be accommodated in the area if a new water source is not available. In the long term this can have a very negative affect on the region and even lead to civil unrest if basic water needs are not satisfied. Without discussing the subject in depth, it must be kept in mind that the rural people tend to settle in family and chieftain groups and the possibility exists that without water this might not be possible.

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1 Background

Conningarth Economists was appointed to conduct the Economic Study of the Environmental Impact Assessment (EIA) for the proposed construction of the Ncwabeni Off-Channel Storage Dam in the Umzimkhulu River at Port Shepstone as part of the Umzimkhulu Regional Water Supply Scheme.

The dam will supply water to areas within the Ugu DM, namely:-

- It will be the primarily supply of water to the existing Mzimkhulu Regional Water Supply Scheme (Hibiscus Coast LM);
- it will supplement the supply of the Mhlabatshane Scheme which is unable to meet the full demand of the Umzumbe LM rural areas; and
- it will also replace the supply of the small existing Assissi WTP which is unable to meet the demand in its supply area of the Umzumbe LM.

The original Terms of Reference (ToR) stated the following: *"The appointed PSP will be required to review the socio-economic studies that were completed as part of the pre-feasibility study, and then to build on these by undertaking further comprehensive socio-economic studies. These studies must establish what the socio-economic benefits/losses for the region will be and what the impact will be if the Ncwabeni Off-channel Storage Dam is not implemented. It is necessary to determine the opportunity cost of water in the donor and recipient catchments. Tools/modules that can be used include:*

- *Cost-Benefit Analysis*
- *General Equilibrium Modules"*

The approach followed in reaction to the original ToR was for the economic analysis to be carried out to determine the viability of the project from the point of view of the economy as a whole. As a section of the ToR refers to General Equilibrium Modules, this was interpreted to refer to a macro-economic impact analysis with the normal macro-economic parameters and not only to the backward linkages but also to the forward linkages for the availability of sufficient water to the regional economy.

To the extent it is possible, all social, economic and environmental costs and benefits were identified and included in the analysis, for both the donor and the recipient areas. Wherever applicable opportunity costs were applied instead of financial costs and shadow pricing was applied as necessary. The opportunity cost of capital was estimated to make a comparison with the Economic IRR in order to determine the viability of the project. The updated KwaZulu-Natal Social Accounting Matrix was used to estimate the macro-economic parameters of the proposed construction.

An Economic Cost Benefit Analysis (ECBA) was performed and the Net Present Value (NPV) and the Economical Internal Rate of Return (EIRR) was determined. An interpretation of the calculations was made, including the social, economic and environmental benefits and disbenefits of the project. The full spectrum of opportunity costs (shadow prices) was estimated where applicable and applied in the econometric model.

Table 1: The differences between an Economic and Financial CBA[3]

Attributes	Economic CBA	Financial CBA
Perspective	The broader community	Project shareholders/capital providers
Goal	The most effective application of scarce resources	Maximization of net value
Discount Rate	Social discount rate	Market determined weighted cost of capital
Unit of Valuation	Opportunity costs	Market prices
Scope	All aspects necessary for a rational, economic decision	Limited to aspects that affect profits
Benefits	Additional goods, services, income and/or cost saving	Profit and financial return on capital employed
Costs	Opportunity costs of goods and services foregone	Financial payments and depreciation calculated according to generally accepted accounting principles

The table shows that the economic CBA analysis targets the broader community on a number of issues compared to the narrow focus of the financial CBA.

During the project it became clear that the provision of water to the rural and urban poor in this area will have to be approached, not only from a socio-economic perspective but also from a socio-political reality to understand the dynamics of the need to provide water in this area.

Secondly it was also necessary to determine the value of the water (opportunity cost[4]) that will be distributed to the community as described in the next chapter.

[3] Source: Water Research Commission Report No. TT 305/07 – A Manual for Cost Benefit Analysis in South Africa with Specific Reference to Water Resource Development.

[4] In the report the term “value of water” is preferred, but has the same meaning as “opportunity cost”.

2 Approach

During the conceptualisation process on how to approach the task it became clear that it will be necessary to discuss a number of issues that will impact on the value of the water (opportunity cost) to be used in the economic cost benefit analysis *versus* the tariff to be used in the financial cost benefit analysis.

The following issues were identified and are discussed in the following paragraphs:

- Who pays for the Provision and Maintenance of Basic Infra Structure,
- Regulatory Environment
- Theoretical Approach;
- Affordability;
- Monetary Value of Domestic/Municipal Water;
- Value of Environmental Water.

2.1 Who Pays for the Provision of Basic Infra Structure

Who actually pays for basic infrastructure is presently a very topical issue in the South African context, as a general rule it has been stated that the "user pay" principle must be applied. However this is not generally accepted at all levels of Government and the population at large, especially in the light of the large discrepancies as far as income is concerned.

If infrastructure is needed as part of the uplifting of the population then the affordability of the infrastructure comes into play and very often it is not feasible to expect the users to pay. For example: If the government wishes to kick-start agricultural development in the deep rural areas, it will have to deliver the infrastructure, otherwise development will never take place.

The construction of the water supply in the rural and urban poor areas of the UMzimkhulu is an example where the "user pay" principle will be tested. The following will rather be the norms to be used to evaluate the project:

- The social acceptability;
- The ecological sustainability;
- The financial sustainability;
- The economic efficiency.

2.2 Regulatory Environment

Issues that must be considered in the regulatory environment in which the supply of water operates are.

The first issue to be addressed is the ***South African Constitution*** and related issues:

The following is quoted from ***Chapter 2 "Bill of Rights" number 27 of the Constitution***
"27. Health care, food, water and social security.-
(1) Everyone has the right to have access to –
(a) health care services, including reproductive health care;

(b) sufficient food and water; and

(c) social security, including, if they are unable to support themselves and their dependants, appropriate social assistance.

(2) The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights.

(3) No one may be refused emergency medical treatment."

The constitution allocates the provision of basic services to local government as shown in the next section.

***152. Objects of local government**.-*

(1) the objects of local government are: -

(a) to provide democratic and accountable government for local communities;

(b) to ensure the provision of services to communities in a sustainable manner;

(c) to promote social and economic development;

(d) to promote a safe and healthy environment; and

(e) to encourage the involvement of communities and community organisations in the matters of local government.

(2) A municipality must strive, within its financial and administrative capacity, to achieve the objects set out in subsection (1).

***153. Developmental duties of municipalities.-**A municipality must-*

(a) structure and manageits administration and budgeting and planning processes to give priority to the basic needs of the community, and to promote the social and economic development of the community, and

(b) participate in national and provincial development programmes

From the above it is clear that the provision of basic services to the community is one of the priority tasks for local government.

The second issue related to and impacting on the regulating sphere is the Water Services Act drawn up by Government to provide and regulate water services.

In this section the availability of water together with the "condition" within its available resources are discussed.

The Government promulgated Act 108 0f 1997, the water Services Act, the main objectives of the Act are:

2. The main objects of this Act are to provide for—

(a) the right of access to basic water supply and the right to basic sanitation necesarry to secure sufficient water and an environment not harmful to human health or well being;

(b) the setting of national standards and norms and standards for tariffs in respect of water services

(c) the preparation and adoption of water services development plans by water services authorities;

(d) a regulatory framework for water services institutions and water services intermediaries;

(e) the establishment and disestablishment of water boards and water services committees and their duties and powers;
(f) the monitoring of water services and intervention by the Minister or by the relevant province
(g) financial assistence to water services institutions;
(h) the gathering of information in a national information system and the distribution of that information;
(i) the accountability of water services providers: and the promotion of effective water resource management and conservation.

The following are the important "***Conditions for providing Water Service***".

Conditions for provision of water services

4. (1) Water services must be provided in terms of conditions set by the water services provider.
(2) These conditions must—
(a) be accessible to the public;
(b) accord with conditions for the provision of water services contained in bylaws 25 made by the water services authority having jurisdiction in the area in question; and
(c) provide for—
(i) the technical conditions of existing or proposed extensions of supply:
(ii) the determination and structure of tariffs:
(iii) the conditions for payment;
(iv) the circumstances under which water services may be limited or discontinued;
(v) procedures for limiting or discontinuing water services: and
(vi) measures to promote water conservation and demand management.
(3) Procedures for the limitation or discontinuation of water services must—
(a) be fair and equitable;
(b) provide for reasonable notice of intention to limit or discontinue water services and for an opportunity to make representations; unless -
(i) other consumers would be prejudiced:
(ii) there is an emergency situation; or
(iii) the consumer has interfered with a limited or discontinued service; and
(c) ***not result in a person being denied access to basic water services for non-payment; where that person proves, to the satisfaction of the relevant water services authority that he or she is unable to pay for basic services.***

Provision of basic water supply and basic sanitation to have preference

5. *If the water services provided by a water services institution are unable to meet the requirements of all its existity consumers. it must give preference to the provision of basic water supply and basic sanitation to them.*

In this case, **4(c)** and **5** are the most relevant conditions in the case of consumers not able to pay for water and for the availability of basic water and sanitation.

In the reaction to the above and to fulfil its mission the Department of Water Affairs developed a programme called "The Strategic Framework for Water Services".

The following is quoted directly from the Strategic Framework Document:- "*The fundamental driver of the Strategic Framework for Water Services (SFWS: 2003) is the Constitution, which states that water service provision is a local government function. The SFWS provides a comprehensive summary of policy with respect to the water services sector in South Africa and sets out a strategic framework for its implementation in the short to medium term, including 19 specific outcome targets. The function of infrastructure implementation has already been transferred and water services scheme operation is in the final phases of being transferred to local government and/or appropriate water services institutions."*

The above analysis shows that for the provision of basic water for domestic consumption the following is applicable:

- In the Constitution of the RSA it is listed as a "Basic Service",
- The Water Services Act states very clearly that if people who can prove they cannot pay cannot be denied access to water.
- The provision of water services is a local government function.

From the above we deduct that the provision of water to the consumers is actually obligatory and not a choice, even to those that cannot pay. However, because the function has been transferred to local government, affordability to pay for the necessary infrastructure becomes even more crucial for the local government or the water service provider as well as the consumers.

The above analysis, a socio-political issue, has been added to the report to set the scene for the rest of the economic analysis as a reminder of regulatory reality in the provision of domestic water.

2.3 Water as a Consumption Good - Theoretical Approach

Water outside the river or other source has two main uses: either consumed directly as a consumption good or used as a factor of production in agriculture, forestry and industry, etc. The economic foundation of the demand for these two consumption uses also differ.

Residential demand is the only water use category where water is consumed directly. Residential water competes directly with other items in the household budget. In this regard, consumer choice can be modelled as utility maximisation given a budget constraint, from which a downward sloping demand for water can be derived[5]. Some characteristics of water resemble that of 'normal' economic goods, thereby implying that demand affects the price, while in other respects demand is expected to be highly in-elastic, reflecting the fact that water is an essential good. The Espey *et al* (1997) survey of 124 estimates of price elasticity of demand for residential water supports this view. The elasticity of –0.64 shows that residential water is not price responsive in the short run, confirming its status as an essential good.

Veck and Bill (2000)[6] record a similar result for Alberton–Thokoza in South Africa where the price elasticity of demand is estimated to be –0.13 for indoor and –0.38 for outdoor use. The lower

[5] WRC Report No. 987/1/02: B. Conradie – The Value of Water in the Fish – Sundays Scheme of the Eastern Cape.

[6] WRC Report No. 790/1/00:- GA Veck and MR Bill- Estimation of the Residential Price Elasticity of Demand for Water by means of a Contigent Valuation Approach

elasticity for indoor use indicates that this is less price responsive, and hence more of an essential good.

From the above short analysis it is clear that domestic indoor demand is not really price elastic, but also has to compete with other household goods in the monthly budget. The above analysis shows that for basic indoor water supply the consumer who can pay and is prepared to pay, the volume of water used indoors does not change with a price change, which is if he can afford to pay.

The above discussion was added to show that it is not really possible to regulate indoor domestic water use by tariffs.

2.4 Affordability

The next issue is the issue of affordability and, from the analysis in the financial report of this study, it appears that the majority of the households cannot afford to pay for the water. The following is quoted directly from Supporting Report 4: Institutional and Financial Arrangements of this study:

"Studies on poverty show that eThekwini has by far the lowest poverty rate (24.6%) in KwaZulu-Natal, and is the only region in the province with a poverty rate estimate below the national average. The remainder of the KwaZulu-Natal regions all have poverty estimates above the national average ranging from 51% for Umgungundlovu to a staggering 80% for Umzinyathi.

Some of these areas, including Ugu, Umzinyathi, Zululand and Umkhanyakude have been identified during the Presidential State of the Nation address in 2001 as 'nodal areas' that would be targeted for rural development programs.

Poverty in the Ugu District is unevenly distributed with Umzumbe municipality being the worst affected followed by the Hibiscus Coast. In 2008 it was estimated that 394 623 people, ***then 55% of the population****, were living in* ***Poverty*** *in Ugu District; while 15 508 people in the District were living on less than USD 1 per day, i.e. in extreme poverty. [source; Global Insight 2010 and Ugu DM IDP].*

Based on these studies it is estimated that approximately 50% of the population to be supplied with water from the Ncwabeni Dam will not be able to pay for the water."

The poverty issue eliminates the so-called "willingness to pay" principle to determine the value of the water, as more than 50% of the future consumers cannot pay for the water, even if they are prepared to pay. It was therefor necessary to follow a different approach to determine the value of the water (opportunity cost) to be used in the Economic CBA.

2.5 Monetary Value of the Domestic Water

The above discussed topics, namely:

- Socio-political and regulatory situation,
- Water as a basic necessity, and
- Affordability was necessary to arrive at the situation where the determination of the value of the water to be used in the economic analysis can be estimated.

In deciding on an appropriate value for the water, extensive use was made of the following five Water Research Commission Reports:

- WRC Report No. 790/1/00: GA Veck and MR Bill – Estimation of the Residential Price Elasticity of Demand for Water by Means of a Contingent Valuation Approach.
- WRC Report No. 987/1/02: B Conradie – The Value of Water in the Fish – Sundays Scheme of the Eastern Cape.
- WRC Report No. 943/1/02: DB Louw – The Development of a Methodology to determine the true Value of Water and the impact of a potential Water Market on the efficient utilisation of water in the Berg River Basin.
- WRC Report No. 990/1/03: Greengrowth Strategies cc - The Value of Water as an Economic Resource in the Vaal River catchment.
- WRC Report No. 989/1/08: - CJ Williams, GA Veck, and MR Bill. – The Value of Water as an Economic Resource in the Greater Letaba River Catchment.

Conradie[7] makes the following comment: "The most surprising result of the econometric model is that poor household's demand for water is not more, or less, price elastic than the demand for of a rich household."

This confirms the results obtained by Veck and Bill as previously quoted.

The Conradie Report also has the benefit that it was undertaken in a relative poor area and that it addresses a water transfer scheme, namely the Fish – Sundays Transfer Scheme. Although this is a much larger scheme than the Ncwabeni, there are some similarities that make it more acceptable to use in the CBA calculations.

In the following table the different values for domestic water, as calculated by different studies, are presented:

Table 2: Value of Domestic Water

Study	Study Area	Year	Value R/m^3	2012 Value R/m^3
WRC Report – 987/1/02 - Conradie	Sundays - Fish	1999	R2.40[8]	R5.68
WRC Report – 990/1/03 – Greengrowth	Vaal River WMA	1998	R4.81[9]	R9.59
WRC Report – 989/1/08 – Williams, et al	Greater Letaba River	2002	R2.22[10]	R4.37
WRC Report – 989/1/08 – Williams, et al	Greater Letaba River	2002	R5.72[11]	R10.56

The first value in the table from the Williams Report represents the current water use, while the second value represents the value of the water if "new" water is allocated to domestic use.

[7] WRC Report No. 987/1/02 – page 63.
[8] All municipal consumers.
[9] Low Income – Indoors.
[10] Current water users – all municipal users.
[11] New water allocation – only domestic use.

The values in the three studies vary quite considerably which makes it difficult to decide on an appropriate value for the current study and it is necessary to discuss the approach of the different studies.

A. The Conradie Study was not directly aimed at municipal (domestic) water but mainly aimed towards Great Fish and Sundays River catchments and the value to the irrigators.
B. The Greengrowth Study concerned the total Vaal River WMA and went into great detail discussing the different users, problematic however is the scale of the economic activities in the catchment and the underlying impact this had on the value of the water.
C. In the Williams Study the author of this report was personally involved in the study and some of the mathematics applied was proposed by him. The value of newly allocated water for domestic use is, in the opinion of the authors, the most applicable one to use. In this study the Value of Water was determined in two urban areas, namely; Polokwane and Giyane, using a Contingent Valuation (CV) approach.

The following discussion is taken from the WRC Report: TT 305/07 – A Manual for Cost Benefit Analysis in South Africa with Specific Reference to Water Resource Development, page 106.

"*The economic value of water is determined by two components. The first component deals with the social (public) portion of 25 litres of water per capita per day. This portion is in accordance with the government's policy on minimum water requirements for urban and rural households.*

The second component deals with the volume of water consumed above the 25 litres per capita per day. This water is regarded as a pure private good."

The calculations in the report deals with user data provided by the Development Bank of Southern Africa (DBSA) and the two components were calculated as follows, expressed in 2007 prices:

- Economic Value of Social Portion of Domestic Water: R7.49 per kl (m^3);
- Economic Value of Private Portion of Domestic Water: R 8.22 per kl (m^3)
- The total Economic Value of the Domestic Water: R7.99 per kl (m^3).

As this is expressed in 2007 prices it is converted to 2012 prices of R10.82 per kl.

This value of R10.82 per m^3 is very close to the Williams value of new water of R10.56 and the Greengrowth value of R9.59.

2.6 Value of Environmental Water

The following description of the Mzimkhulu Estuary is drawn largely from the recent estuarine ecological water requirements study (Forbes *et al*. 2011) that was completed as part of the Mzimkhulu River Catchment Water Resources Study (Aurecon 2011): "*It should be noted that the overall confidence regarding the hydrodynamics of the estuary and hence the overall study was low, owing to the lack of historical water level data for the system, lack of good data on the state of the mouth, and the lack of a flow record just upstream of the estuary. This does not necessarily affect the accuracy of the information on the status of the system but may affect the accuracy of prediction made in the study."*

The mean annual runoff for the Mzimkhulu Estuary under virgin conditions is estimated at 1 453 Mm^3 per annum, however, under current conditions it is estimated at 1 176 Mm^3per annum. This places the Mzimkhulu amongst the three largest rivers in KZN, along with the Thukela and the Mkomazi systems. Flow in the river is highly seasonal, with most of the run-off (88.3%) occurring between November and April each year. The seasonal flow varies between 80 m^3/s in the rainy season and 10 m^3/s in the low flow winter months.

Mouth closing has historically occurred in the winter months and cases of artificial opening have been carried out over a number of years. According to the report anecdotal observations suggest that closure has become more frequent, but in the absence of long term monitoring it was decided to treat these reports with caution.

The report score the "Estuarine Health Index" (EHI) at 79, therefore the Present Ecological Status (PES) is established as a "B".

The report also allocated, what is known as the "Recommended Ecological Score", and put a value of 84 on it.

Without going into the detail of the report the Recommended Ecological Category (REC) is established at a "B", with the description "Largely natural with few modifications".

The following table is copied from the Ncwabeni Off-Channel Storage Dam: Assessment of potential impacts on the Mzimkhulu Estuary by Anchor Environmental as part of the feasibility study.

Table 3: Abiotic States for the Mzimkhulu Estuary with Associated Flow Ranges and Estimated Frequency of Occurrence during the Reference (natural) and under Present Day Conditions

Abiotic states	Flow Range (m^3/s)	Reference (% Occurrence)	Present Day (% Occurrence)
State 1: Closed mouth	<0.5	0.0	3.1
State 2: Intermittently closed	0.5-3.0	1.7	16.6
State 3: Open, marine	3.0-5.0	9.7	8.9
State 4: Open, brackish	5.0-20.0	35.8	23.8
State 5: Open, fresh	>20.0	52.8	47.6

From the table it is clear that the situation in the estuary has deteriorated and it appears as if the occurrence of the "Closed Mouth" situation is on the increase.

The implementation of the proposed OCS dams on the Ncwabeni River has the potential to mitigate the negative impacts of reduced freshwater flows during the low flow months by abstracting water from the main stem of the system during the high flow months (November to April each year), pumping this water up to the dams and releasing it again during the low flow months. It will, however, only be effective if the scheme ensures that flows reaching the estuary are not permitted to decline below present day levels.

As this report is part of the project documentation, the following assumptions are made using a number of the project reports:

- Number of annual days needed to prevent "mouth closure" – July to September 90 days;

- Volume to be released to prevent "mouth closure" is set 0.5 m^3/s;
- Annual estimated maximum volume to be released – 3.9 Mm^3, 13% of the dam's capacity.

This would be very feasible for the first 25 years of the project, after that the water might be needed for municipal users.

The issue at stake is "value of the environmental water" (opportunity cost) to be used in the calculations. A number of approaches are possible and it is necessary to briefly discuss them and motivate the eventual selection.

A. It has the same value as domestic water. The approach rests on the fact that the water in Ncwabeni is reserved for domestic use and therefor the opportunity cost of the water is the same. However, in the first number of years the water released into the river will be surplus water that is not needed for domestic use.
B. The value of the water should be the same as the value attributed to municipal water used for watering public parks and sports grounds. The counter argument is that this water is removed and used outside the river while the water released is used within the river.
C. This is a very important estuary and it also has tourism and other implications which makes the ecological health of the estuary a very important issue.

In evaluating the three mentioned approaches we decided that (C) is probably the most acceptable option. The only value of water that has been calculated in these circumstances was work done by Turpie[12] and Joubert who derived a value of river water for the whole of the Kruger Park based on a travel cost methodology. Williams again used this to estimate the value of the water in the Letaba Catchment. The value estimated by Williams was R 0.85 per m^3, converted to 2012 prices to R1.68 per m^3. This value was used as the opportunity cost of the water released.

[12] Institute of Natural Resources, University of Natal: Incorporating Economic consideration into the determination of the Environmental Reserve – Case Study: The tourism value of rivers in and adjacent to the Kruger National Park, and impacts of a change in river quality – 2001.

3 Data

The following data were provided by the project team and has been adapted to be used in the Cost Benefit Analysis and the Macro-Economic Impact Analysis.

3.1 Construction Capital

In the next table the Construction Capital (Capex) is presented in constant 2012 prices per implementation year for the Ncwabeni Dam, the abstraction works and the electricity supply.

Table 4: Estimated Capital Costs for the Ncwabeni Dam and Abstraction Works Expressed in Constant 2012 Prices

	Project Year	1 Rand mil.	2 Rand .mil	3 Rand. mil.	4 Rand.mil.
Ncwabeni Dam	Civil	R 0.00	R 0.00	R 151.84	R 227.76
	M&E	R 0.00	R 0.00	R 8.01	R 12.02
	Pre engineering	R 7.99	R 11.86	R 0.00	R 0.00
	Supervision	R 0.00	R 0.00	R 15.99	R 23.988
Abstraction Works	Civil	R 0.00	R 0.00	R 12.66	R 18.99
	M&E	R 0.00	R 0.00	R 6.23	R 9.35
	Pre engineering	R0.94	R 1.42	R 0.00	R 0.00
	Supervision	R 0.00	R 0.00	R 1.89	R 2.83
Electricity supply	Civil	R 0.00	R 0.00	R 0.00	R 0.00
	M&E	R 0.00	R 0.00	R 6.00	R 9.00
	Pre engineering	R 0.30	R 0.45	R 0.00	R 0.00
	Supervision	R 0.00	R 0.00	R 0.60	R 0.90
Total		***R9.23***	***R 13.72***	***R203.55***	***R304.84***

The next table is a summary of the projected capital costs for social and environmental services as provided by the relevant project engineers.

Table 5: Estimated Capex for Administration, Environmental Structures and Social Structures – 2011 constant prices

Project Year	1 Rand. mil.	2 Rand. mil.	3 Rand. mil.	4 Rand. mil.
Admin cost	R 4.00	R 4.00	R 6.00	R 6.00
Environmental cost	R 1.40	R 1.40	R 2.10	R 2.10
Social Cost	R1.40	R1.40	R2.10	R2.10
Total	***R6.80***	***R6.80***	***R10.20***	***R10.20***

The total projected capital expressed in constant 2012 prices is R 565 million to be spent over a four year period.

3.2 Operational Costs

In the following table the parameters that were used to calculate the maintenance costs and the residual value of capital structures at the end of the analysis period as applied in the Economic Cost Benefit Analysis, are presented.

Table 6: Parameters used to Calculate Maintenance and Residual Values

	Engineering		Maintenance		Useful life	
Element	**Pre engineering**	**Supervision**	**Civil**	**M&E**	**Civil**	**M&E**
Ncwabeni Dam	5.00%	10%	0.25%	1%	50	30
Abstraction Works	5.00%	10%	0.25%	4%	50	30
Electricity supply	5.00%	10%	0.25%	3%	50	30

The following table presents a summary of the annual operational costs used in the analysis.

Table 7: Operational Costs as used in the Analysis (constant 2012 prices)

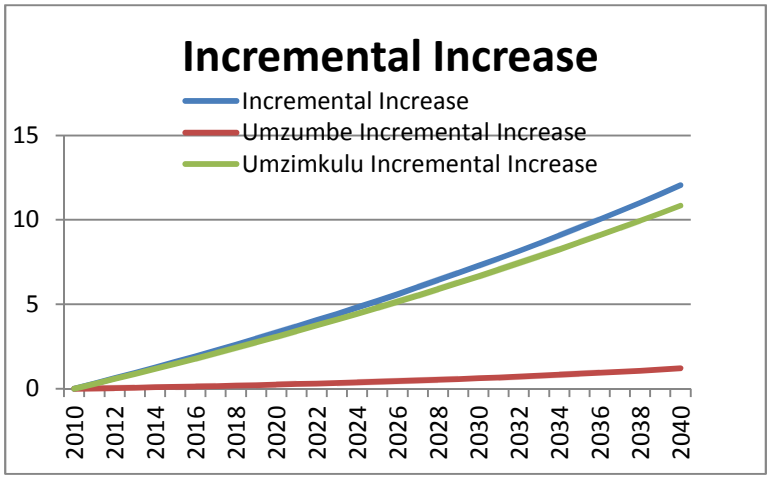
Structure	From year 5	Year 6	Up to year 30
	Rand 1000's	***Rand 1000's***	***Rand 1000's***
Ncwabeni Dam	R 1 149.27	R 1 149.27	R 1 149.27
Abstraction Works	R 702.58	R 702.58	R 702.58
Electricity Supply	R 450.00	R 450.00	R 450.00
Admin Cost	R 1 000.00	R 1 000.00	R 1 000.00
Environmental Costs	R 1 000.00	R 1 000.00	R 1 000.00
Social Costs	R 1 000.00	R 1 000.00	R 1 000.00
Electricity Variable	R 297.38	R 297.38	R 444.72
Electricity Fixed	R 274.21	R 274.21	R 274.21

3.3 Water Demand

The projected water demand, as supplied by BKS, has been accepted and used in the analysis.

The following graph illustrates the projected demand over the analysis period.

Figure 1: Illustration of the Increase in Water Use in the UMzimkhulu and Umzumbe Areas



The graph illustrates that the bulk of the water is destined for use by the UMzimkhulu households and a smaller volume is destined for the Umzumbe area.

Table 8: Illustration of the Calculation of the Incremental Demand as used in the CBA

	2010	2011	2012	2013	2014	2015
	Mm^3 per A	**Mm^3 per A**	**Mm^3 per A**	**Mm^3 per A**	**Mm^3 per A**	**Mm^3 per A**
Umzumbe Water	0.43	0.45	0.47	0.49	0.51	0.54
Umzimkulu Water	18.26	18.55	18.84	19.13	19.43	19.73
Projected Water Demand	***18.69***	***19.00***	***19.31***	***19.62***	***19.94***	***20.27***
Umzumbe Incremental Increase	-	***0.02***	***0.04***	***0.06***	***0.08***	***0.11***
Umzimkulu Incremental Increase	-	***0.29***	***0.58***	***0.87***	***1.17***	***1.47***
Incremental Increase	**0**	**0.31**	**0.62**	**0.93**	**1.25**	**1.58**

The 2040 incremental demand is estimated at 12.05 Mm^3 per annum, getting close to the yield capacity of the Ncwabeni Dam.

4 Methodology

As already stated the economic analysis was carried out to define the viability of the project from the point of view of the economy as a whole. An Economic Cost Benefit Analysis (ECBA) together with a General Equilibrium Module was used to estimate the CBA parameters as well the normal macro-economic parameters.

4.1 Economic Cost Benefit Analysis

To the extent it was possible, all social, economic and environmental costs and benefits have been identified and included in the analysis. Applicable opportunity costs have been applied instead of the financial costs and shadow pricing, where necessary.

The normal cost-benefit analysis was carried out to determine the Net Present Value (NPV) and the Economical Internal Rate of Return (EIRR).

These various parameter criteria were then used to assist in the evaluation of each project. These criteria are:

- Net Present Values (NPV)
  - *The criterion for the acceptance of a project is that the net present value must be positive; in other words, funds will be voted for a project only if the analysis produces a positive net present value. Where a choice has to be made between mutually exclusive projects, the project with the highest net present value will be chosen since it maximizes the net benefit to the community.*
- The internal rate of return (IRR)
  - *Only projects with an internal rate of return higher than the social discount rate, which forms a lower limit, will be considered for funding.*
- The discounted benefit-cost ratio (BCR)
  - *A project will only be considered for funding if the benefit-cost ratio is greater than one.*

The analysis was based on data collected and the design criteria established as provided by the rest of the project team and approved by the client during the basic data collection stage. The most critical linkages between the options and the national macro-economic policies and variables that are most likely to affect the viability of the selected options have been highlighted.

4.1.1 Appropriate Discount Rate

The determination of an appropriate discount rate is always a debatable subject and the opinions between economists vary considerably.

In the determination of the discount rate extensive use was made of the following publication:

- Water Research Commission – Report No. TT 305/07: Conningarth Economists – A Manual for Cost Benefit Analysis in South Africa with Specific Reference to Water Resource Development.

The report states under paragraph 6.2.4 Discount rate for environmental purposes - page 68 the following: *In view of the contrasting views by economists regarding the discount rate that should be*

used for environmental purposes and for other social and industrial projects, it is proposed that environmental projects in South Africa should be discounted at the official discount rate of 8%, and that this base rate should be further tested against much lower rates as well. Once again, these differing results should be disclosed to the policy maker.

As this is social as well as an environmental CBA it was decided to run the models for the standard 8% and also a 6% rate.

4.1.2 Value of Water

As the different values of water have already been discussed in a previous section it was decided to use the following values in the ECBA: The WRC Manuel updated value R10 82 per m^3 and the William's new water value of R 10.56 per m^3.

4.2 Macro-Economic Impact Analysis

4.2.1 Objective

The objective of this section is to present the macro and socio-economic impacts that emanate from both the construction and operational phases of the capital investment project under consideration. The Cost Benefit Analysis (CBA) preceded the macro-economic impact analysis and the information requirements for the CBA will serve as a major data source needed to initiate the macro-economic modelling system that quantifies the impacts.

The macro-economic impact analysis was conducted at a national, regional/provincial and local level. However, the main focus of the analysis is the KwaZulu - Natal Province and the Umzumbe Local Municipality area, in particular. The impact analysis is based on the contribution that the project is expected to make towards the national, provincial and local economies in terms of the following macro-economic aggregates:

- Gross Domestic Product (Economic Growth);
- Employment Creation:
  - Skilled Labourers;
  - Semi-Skilled Labourers; and
  - Unskilled Labourers.
- Capital Utilisation (Investment);
- Household Income (Poverty Alleviation in terms of Low Income Households);
- Fiscal Impacts; and
- Balance of Payments.

4.2.2 Methodology

4.2.2.1 Overview of the Macro Economic Analysis

As indicated previously in the report, the main purpose of this chapter of the study is to estimate the impact of the proposed Ncwabeni Dam on the South African economy as well as to give an indication of the impact it will have on the provincial economy of KwaZulu-Natal and the local economy of the Local Municipality. *It is important to note that the National and Provincial macro-economic impact*

results are shown in a separate format for the construction and operational phases. For purposes of the impact analysis Conningarth Economists has compiled and updated the Social Accounting Matrixes (SAMs) for the South African and the KZN economies which formed the basis of the impact model – *via* – a general equilibrium model. This model will quantify the direct, indirect and induced impacts over time.

The compilation of the updated South African and KZN SAMs was part of a major initiative by the Development Bank of Southern Africa (DBSA), Department of Provincial and Local Government (DPLG), StatsSA and the South African Reserve Bank (SARB) to compile nine comparable provincial SAMs that have all been updated to 2006 prices and have been benchmarked with the new South African SAM of 2006. The KZN SAM was finalized in October 2009, and was overseen by an expert group of people from the KZN Province, chaired by the KZN Economic Development Department.

The benchmarking exercise was necessary to ensure that all control totals add up to the National Account figures as reflected in the SARB Quarterly Bulletin – June 2008 and the relevant figures reflected in the StatsSA publications, especially P0144 that reflects the 2006 Supply and Use Matrix.

The provincial SAMs compiled by Conningarth Economists were converted into user-friendly macro-economic impact models which can be used by each province to calculate the economic impact of "interventions" by way of programmes and projects on the economy of the relevant province.

The model makes use of Excel spread sheets and is driven by a set of "Macros" which are used to eliminate the need to repeat the steps in a simple task over and over. For a specific project or say a policy intervention, the model provides the size of the macro-economic impacts, the values of which are then also used to calculate key economic performance or efficiency indicators at national, provincial and local government level. Such key macro-economic performance indicators can be produced for both the construction and operational phases of a specific project.

It is also important to highlight the fact that the macro-economic impact model is robust enough to cater for varying degrees of input data quality and availability. For instance, if the impacts are required at local government level, the model lends itself well to adjusting relevant provincial coefficients to realistically portray the situation at lower levels.

4.2.2.2 The Social Accounting Matrix.

In layman's terms a Social Accounting Matrix (SAM) also represents a mathematical matrix depicting the linkages that exist in financial terms between all the major role players in the economy, i.e. business sectors, households and government. It is very similar to the input/output table in the sense that it also reflects the inter-sectorial linkages that are present in an economy. The development of the SAM also provides a logical framework within the context of the National Accounts in which the activities of especially households are accentuated and distinguished prominently. The households are indeed the basic economic units where significant decisions are taken affecting economic variables, such as consumption expenditure and personal saving. By combining households into homogenic groups in the SAM, makes it possible to study how the economic welfare of these groups is affected by changes in the economy.

To summarise, the SAM serves a dual purpose. Firstly, it is a reflection of the magnitude of financial linkages that exist between the major stakeholders in an economy, and secondly, it becomes a

powerful econometric tool that can be used to conduct various economic analyses such as calculating the impact of investment projects on the economy.

By applying the general tenets of the general equilibrium economic model to the SAM structure, the so-called direct, indirect and induced effects emanating from the various levels of value adding at all levels i.e. primary (including mining), manufacturing, commercial services etc. are quantified.

The direct impact that occurs, for example, in the construction industry, is measured through changes in production/turnover, payment or remuneration to employees and profit generation. The indirect impacts refer to impacts on industries that provide raw material inputs to the construction industry and other backward linkages. The induced effect or income effect refers to a further round of economic activity that takes place in the economy because of additional consumer spending as a result of the additional salaries and wages that occur throughout the economy. The impact analysis will be based on the standard economic aggregates.

5 Results

The results of the two sets of economic models are presented and interpreted in this section.

5.1 Economic Cost Benefit Analysis

The results for the ECBA is presented for constant and current prices, current prices were estimated using an inflator of 6% over the period.

5.1.1 Constant Price ECBA Results

In the following table the CBA results for the constant price analysis are provided.

Table 9: CBA Constant Water Values (2012 Price Results)

	Parameter	*Discount Rate 6%*	*Discount Rate 8%*
WRC Prices	***Net Present Value***	R181.8 mil.	R21.8 mil.
	IRR	8.36%	8.36%
	BCR	1.35	1.04
Letaba New Water Prices	***Net Present Value***	R167.96 mil.	R11.68 mil.
	IRR	8.19%	8.19%
	BCR	1.32	1.02

The ECBA results show how narrow the margins are in the specific project, for a 6% and an 8% discount rate all three parameters are positive for the WRC water values, although for the 8% discount rate the parameters are marginal and just above the minimum values.

As previously mentioned the Letaba water values are preferred because the "Value of domestic water" was determined in two urban areas, namely; in Polokwane and Giyane, using a Contingent Valuation (CV) approach. For the Letaba new water values the parameters indicate the order of results, the impact of the lower 6% discount rate shows all three parameters as positive while in the case of a 8% discount rate all three are very marginal and just above the minimum values.

5.1.2 Current Price ECBA Results

The following table presents the results for the current value analysis.

Table 10: CBA Current Water Values (2012 prices)

	Parameter	*Discount Rate 6%*	*Discount Rate 8%*
WRC Prices	***Net Present Value***	R 1 474.1 mil.	R 1 295.3 mil.
	IRR	14.9%	13.9%
	BCR	3.64	3.32
Letaba New Water Prices	***Net Present Value***	R860.03 mil.	R730.4 mil.
	IRR	14.9%	13.1%
	BCR	2.54	2.30

The current price analysis for both the discount rates as well as the two values for water show very positive results.

In the interpretation of the current price results it is necessary to discuss the variables that could impact on the results:

- The current price model is built on a 6% inflator over a 30 year period; even 5 and 4% inflators provide very positive results. A higher than 6% even a more positive result.
- If the population growth is lower than the projected numbers used, a more severe impact will be experienced with the current price results than in the case of the constant price model.

5.2 Macro-Economic Impact Analysis Results

The next two tables present the macro-economic impact of the construction phase on the national and provincial economies. It must be kept in mind that the provincial impact is also represented in the national impact.

The macro-economic impact assessments contained in this study cover the totals of the construction phase over the construction phase period of two years and the average annual operational phase totals for the remaining 28 years of the analysis. The entire results section is reflected in a construction phase and/or in an operational phase, respectively. The results that follow reflect the impact arising from the main components involved with the construction and operation of the water supply infrastructure.

5.2.1 National Economic Impacts

In the two tables below the impact on the National Economy is presented for the construction period and the operational period.

Table 11: Macro-Economic Impact of the Construction Phase on the National Economy (2012 prices)

	Construction Impact: *National*			
	25.Water Infrastructure			
	Direct impact	**Indirect impact**	**Induced impact**	**Total impact**
Impact on Gross Domestic Product (GDP)	R 338 mil	R 101 mil.	R 291 mil	**R 730 mil.**
Impact on capital formation	R 747 mil.	R 183 mil.	R 541mil.	**R 1,471 mil.**
Impact on employment [person years]	1,900	528	1,471	**3,899**
Skilled impact on employment [person years]	267	125	402	**794**
Semi-skilled impact on employment [person years]	1,270	289	759	**2,318**
Unskilled impact on employment [person years]	363	114	310	**787**
Impact on Households				**R 480 mil.**
Low Income Households				R 77 mil.
Medium Income Households				R 90 mil.
High Income Households				R 312 mil.
Fiscal Impact				**R 197 mil.**
National Government				R 182 mil.
Provincial Government				R 2.2 mil.
Local Government				R12.7 mil.
Impact on the Balance of Payments				**R – 195 mil.**

Table 12: Macro-Economic Impact of the Operational Phase on the National Economy (2012 prices)

	Operational Impact: *National*			
	25.Water Supply			
	Direct impact	**Indirect impact**	**Induced impact**	**Total impact**
Impact on Gross Domestic Product (GDP)	R 1.92 mil.	R 2.70 mil.	R 2.97 mil.	**R 7.59 mil.**
Impact on capital formation	R 5.65 mil.	R 7.08 mil.	R 5.52 mil.	**R 18.25 mil.**
Impact on employment [person years]	40	12	15	**67**
Skilled impact on employment [person years]	6	3	4	**13**
Semi-skilled impact on employment [person years]	12	7	8	**27**
Unskilled impact on employment [person years]	22	2	3	**27**
Impact on Households				**R 4.90 mil.**
Low Income Households				R 0.80 mil
Medium Income Households				R 0.99 mil.
High Income Households				R 3.11 mil.
Fiscal Impact				**R 2.39 mil.**
National Government				R 2.20 mil.
Provincial Government				R 0.03 mil.
Local Government				R 0.16 mil.
Impact on the Balance of Payments				**R 3.76 mil**

5.2.1.1 Impact on Gross Domestic Product (GDP)

GDP is a good indicator of economic growth and welfare as it represents, among other criteria, remuneration of employees and gross operating surplus (profits) as components of value added at all the levels of the economy.

According to Table 11 the total GDP of the construction phase impact on the RSA's GDP, is estimated to amount to approximately R730 million (in constant, 2012 prices) annual impact over the construction period, of which the direct impact is estimated at R 338 million.

Similarly, Table 12 reflects the total average annual GDP, during the operational phase, impact on the RSA's GDP, which is estimated to amount to approximately R 7.59 million (in constant, 2012 prices), of which the direct impact is estimated at R 1.92million and accounting for 25.2% when compared to the total of R 7.59 million. This emphasises the importance of the so-called multiplier effects which the water supply will have on the South African economy.

From these figures, it can already be assumed, that the ultimate benefit of the bulk of salaries and wages paid out, directly and indirectly, in the course of constructing and operating the project will not accrue within KwaZulu-Natal, but will filter through to the other provinces in SA.

5.2.1.2 Impact on Capital Investments

Productive capital assets are required to support or generate any given amount of economic activity (i.e. GDP). These capital assets, together with labour and entrepreneurship, form the core productive factors needed for production. Obviously the effectiveness and efficiency with which these factors are combined will determine the overall level of productivity and profitability of such assets. The former will in turn depend on a whole array of factors, of which the appropriate technology and skills content of the labour force are important. The above Table 11 indicates the following: construction phase capital stock that needs to be employed (utilised) nationally to sustain

this project amounts to R 1 471 million, of which, R 747 million is attributed directly to the Ncwabeni Dam and water supply works.

During the operational phase the total annual capital necessary to sustain the water works and water delivery is presented in Table 12 and amounts to R18.25 million.

5.2.1.3 Impact on Employment Creation

The construction phase impact on total employment amounts to 3 900 employment year opportunities that will only be sustained over the two year construction period, about 1 850 per annum. Of this number, the annual labour compliment of 950 per year over the two year construction period is associated directly with the project.

The operational phase impact on employment amounts to 67 employment opportunities that will be sustained on an annualised basis over the lifespan of the project in the province. Of this number, 40 employment opportunities are associated directly with the project, the rest is indirect and induced opportunities created at various sectors of the economy.

5.2.1.4 Impact on Households

One of the crucial aspects of any macro-economic assessment is determining the personal income distribution characteristics thereof, especially with regard to how low income households will be impacted. In this section the extent to which low-income households will be positively affected by the spin offs created by the total development project is under scrutiny.

The impact on low-income households is presented in the two (2) tables above. From Table 11 it is evident that the construction phase impact on low-income households will be R 77 million per annum which translates to 16.1% of the total impact on households' income.

The operational phase impact on low income households is given in Table 12. From this table it is evident that the operational phase impact on low income households will be R 0.80 million per annum which translates to ±16.4% of the total (direct, indirect and induced) operational phase impacts on household income.

5.2.1.5 Impact on Balance of Payments

It is estimated that the positive impact on the Balance of Payments will amount to approximately R -194 million per annum for the construction phase. The methodology used in this particular calculation is elementary, but does at least indicate whether a notable positive or negative impact on the Balance of Payments can be expected.

5.2.1.6 Fiscal Impact

According to Table 11, total government revenue is expected to increase on an average annual basis of approximately R 197 million during the construction phase. The main tax revenues are from direct tax and indirect tax, where direct tax consists mainly of personal income tax and company tax. Examples of indirect taxes are value added tax (VAT) and customs and excise tax. The increase in VAT is the result of additional household spending made possible by the increase in household incomes as a result of the project being implemented.

The increase in annual state revenue as a result of the construction and operation of the identified project could provide the means to increase government expenditure on social services. Using the latest information on the functional distribution of government spending on social services an estimate is made of how the state can expand its services in this regard.

5.2.2 Provincial Macro-Economic Impacts

The following macro-economic impact table reflects the total construction phase of two years and the average annual totals for the operational phase for the period of the residual 30 year period on the Province of KwaZulu-Natal, keeping in mind that the provincial impact is included in the national impact. The components measured incorporate the construction and operation of the water project.

Table 13: Macro-Economic Impact of the Construction Phase on the Provincial KZN Economy (2012 prices)

	Construction Impact: *Provincial*			
	25.Water Supply Construction			
	Direct impact	**Indirect impact**	**Induced impact**	**Total impact**
Impact on Gross Domestic Product (GDP) (R mil.)	R 313.01	R 65.82	R 107.08	**R 485.92**
Impact on capital formation (R mil.)	R 708.24	R 134.23	R 246.66	**R 1,089.13**
Impact on employment [person years]	1,799	454	844	**3,096**
Skilled impact on employment [person years]	234	93	129	**456**
Semi-skilled impact on employment [person years]	1,215	260	521	**1,996**
Unskilled impact on employment [person years]	350	101	194	**645**
Impact on Households (R mil.)				**R 261.26**
Low Income Households				**R 39.51**
Medium Income Households				**R 52.69**
High Income Households				**R 169.06**
Fiscal Impact (R mil.)				**R 102.99**
National Government				R 95.08
Provincial Government				R 0.81
Local Government				R 7.10
Impact on the Balance of Payments (R mil.)				**-R 334.21**

Table 14: Macro-Economic Impact of the Operational Phase on the KZN Provincial Economy (2012 prices)

	Operational Impact: *Provincial*			
	25.Water Supply			
	Direct impact	**Indirect impact**	**Induced impact**	**Total impact**
Impact on Gross Domestic Product (GDP)(R mil.)	R 1.92	R 1.84	R 1.04	**R 4.80**
Impact on capital formation (R mil.)	R 565.02	R 5.97	R 2.37	**R 573.36**
Impact on employment [person years]	40	10	8	**58**
Skilled impact on employment [person years]	6	2	1	**9**
Semi-skilled impact on employment [person years]	12	6	5	**23**
Unskilled impact on employment [person years]	22	2	2	**26**
Impact on Households (R mil)				**R 2.55**
Low Income Households				**R 0.41**
Medium Income Households				**R 0.60**
High Income Households				**R 1.53**
Fiscal Impact (R mil.)				**R 1.35**
National Government				R 1.24
Provincial Government				R 0.01
Local Government				R 0.10
Impact on the Balance of Payments (R mil.)				**R 2.22**

5.2.2.1 Impact on Gross Domestic Product (GDP)

GDP is a good indicator of economic growth and welfare as it represents, among other criteria, remuneration of employees and gross operating surplus (profits) as components of value added at all the levels of the economy.

According to Table 13 the total GDP of the construction phase impact on the Provincial GDP, is estimated to amount to approximately R 485 million (in constant, 2012 prices) annual impact over the construction period, of which the direct impact is estimated at R 313 million.

Similarly, Table 14 reflects the total average annual GDP, during the operational phase, impact on the Provincial GDP, which is estimated to amount to approximately R 4.80 million (in constant, 2012 prices), of which the direct impact is estimated at R 1.92million and accounting for 40% when compared to the total of R 4.80 million. This emphasises the importance of the so-called multiplier effects which the water supply will have on the South African economy.

5.2.2.2 Impact on Capital Investments

Productive capital assets are required to support or generate any given amount of economic activity (i.e. GDP). These capital assets, together with labour and entrepreneurship, form the core productive factors needed for production. Obviously the effectiveness and efficiency with which these factors are combined will determine the overall level of productivity and profitability of such assets. The former will in turn depend on a whole array of factors, of which the appropriate technology and skills content of the labour force are important. The above Table 13 indicates the following: construction phase capital stock that needs to be employed (utilised) provincially to

sustain this project which amounts to R 1 089 million, of which, R 708 million is attributed directly to the Ncwabeni Dam and water supply works.

During the operational phase the total annual capital necessary to sustain the water works and water delivery is presented in Table 14 and amounts to R18.72 million per annum.

5.2.2.3 Impact on Employment Creation

The construction phase impact on total employment amounts to 3 096 employment opportunities that will only be sustained over the two year construction period, about 1 548 per annum. Of this number, the annual labour compliment of 899 during the construction phase is associated directly with the project.

The operational phase impact on employment amounts to 58 employment opportunities that will be sustained on an annualised basis over the lifespan of the project in the province. Of this number, 40 employment opportunities are associated directly with the project, the rest is indirect and induced opportunities created at various sectors of the economy.

5.2.2.4 Impact on Households

One of the crucial aspects of any macro-economic assessment is determining the personal income distribution characteristics thereof, especially with regard to how low income households will be impacted. In this section the extent to which low-income households will be positively affected by the spin offs created by the total development project is analysed.

The impact on low-income households is presented in the two (2) tables above. From Table 13 it is evident that the construction phase impact on low-income households will be R 39.50 million per annum which translates to 15.1% of the total impact on households' income.

The operational phase impact on low income households is given in Table 14. From this table it is evident that the operational phase impact on low income households will be R 0.41 million per annum which translates to ±16.2% of the total (direct, indirect and induced) operational phase impacts on household income.

5.2.2.5 Fiscal Impact

According to Table 13, total government revenue is expected to increase on an average annual basis of approximately R 102.99 million during the construction phase. The main tax revenues are from direct tax and indirect tax, where direct tax consists mainly of personal income tax and company tax. Examples of indirect taxes are value added tax (VAT) and customs and excise tax. The increase in VAT is the result of additional household spending made possible by the increase in household incomes as a result of the project being implemented.

The increase in annual state revenue as a result of the construction and operation of the identified project could provide the means to increase government expenditure on social services. Using the latest information on the functional distribution of government spending on social services an estimate is made of how the state can expand its services in this regard.

6 Results Interpretation and Recommendation

6.1 Interpretation

The CBA results show that the project is economically feasible, although the parameters are in some cases marginal as highlighted by the constant price results in the next table. However, if the CBA parameter results are interpreted together with the socio-political imperative as conceptualised in the RSA Constitution and the Water Services Act about the need to supply water and sanitation to the population then the project is feasible.

Table 15: CBA Constant Price Parameters

	Parameter	***Discount Rate 6%***	***Discount Rate 8%***
WRC Prices	***Net Present Value***	R181.8 mil.	R21.8 mil.
	IRR	8.36%	8.36%
	BCR	1.35	1.04
Letaba New [13]Water Prices	***Net Present Value***	R167.96 mil.	R 11.68
	IRR	8.19%	8.19%
	BCR	1.32	1.02

This is strengthened by the very positive results produced by the Macro Economic Impact Analysis, although the construction period will only be for a very short period, the number of temporary jobs created during the construction period, 1 548 per annum, will contribute to the economic wellbeing of the locals.

6.2 Recommendation

The two issues that play an important role in the final recommendation are:

- Affordability; and
- The possible impact should the project not be implemented, the so-called "no – go" option, seen from a regional perspective.

Although the project is economically feasible according to the above analysis the situation around the financial affordability will have to be addressed. It is not only the poverty levels of the recipients of the water but also the possible financial situation of the local authority or Regional Water Service Supplier that must be taken into consideration.

The affordability by the local authority is addressed in the financial report, however, it is necessary that the option of treasury grants be raised against the backdrop of who pays for "basic infrastructure" if the locals and the local authority cannot afford the full capital complement.

[13] As previously mentioned the Letaba water values are preferred because the "Value of domestic water" was determined in two urban areas, namely; in Polokwane and Giyane, using a Contingent Valuation (CV) approach. For the Letaba new water values the parameters indicate the order of results, the impact of the lower 6% discount rate shows all three parameters as positive while in the case of a 8% discount rate all three are very marginal and just above the minimum values.

In the above analysis the value of the water (opportunity cost) used in the analysis is above R10 per m^3, a value that produces acceptable Economic Cost Benefit Analysis parameters, but as a tariff would probably be outside the affordability levels of many of the local population, should the full capital cost be transferred to the tariff. It will therefore be necessary for the authorities to assist the local government with financing options or appoint the Regional Water Services Supplier to act as the implementing agent.

The "no – go" option also has implications, not only on a local but also on a regional basis. The need for water supplementation on the Lower South Coast, south of Port Shepstone has been discussed in the relevant project documents. The situation is becoming critical and it appears as if no further population or economic growth can be accommodated in the area if no new water source is available. In the long term this can have a very negative affect on the region and eventually give rise to civil unrest if basic water needs are not satisfied. Without discussing the subject in depth, it must be kept in mind that the rural people tend to settle in family and chieftain groups and the possibility exists that without water this might not be possible.

7 Sources

A. Water Research Commission Report No. TT 305/07 – Conningarth Economists: A Manual for Cost Benefit Analysis in South Africa with Specific Reference to Water Resource Development – Second Edition (Updated and Revised)
B. Water Research Commission Report No.1383/1/04 – Palmer Development Group: Economic Regulation of Water Services in South Africa
C. Water Research Commission Report No.989/1/08 – CJ Williams, GA Veck, MR Bill: The Value of Water as an Economic Resource in the Greater Letaba River Catchment
D. Water Research Commission Report No.987/1/02 – B Conradie: The Value of Water in the Fish – Sundays Scheme of the Eastern Cape.
E. Water Research Commission Report No.943/1/02 – The Development of a Methodology to Determine the True Value of Water and the Impact of a Potential Water Market on the Efficient Utilisation of Water in the Berg River Basin.
F. Constitution of South Africa No. 108 0f 1996 with the accompanying amendments.
G. Water Services Act, Act no. 108 of 1997.

8 Appendix A –The Social Accounting Matrix (SAM)

A Social Accounting Matrix (SAM) is a comprehensive, economy-wide database, which contains information on the flow of resources that take 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. As a system for organising information, a SAM presents a powerful tool in terms of which the economy can be described in a complete and consistent way:

Complete in the sense that it provides a comprehensive accounting of all economic transactions for the entity being represented (i.e. country, region/province, city, etc.), and Consistent in that all incomes and expenditures are matched.

Consequently, a SAM can provide a unifying structure within which the statistical authorities can compile and present the national accounts.

Like the traditional Input-Output Table, the SAM reflects the inter-sectorial linkages in terms of sales and purchases of goods and services, as well as the remuneration of production factors that forms the essence of any economy's functioning. What is also of importance is that a SAM reflects the economic related activities of households in some detail. Households are responsible for decisions that have a direct and indirect effect on important economic variables such as private consumption expenditures and savings. These economic aggregates are important drivers of the economic growth processes and ultimately the creation of employment opportunities and wealth. Private consumption expenditure, for example, comprises approximately 60 percent of total gross final domestic spending in the economy. By combining households into meaningful categories, such as a range of income levels, the impact on these households' welfare of a changing economic environment is made possible by the SAM.

It is clear from the above that because of the intrinsic characteristics of the SAM, once compiled, it renders itself as a useful tool for analytical purposes. Especially, based on the mathematical traits of the matrix notations that describe its structure, a SAM can be transformed into a powerful econometric tool/model. For example, the model can be used to quantify the probable impact on the economy of a new infrastructural project such as a new power station – both the construction phase and the operational phase will be modelled.

Thus apart from serving as an extension to a country's National Accounts, the SAM in its model form opens up many opportunities for the economic analyst to conduct rigorous policy and other impact analyses for the purpose of ensuring optimal benefit to the stakeholders concerned.

Application(s) of the SAM

The development of the SAM is very significant as it provides a framework within the context of the International System of National Accounts (SNA) in which the activities of all economic agents are

accentuated and prominently distinguished. By combining these agents into meaningful groups, the SAM makes it possible to clearly distinguish between groups, to research the effects of interaction between groups, and to measure the economic welfare of each group. There are two key reasons for compiling a SAM:

Firstly, a SAM provides a framework for organising information about the economic and social structure of a particular geographical entity (i.e. a country, region or province) for a particular time period (usually one calendar year), and

Secondly, to provide a database that can be used by any one of a number of different macro-economic modelling tools for evaluating the impact of different economic decisions and/or economic development programmes.

Because the SAM is a comprehensive, disaggregated, consistent, and complete data system of economic entities that captures the interdependence that exists within a socio-economic system, it can be used as a conceptual framework for exploring the impact of exogenous changes in such variables as exports, certain categories of government expenditure, and investment on the entire interdependent socio-economic system. The SAM, because of its finer disaggregation of private household expenditure into relatively homogenous socio-economic categories that are recognisable for policy purposes, has been used to explore issues related to income distribution.

The SAM's main contribution in the field of economic policy planning and impact analysis is divided into two categories:

As a Primary Source of Economic Information

As a detailed and integrated national and regional accounting framework consistent with officially published socio-economic data, a SAM instantly projects a picture of the nature of a country or region's economy. It lends itself to both descriptive and structural analysis.

As a Planning Tool

Due to its mathematical/statistical underpinnings it can be transformed into a macro-econometric model that can be used to:

- Conduct economic forecasting exercises/scenario building.
- Conduct economic impact analysis both for policy adjustments at a national and provincial level and for large project evaluation.
- Conduct self-sufficiency analysis i.e. gap analysis to determine, with the help of the inter industry and commodity flows contained in the provincial SAM, where possible investment opportunities exist, and
- Calculate the inflationary impacts on provincial level of price changes instigated at national level (i.e. administered prices, VAT, etc.).

To summarise, the SAM mechanism provides a universally acceptable framework within which the economic impact of development projects and policy adjustments can be reviewed and assessed at both national and provincial/regional levels. It serves as an extension to the official National

Accounts of a country's economy and, therefore, provides a wealth of additional information, especially when disaggregated to more detailed levels.

9 Appendix B – Cost Benefit Analysis (CBA)

Introduction

The CBA method provides a logical framework for evaluating development programmes, and can serve as an aid in decision-making processes. The following is a brief overview of the theory underlying the CBA method.

The theoretical foundations of CBA are: benefits are defined as increases in human wellbeing (utility) and costs are defined as reduction in human wellbeing. For a project of policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs. "Society" is simply the sum of individuals. The geographical boundary for a CBA is usually the nation, but can be readily extended to wider limits.

Basic Aggregation Rules

There are two basic aggregation rules. Firstly, aggregating benefits across different social groups or nations involves summing willingness to pay for benefits, its willingness to accept compensation for losses (WTP and WTA, respectively), regardless of the circumstances of the beneficiaries or losers. A second aggregation rule requires that higher weights be given to benefits and costs accruing to disadvantages or low income groups. One rationale for the second rule is that marginal utilities or income will vary, being higher for the low income group.

The notions of WTP and WTA are firmly grounded in the theory of welfare economics and correspond to the notions of compensation and equivalent variations. WTP and WTA should not, according to past theory, diverge very much. In practice they appear to diverge, often substantially, and with WTA > WTP. Hence, the choice of WTP or WTA may be of importance when conducting a CBA.

Discounting

Aggregating over time involves discounting. Expressing future benefits and costs in present value is known as discounting. Inflation can result in future benefits and costs appearing to be higher than is really the case. Inflation should be netted out to secure constant price estimates.

Costs and benefits that are immediately incurred are judged differently by the community from costs and benefits that materialize over a period of time. Usually a community would prefer receiving a benefit today rather than reaping the benefits in the future, while deferred costs are more attractive than immediate payment. Therefore, the money value of costs and benefits over time cannot simply be added together, and the time preference of the community has to be taken into account through the use of a weighting process. This is done by calculating the net present value by discounting future cash-flows at a rate that reflects the value of a benefit or cost over time, known as the social discount rate. In other words, at what real interest rate will the community be prepared to forego immediate benefits in exchange for longer term benefits?

Suppose b0, b1, b2, …, bn are the project benefits in years 0, 1, 2, …, n and c0, c1, c2, …, cn are the costs in years 0, 1, 2, …, n, respectively, and i is the social discount rate, then the present value of the benefits is given by

b_0÷〖(1+i)〗^0 + b_1÷〖(1+i)〗^1 + … +b_n÷〖(1+i)〗^n

And the present value of the costs are given by

c_0÷〖(1+i)〗^0 + c_1÷〖(1+i)〗^1 + … +c_n÷〖(1+i)〗^n

These present values are then used to calculate various assessment criteria, while assisting in the evaluation of each development sphere. These criteria are:

- Net Present Value (NPV).
- Internal Rate of Return (IRR).
- Benefit Cost Ratio (BCR).

Net Present Value (NPV)

The difference between the benefits and costs (the net benefits) in the specific year is discounted to the present by using the social discount rate. The discounted sum of all these net benefits over the economic project life is defined as the NPV. In terms of terminology set out above:

NPV= ∑▒b_j ÷〖(1+i)〗^j-∑▒c_j ÷〖(1+i)〗^j

The criteria for the acceptance of a project are that the NPV must be positive; in other words, funds will be voted for a project only if the analysis produces a positive net present value. Where a choice has to be made between mutually exclusive projects, the project with the highest present value will be chosen since it maximizes the net benefits to the community.

Internal Rate of Return (IRR)

The IRR is the discount rate at which the present value of costs and benefits are equal. It is therefore the value of the discount rate, r, which satisfies the following criteria:

∑▒b_j ÷〖(1+r)〗^j-∑▒c_j ÷〖(1+r)〗^(j)=0

Only projects with an IRR higher than the social discount rate, which forms a limit, will be considered for funding. The IRR must be handled carefully, because there are situations in which mathematical solution of the above equation is not unique. This happens when the stream of net benefits over the assessment period changes its sign (positive or negative) more than once.

Benefit Cost Ration (BCR)

The discounted BCR is the ratio of the present value of the benefits to the present value of the costs, i.e.

BCR={∑▒b_j ÷(1+r)^j }÷{∑▒c_j ÷(1+r)^(j)}

A project will be considered for funding if the BCR is greater than 1.

Appropriate Discount Rate

When considering an appropriate discount rate, note must be taken of the various points of departure in the economic literature as well as of the rates applied in other countries and by international development institutions.

The points of departure described in the literature can be broadly divided into three schools of thought, namely those who argue that the discount rate should be equal to the marginal return on capital (opportunity cost of capital), those whose arguments rests on long-term real interest rate (cost of funding to the State), and those who advocate a social time preference rate.

The first two schools take an economic view, whilst the third school adopts a multiple-goal approach which includes social aims. There is no consensus which method should be used to determine the social discount rate that would apply for a specific country. Therefore, a relative pragmatic approach takes the following factors into account:

- The discount rate should not be influenced by business cycle conditions and policy, since the preferences that find expression in this rate are aimed at the extension of the long-term welfare structure.
- A low discount rate generally favours projects with a higher capital cost and low future current costs, while the opposite applies to high discount rates. Since labour costs are part of current expenditure, a high discount rate favours the employment of labour in the future. If the real social discount rate is lower than the real implicit discount rate in the private sector, then investment by the public sector will be encouraged at the expense of investment by the private sector. The larger the gap between the two discount rates, the stronger the effect.

Financial Discount Rate

In the case of public projects, where CBA is being performed for financial purposes, calculations are done at either current price, where inflation is taken into consideration or at constant/real prices, where inflation is excluded.

In terms of the financial analysis, the discount rate used is equal to the market rate, or weighted marginal cost of capital, plus uncertainty and a risk premium. It should be noted that if the calculation is being done in constant/real prices, the discount rate used should be in real terms. For instance, if the discount rate in current prices is 10% and the prospects for inflation over the project appraisal is 5%, then the real discount rate is approximately 5%. It can be calculated as follows:

$((1.10 \div 1.05)-1) \times 100 = 4.76\%$

Therefore the real discount rate is not exactly 5% but 4.76%.

Due to the fact that projections are made over a long period into the future, and the fact that the future inflation rate is dependent on various economic factors (e.g. worldwide shocks such as oil price, etc.), it is generally difficult to estimate long-term price movements. In this study, the Consultants have used a real discount rate of 5%, and an inflation rate of 6%. Using the methodology described above, this yields a nominal discount rate of 11%.

Economic Discount Rate

Although the calculation of the social time preference rate (STPR) is very difficult to determine, this has not stopped some analysts attempting empirical estimates. According to Kirkpatrick and Weiss (1996) "… such estimates are normally in the 1 percent to 5 percent range, since per capita consumption growth will rarely exceed 3 percent annually, and the conventional estimates of the elasticity of the marginal utility of consumption are typically between 1.0 and 1.5." Walshe and Dafferen calculated that the STPR is slightly in excess of the potential growth rate of an economy.

The study uses an economic discount rate of 8%, which is standard to most studies of this nature.

Market *versus* Shadow Prices

As indicated above, the CBA can be conducted in financial (market) as well as economic (shadow) prices. Market prices are those perceived prices at which products and services are traded in the market place, irrespective of the level of interference in the market, e.g. the market wage rate of labour, the price of 2kg of maize meal, the price of 1 kilowatt-hour of electricity, etc. In theory, market prices are mainly manifestations of consumers' willingness to pay.

Shadow prices (economic prices) are regarded as the opportunity costs of products and services when the market price, for whatever reasons, does not reflect these costs in full. Examples are the shadow wages of labour, where minimum wages are fixed at levels higher than market prices; shadow price for fuel, where taxes and subsidies are excluded; and shadow exchange rates are pegged and/or some kind of exchange control is still in place. The shadow price is therefore nominal (market) price, adjusted for the effect of interventions or other factors that are causing the market not to perform its natural role.

In practice, shadow prices should only be use when the market price of products and services do not reflect their scarcity value or economic contributions. In cases where market prices give an indication of the scarcity of products and services, market prices are used not only for financial analysis, but also for economic analysis.

Financial and Economic Cost Benefit Analysis

The private and public sectors evaluate projects very differently. The private sector is mostly interested in the profitability of a project and the return on capital that will be achieved. In doing so, the private sector makes use of market prices (i.e. the prices that would be paid in the open market for inputs, labour, etc.) when determining the value of direct project-related costs and financial benefits. Furthermore, a financial CBA evaluated the project using market-determined interest and return rates that reflect the cost of private funds, uncertainties and risk.

In contrast, evaluating a public sector project involves determining a broader range of costs and benefits that will affect the community. Furthermore, when calculating the value of costs and benefits, economic analysis re-evaluates the project by making use of prices that reflect the relative economic scarcity/value of inputs and outputs. As such, in the public sector it is necessary to evaluate and weigh the wider benefits emanating from a project against the capital expenditure and costs associated with a project, using discount and return rates that reflect the time preferences of the community, known as the social discount rate.

The table below summarises the main differences between a financial and economic CBA.

Table 16: Comparison of Financial and Economic Costs Benefit Analysis

Attributes	Economic CBA	Financial CBA
Perspective	The broader community	Project shareholders/capital providers
Goal	The most effective application of scarce resources	Maximization of net value
Discount Rate	Social discount rate	Market determined weighted cost of capital
Unit of Valuation	Opportunity costs	Market prices
Scope	All aspects necessary for a rational, economic decision	Limited to aspects that affect profits
Benefits	Additional goods, services, income and/or cost saving	Profit and financial return on capital employed
Costs	Opportunity costs of goods and services foregone	Financial payments and depreciation calculated according to generally accepted accounting principles