PREPARED FOR:

water & forestry

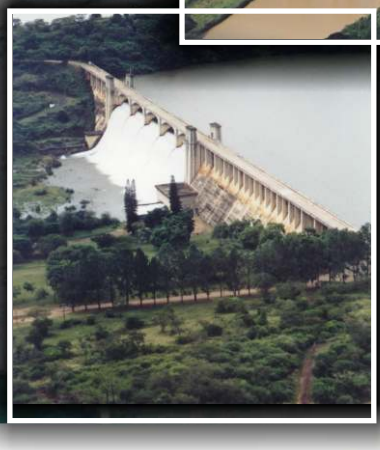
Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

DIRECTORATE: NATIONAL WATER RESOURCE PLANNING

DWAF NUMBER: PWMA 11/000/00/2709

Water Reconciliation Strategy Study for the Kwazulu Natal Coastal Metropolitan Areas

First Stage Strategy: Infrastructure



JANUARY 2009

SUBMITTED BY:

DMM

Golder Associates

KV3 KWEZI V3 ENGINEERS

wrp A Miya Group Company

ZITHOLELE CONSULTING

WRP_FC0897.CDR

WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS

FIRST STAGE STRATEGY REPORT:

INFRASTRUCTURE

REFERENCE

This report is to be referred to in bibliographies as:

Department of Water Affairs and Forestry, South Africa, January 2009. ***WATER RECONCILIATION STRATEGY STUDY FOR THE KWAZULU-NATAL COASTAL METROPOLITAN AREAS*** : **FIRST STAGE STRATEGY: INFRASTRUCTURE**.

Prepared by:

Kwezi V3 Engineers and Visipro

Report No. PWMA 11/000/00/2709

Title:	***First Stage Strategy: Infrastructure***
Authors:	*NL Serfontein and J van der Mescht*
Study Name:	***Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas***
DWAF Report No:	*PWMA 11/000/00/2709*
Status of Report:	*Final*
First Issue:	*May 2008*
Second Issue:	*January 2009*
Final Issue:	*January 2009*

Consultants: WRP Consulting Engineers(Pty) Ltd, in association with DMM Development Consultants cc, Golder Associates Africa Kwezi V3 Engineers and Zitholele Consulting

Approved for the Consultants by:

.....

PG van Rooyen
Study Leader

DEPARTMENT OF WATER AFFAIRS and FORESTRY

Directorate National Water Resource Planning

Approved for DWAF by:

.....

NJ van Wyk 14/4/2010
Chief Engineer: National Water Resource Planning East
(Project Manager)

.....

JA van Rooyen
Director: National Water Resource Planning

Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas

EXECUTIVE SUMMARY

INTRODUCTION

The objectives of the Reconciliation Study are to identify, evaluate and prioritise interventions to reconcile the water requirements with the available water resource up to the year 2030. The project area was divided in to three study areas, so as to distinguish between the common water resources within each area:

- *the North Coast (the coastal area between eThekwini Municipality and the Thukela River)*
- *Mgeni system (area served by the Mgeni river and its dams and including the Msunduzi and the eThekwini Metro areas, amongst others) and*
- *the South Coast (the coastal areas of the eThekwini Metro to the south of Durban, up to Umkomaas).*

Given the extent of the current bulk water supply infrastructure (owned and operated by different water services authorities and providers), it was essential to practice integrated intervention planning that extended across institutional boundaries.

The Reconciliation Study team was divided into various task groups to deal with specific components of the strategy plan (water requirements; water conservation and demand management; water resources; water quality and re-use, environmental and infrastructure). This report deals with the First Stage requirements for the latter component of the strategy. The results of all the various task team reports were then integrated into an overarching Reconciliation Strategy Report.

General Approach

The Reconciliation study is conducted by following a number of steps being:

- *Literature review*
- *Inception report*
- ***First stage strategy***
- *Second stage strategy*

The Literature Review comprised the gathering of information and perusal of previous study reports, so as to obtain an understanding of the past and current dynamics underlying the planning of water resource utilization. A number of role-players where also consulted to ensure that the information obtained, was correctly interpreted. This resulted in the Literature Review report and was followed up by the Inception report, which explained the processes to be followed towards achieving the goals of the study.

In dealing with the infrastructure components of the study, a preliminary optimization of the infrastructure systems in the three study areas (North Coast; Mgeni system; South Coast), was done. The goal here was not to identify new options, but rather to integrate planned options in existence and also those available in conceptual format (hence the discussions with the various role-players). The most viable options were studied to determine how best to optimise the use of existing infrastructure so as to maximise the use of each scheme's capacity.

The focus of the Reconciliation Study is to identify the most feasible options where the available water resources can be developed further to add volume to the resources that are already under stress. Hence, a number of schemes were identified as "Intervention Possibilities" that could either act as stand-alone schemes, or in combination with others. These were then summarised in brief format and the lesser desirable options discarded. The risks associated and possible mitigation measures were determined for each Development Option, as well as the relevant constraints. The cost estimates for the shortlisted schemes (called Development Options), were then updated, development timelines determined and each analysed economically. The result of this was a Unit Reference Value (URV) for each of the schemes. The base date used for determining and calculating the URVs, was 2017.

There-after, the solutions were combined into various Development Scenarios for water resource development and waste water re-use, that essentially resulted in possible solutions for a First

Stage Reconciliation strategy. The URVs of each of these scenarios were then calculated to determine the economic background to these scenarios. Following the conclusions that were made, recommendations were made.

DEVELOPMENT OPTIONS

The following Development Options were studied. The depicted results assume:

- *10% discount rate*
- *45 year operational life*
- *Sept. 2007 cost estimates*

Mooi-Mgeni Transfer Scheme Phase 2

This scheme comprises two sub-phases which will culminate in the constructed Spring Grove Dam with a 4,5m³/s pump station and rising main, with the aim of conveying water from the Mooi River into the Midmar Dam. Even though a decision was taken some time ago to implement Phase 2, the commencement date has been postponed due to a variety of reasons. It is therefor important to include this project in the study, not as an option per se, but using it as reference when determining the impact that its delayed implementation date has on the Development Scenarios investigated.

Water Availability	***Yield of dam***	***Cost estimate***	***NPV***	***URV***
October 2013	*60 million m^3/a*	*R 407,4 million*	*R 203,8 million*	*R 1,09 per m³*

Mkomazi-Mgeni Transfer Scheme Phase 1

The objective of this scheme is to construct the Smithfield Dam on the Mkomazi River and pump water via a water treatment plant to reservoirs at Umlaas Road. Pre-feasibility studies have shown this phase of the scheme to be a viable bulk water option subsequent to development of the second phase of the Mooi-Mgeni transfer scheme.

Water Availability	***Yield of dam***	***Cost estimate***	***NPV***	***URV***
December 2018	*147 million m^3/a*	*R 2 968 million*	*R 1 279 million*	*R 4,45 per m³*

Mvoti River (isiThundu Dam)

Though earlier studies proved this dam to be the most viable when compared to the alternative Welverdient Dam, the circumstances supporting the viability of the dam, have changed. It is therefore advisable review the feasibility of the two dams.

Water Availability	Yield of dam	Cost estimate	NPV	URV
July 2018	46,3 million m^3/a	R 1 261 million	R 617,6 million	R 3,19 per m^3

Desalination of sea water

The desalination of sea water was studied at a desktop level as an alternative to the re-use of waste water.

Water Availability	Scheme capacity	Cost estimate	NPV	URV
End 2016	50 million m^3/a	R 2 381 million	R 2 485 million	R 15,05 per m^3

Lower Thukela Scheme

This is based on the preliminary proposal which was studied by Mhlathuze Water and needs to be updated with the subsequent work done on the so-called Ngcebo 3 scheme. The development time frame of this project could also be drastically influenced by the proposed development of AmaZulu World to the north of the Thukela River.

Water Availability	Scheme capacity	Cost estimate	NPV	URV
July 2013	36,8 million m^3/a	R628,2 million	R303,4 million	R1,97 per m^3

Waste water re-use

Due to the long implementation periods of some of the identified development options, the possibility to implement waste water re-use options were investigated, as these schemes can possibly be implemented over a shorter time span. Various levels of sewage purification was looked into:

- *the use of treated waste water for direct use (potable water)*
- *indirect use (discharging into a dam or for irrigation).*

The waste water treatment plants considered were KwaMashu, Northern, Tongaat, Verulam and Phoenix. It was seen that using waste water from these treatment plants would have a benefit for both the Mgeni system and the North Coast study areas. During the study it came to the fore

that the Tongaat and Verulam streams could be used to augment the Mdloti River environmental reserve. As there are, at this stage, a number of issues around this that need to be resolved, these streams were studied as re-use options.

Scheme capacities:

- *KwaMashu WWTW: 23 million m^3/a*
- *Northern WWTW: 19,7 million m^3/a*
- *Tongaat WWTW: 2,9 million m^3/a*
- *Verulam WWTW: 2,4 million m^3/a*
- *Phoenix WWTW: 5,1 million m^3/a*

Three scenarios were calculated, with the allocated outflow from the KwaMashu WWTW to the Hazelmere and Inanda Dams differing in each. In each scenario, Northern WWTW supplies Inanda Dam and the Tongaat, Verulam and Phoenix WWTWs, Hazelmere Dam.

The results of the waste water re-use development scenarios (excluding Phoenix WWTW), are summarised as follows:

Scenario		***Assumed water delivery date***	***Cost Estimate***	***NPV***	***URV***
				10% discount rate	
Northern WWTW	*1A, 1B, 2*	*End 2013*	*R227,4m*	*R126,9m*	*R1,67/m³*
Tongaat & Verulam WWTW			*R49,7m*	*R33,0m*	*R1,20/m³*
KwaMashu WWTW	*1A*	*End 2013*	*R213,7m*	*R113,5m*	*R1,18/m³*
	1B		*R249,0m*	*R130,1m*	*R1,88/m³*
	2		*R264,2m*	*R140,6m*	*R1,75/m³*

<u>DEVELOPMENT SCENARIOS</u>

Three Development Scenarios were evaluated. The background to these are explained in the First Stage Reconciliation Strategy report.

Scenario 1A

Description	***Implementation Date***	***Max Yield From Option Utilised (million m^3/a)***
Lower Thukela Option	*2012*	*27,8*
North Coast: Tongaat WWTW to Hazelmere Dam	*2012*	*2,9*
Verulam WWTW to Hazelmere Dam	*2012*	*2,4*
Phoenix WWTW to Hazelmere Dam	*2012*	*5,1*
KwaMashu WWTW to Hazelmere Dam	*2012*	*23,0*
Spring Grove Dam	*2012*	*60,0*
Northern WWTW to Inanda Dam	*2017*	*19,7*
Smithfield Dam	*2020*	*147,0*

Scenario 1B

Description	***Implementation Date***	***Max Yield From Option Utilised (million m^2/a)***
Lower Thukela Option	*2012*	*36,8*
North Coast: Tongaat WWTW to Hazelmere Dam	*2012*	*2,9*
Verulam WWTW to Hazelmere Dam	*2012*	*2,4*
Phoenix WWTW to Hazelmere Dam	*2012*	*5,1*
KwaMashu WWTW to Hazelmere Dam	*2012*	*14,0*
KwaMashu WWTW to Inanda Dam	*2017*	*9,0*
Spring Grove Dam	*2012*	*60,0*
Northern WWTW to Inanda Dam	*2018*	*19,7*
Smithfield Dam	*2021*	*147,0*

Scenario 2

Description	*Implementation Date*	*Max Yield From Option Utilised (million m²/a)*
North Coast: Tongaat WWTW to Hazelmere Dam	*2012*	*2,9*
Verulam WWTW to Hazelmere Dam	*2012*	*2,4*
Phoenix WWTW to Hazelmere Dam	*2012*	*5,1*
KwaMashu WWTW to Hazelmere Dam	*2012*	*10,0*
KwaMashu WWTW to Inanda Dam	*2017*	*13,0*
Spring Grove Dam	*2012*	*60,0*
Northern WWTW to Inanda Dam	*2019*	*19,7*
Smithfield Dam	*2021*	*147,0*

The cash flow of capital expenditure was calculated for each scenario, as well as the net present cost and unit reference values. The results were as follows:

Description	*Capital Cost (Rand)*	*O & M (Rand)*	*Total Cost (Rand)*	*URV R/m³*
Scenario 1A	*2 355 436 453*	*349 172 971*	*2 704 609 424*	*2.13*
Scenario 1B	*2 245 363 649*	*348 697 194*	*2 594 060 843*	*2.02*
Scenario 2	*2 437 627 339*	*344 158 453*	*2 781 785 792*	*2.18*

CONCLUSIONS

1. *From an engineering economic viewpoint it can be seen that Scenario 1B is preferred. When making the final decision on the scenario to be studied in further detail, other aspects such as social and environmental issues must also be considered.*

2. *Waste water re-use needs to be studied in further detail as it has comparable URVs and development time frames which can synchronise with that of the development of water resources in cells. Further to this, there is the obvious saving in the use of fresh water.*

3. *There are a number of risks common to all of the identified development options:*

   a) *<u>Resource shortages:</u>*

      The studies, design and construction of the various water supply projects will be running concurrent to other major infrastructure projects in South Africa (Gautrain, Eskom's expansion program, Dube Trade Port, soccer stadium for Soccer 2010, etc.). This has already led to shortages in skills and materials and could delay the delivery of water if not proactively dealt with.

   b) *<u>Implementation of the environmental reserve:</u>*

      It is assumed that the environmental reserves for the affected rivers will be determined concurrently with the planning and design of the various projects. The practical implementation of these reserves is a contentious issue – as yet to be resolved by the DWA&F. The uncertainty caused by the delayed implementation of the environmental reserve is carried through to the yield of proposed schemes, and their viability.

   c) *<u>Delayed decision making:</u>*

      Authority approvals are required throughout all stages of the projects, and are affected by role-player involvement processes and the budgetary allocations. Delayed project approvals, if not well-managed, could impact negatively on project delivery dates.

<u>RECOMMENDATIONS</u>

a) *From an engineering economic viewpoint, Scenario 1B appears to be the most favourable. The various development options that make up this Scenario, thus need to be scrutinised and investigated to a higher level of detail before a final decision is made concerning the implementation of the proposed strategy.*

b) *Commence construction of a raised Hazelmere Dam wall and associated upgrade of the Hazelmere WTW.*

c) *Finality on the implementation of the Mdloti River ecological reserve.*

d) *Commence construction of the Spring Grove Dam and associated works.*

e) *Conduct studies to compare the viability of the isiThundu and the Welverdient Dams, also considering conveying water from the lower Thukela River.*

f) *The construction of a gauging weir in the middle to lower Mvoti River.*

g) Mvoti River: Commence with the comprehensive determination of the environmental reserve.

h) Mkomazi River: Commence with the comprehensive determination of the environmental reserve.

i) Arrive at a common approach of developing the proposed "Ngcebo 3" scheme (driven by the AmaZulu World development), in combination with the Lower Thukela scheme.

~~~~~~~~~~
~~~~~~~~~~

Abbreviations & Acronyms

Capex	Capital expenditure
CMA	Catchment management agency
DM	District Municipality
DWAF	Dept. of Water Affairs & Forestry
NPV	Nett present value
Opex	Operational and maintenance expenditure
SSA	Statistics South Africa
SSC	Study Steering Committee
STC	Study Technical Committee
URV	Unit reference value
WSA	Water services authority
WSP	Water services provider
WTW	Water treatment works
WWTW	Waste water treatment works

Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas

TABLE OF CONTENTS

EXECUTIVE SUMMARY

ABBREVIATIONS & ACRONYMS

1 INTRODUCTION 1

2 METHODOLOGY 1

2.1 Site and role-player visits 1

2.2 Preliminary optimisation of Infrastructure Systems 3

2.3 Evaluate Upgrading, Expanding or New Infrastructure Systems 4

3 ASSUMPTIONS 6

4 INTERVENTION POSSIBILITIES 7

4.1 Ngcebo Schemes & the Lower Thukela River 10

4.2 Development Options 11

4.3 Development Scenarios 12

5 COST ESTIMATES: BASE DATA 12

5.1 Escalation of Unit Rates 12

6 DEVELOPMENT OPTION: MOOI-MGENI TRANSFER SCHEME PHASE 2 15

6.1 Introduction & Background 15

6.2 Demands & Flows 16

6.3 Strategic Potential 17

6.4 Development Time Frame 17

6.5 Risks 17

6.6 Constraints 18

6.7 Costing 18

7 DEVELOPMENT OPTION: MKOMAZI-MGENI TRANSFER SCHEME PHASE 1 21

7.1 Introduction & Background 21

7.2 Demands & Flows 22

7.3 Strategic Potential 22

7.4 Development Time Frame 23

7.5 Risks 23

7.6 Constraints 24
7.7 Costing 24
8 DEVELOPMENT OPTION: MVOTI RIVER - ISITHUNDU DAM 27
8.1 Introduction & Background 27
8.2 Demands & Flows 28
8.3 Strategic Potential 28
8.4 Development Time Frame 29
8.5 Risks 29
8.6 Constraints 30
8.7 Costing 31
9 DEVELOPMENT OPTION: DESALINATION OF SEA WATER 33
9.1 Introduction & Background 33
9.2 Demands & Flows 34
9.3 Strategic Potential 34
9.4 Development Time Frame 34
9.5 Risks 34
9.6 Constraints 35
9.7 Costing 35
10 DEVELOPMENT OPTION: LOWER THUKELA SCHEME 37
10.1 Introduction & Background 37
10.2 Demands & Flows 39
10.3 Strategic Potential 39
10.4 Development Time Frame 40
10.5 Risks 40
10.6 Constraints 40
10.7 Costing 41
11 DEVELOPMENT OPTION: WASTE WATER REUSE OPTIONS 43
11.1 Introduction & Background 43
11.2 Demands & Flows 44
11.3 Strategic Potential 45
11.4 Development Time Frame 45
11.5 Risks 46
11.6 Constraints 47
11.7 Costing 47

12 SCENARIO ANALYSIS 61
12.1 Introduction & Background 61
12.2 Demands & Flows 63
12.3 Costing 63
13 INSTITUTIONAL ARRANGEMENTS & TARIFF STRUCTURES 67
13.1 Institutional Arrangements 67
13.2 Water services tariff structures 69
14 CONCLUSIONS 69
15 RECOMMENDATIONS 71
16 ACKNOWLEDGEMENTS 72

LIST OF FIGURES

Figure 2.1: Map showing the study area 2

LIST OF TABLES

Table 4-1 Summary of Identified Interventions 8

Table 6-1 Cost Summary: Mooi-Mgeni Transfer Scheme Phase 2 19

Table 6-2 Summary of NPVs (ZAR) for the Spring Grove Dam Scheme 21

Table 6-3 Unit Reference Values for the Spring Grove Scheme 21

Table 7-1: Cost Summary: Mkomazi-Mgeni Transfer Scheme Phase 1 25

Table 7-2 Summary of NPVs (ZAR) for the Smithfield Dam Scheme 26

Table 7-3 Unit Reference Values for the Smithfield Dam Scheme 27

Table 8-1 Cost Summary: Mvoti River - IsiThundu Dam Option 31

Table 8-2 Summary of NPVs (ZAR) for the isiThundu Dam Scheme 32

Table 8-3 Unit Reference Values for the isiThundu Dam Scheme 33

Table 9-1: Cost Summary: Desalination Plant 36

Table 9-2 Summary of NPVs (ZAR) for the Desalination Plant 37

Table 9-3 Unit Reference Values for the Desalination Plant 37

Table 10-1: Cost Summary: Lower Thukela Scheme 41

Table 10-2 Summary of NPVs (ZAR) for the Lower Thukela Scheme 42

Table 10-3 Unit Reference Values for the Lower Thukela Scheme 43

Table 11-1 Water re-use scenarios 45

Table 11-2: Scenario 1A Capex: KwaMashu WWTW To Hazelmere Dam (23 million m³/a) 48

Table 11-3 Scenario 1B Capex: KwaMashu WWTW to Hazelmere (14 million m³/a) and Inanda Dams (9 million m³/a) 48

Table 11-4 Scenario 2 Capex: KwaMashu WWTW to Hazelmere (10 million m³/a) and Inanda Dams (13 million m³/a) 49

Table 11-5 Capex: Northern WWTW to Inanda Dam (19,7 million m³/a) 49

Table 11-6 Capex: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix WWTW (5,1 million m³/a) to Hazelmere Dam. 50

Table 11-7 Capex: Tongaat (2,9 million m³/a) and Verulam (2,4 million m³/a) WWTW to Hazelmere Dam. 51

Table 11-8: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (23 million m³/a) – Block Demand 52

Table 11-9: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (23 million m³/a) 53

Table 11-10: NPV (ZAR) for Northern to Inanda Dam (19.7 million m³/a) 53

Table 11-11: NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam ... 53

Table 11-12: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam 54

Table 11-13: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (14 million m³/a) and Inanda Dam (9 million m³/a) 54

Table 11-14: NPV (ZAR) for Northern to Inanda Dam (19,7 million m³/a) 54

Table 11-15: NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam ... 55

Table 11-16: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam 55

Table 11-17: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (10 million m³/a) and Inanda Dam (13 million m³/a) 55

Table 11-18: NPV (ZAR) for Northern to Inanda Dam (19,7 million m³/a) 56

Table 11-19: NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam ... 56

Table 11-20: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam 56

Table 11-21: URV - KwaMashu WWTW to Hazelmere Dam (23 million m³/a) – Block Demand 57

Table 11-22: URV for KwaMashu WWTW to Hazelmere Dam (23 million m³/a) 57

Table 11-23: URV for Northern to Inanda Dam (19.7 million m³/a) 57

Table 11-24: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam 58

Table 11-25: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam 58

Table 11-26: URV for KwaMashu WWTW to Hazelmere Dam (14 million m³/a) and Inanda Dam (9 million m³/a) 58

Table 11-27: URV for Northern to Inanda Dam (19.7 million m³/a) 59

Table 11-28: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam 59

Table 11-29: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam 59

Table 11-30: URV for KwaMashu WWTW to Hazelmere Dam (10 million m³/a) and Inanda Dam (13 million m³/a) 60

Table 11-31: URV for Northern to Inanda Dam (19.7 million m³/a) 60

Table 11-32: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam 60

Table 11-33: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam..... 61

Table 12-1 : Development Scenario 1A..... 61

Table 12-2 : Development Scenario 1B..... 62

Table 12-3 : Development Scenario 2 62

Table 12-4 Summary of NPVs (ZAR) for Scenario 1 – INCLUDING Phoenix WWTW..... 63

Table 12-5 Summary of NPVs (ZAR) for Scenario 1A – EXCLUDING Phoenix WWTW .. 64

Table 12-6 Summary of NPVs (ZAR) for Scenario 1B – INCLUDING Phoenix WWTW ... 64

Table 12-7 Summary of NPVs (ZAR) for Scenario 1B – EXCLUDING Phoenix WWTW .. 64

Table 12-8 Summary of NPVs (ZAR) for Scenario 2 – INCLUDING Phoenix WWTW..... 65

Table 12-9 Summary of NPVs (ZAR) for Scenario 2 – EXCLUDING Phoenix WWTW..... 65

Table 12-10 Unit Reference Values for Scenario 1A – INCLUDING Phoenix WWTW 65

Table 12-11 Unit Reference Values for Scenario 1A – EXCLUDING Phoenix WWTW..... 66

Table 12-12 Unit Reference Values for Scenario 1B – INCLUDING Phoenix WWTW 66

Table 12-13 Unit Reference Values for Scenario 1B – EXCLUDING Phoenix WWTW..... 66

Table 12-14 Unit Reference Values for Scenario 2 – INCLUDING Phoenix WWTW..... 67

Table 12-15 Unit Reference Values for Scenario 2 – EXCLUDING Phoenix WWTW..... 67

Table 14-1 Summary: Results of Scenario Economic Analyses 69

APPENDIX A: *INFRASTRUCTURE: DRAWINGS*

APPENDIX B: DETAILS OF INTERVENTION POSSIBILITIES

APPENDIX C: INTERVENTION TIME FRAMES

APPENDIX D: COST, NPV AND URV CALCULATION SHEETS

Water Reconciliation Strategy Study for the KwaZulu-Natal Coastal Metropolitan Areas

FIRST STAGE STRATEGY: INFRASTRUCTURE

1 INTRODUCTION

The objectives of the Reconciliation Study are to identify, evaluate and prioritize interventions to reconcile the water requirements with the available water resource up to the year 2030. The strategy should be flexible to accommodate future changes in actual water use trends. Given the extent of the current bulk water supply infrastructure, which are owned and operated by different institutions, it is essential to practice integrated intervention planning that extends across institutional boundaries. This is to ensure optimum solutions are identified and implemented in order to maximise the overall benefits to the water users.

This report deals with the Infrastructure component of the Reconciliation Strategy study by providing a First Order Assessment of proposed development scenarios.

2 METHODOLOGY

The following describes the methodology that was followed and the results attained towards obtaining a First Order Strategy from the Infrastructure perspective. The framework of this section is similar to that which was included in the study's Inception Report.

The study area is depicted in **Figure 2.1**.

2.1 SITE AND ROLE-PLAYER VISITS

Doing the literature study was the first step towards gathering information and obtaining an understanding of the past and current dynamics underlying the planning of water resource utilisation. A number of role-players were also consulted throughout to ensure that the information obtained, was correctly interpreted, and discuss its fit with their planning. Of importance was to determine which projects are due for implementation soon and how these impact on the future planning of water provision. These role-players included:

- eThekwini Water & Sanitation Services (water services authority)
- iLembe District Municipality (water services authority)
- Ugu District Municipality (water services authority)
- Msunduzi Local Municipality (water services authority)
- Umgeni Water (water board – water services provider)
- Mhlathuze Water (water board – water services provider)

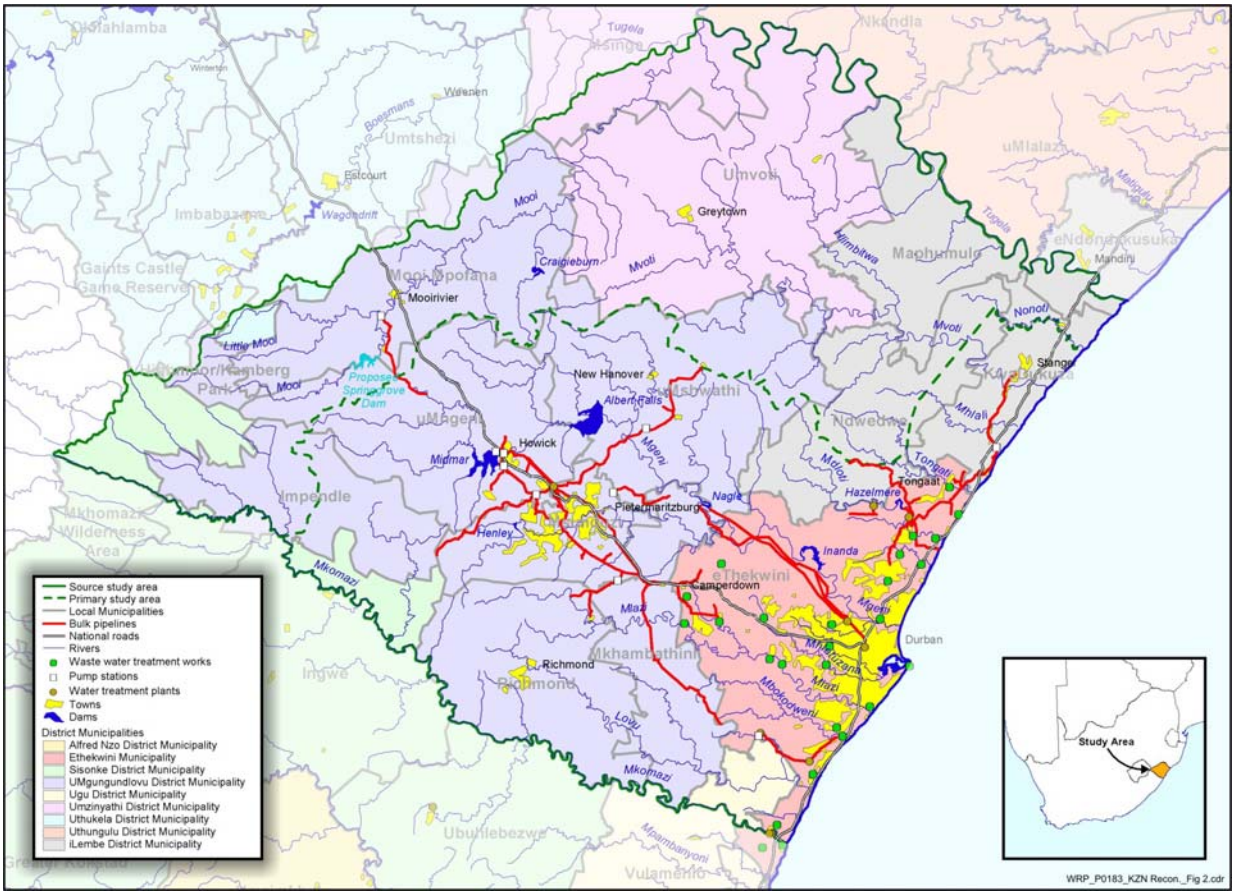


Figure 2.1: Map showing the study area

Attempts to have discussions with the uMgungundlovu District Municipality proved unsuccessful, but interaction with the Msunduzi Local Municipality and Umgeni Water filled this gap.

Other role-players included the Dept. of Water Affairs & Forestry (Durban and Pretoria), SAPPI SAICCOR, as well as a number of consulting engineering firms who are, or had been involved with the planning & development of water resources and bulk water services in the affected areas (Ninham Shand; Stemele Bosch Africa; Mbona Saunders & Wium; Jeffares Green; UWP; Bigen Africa).

The intention was to also do site visits to perform a number of activities that were retrospectively considered to be at a level of detail (pre-feasibility, feasibility), not appropriate to the strategic approach of the Reconciliation study. These site visits therefore did not take place.

2.2 PRELIMINARY OPTIMISATION OF INFRASTRUCTURE SYSTEMS

Appendices A.1 and **A.2** are, respectively, schematic and spatial presentations of the existing bulk water supply infrastructure in the study area**.** Added to this, are the depiction of schemes planned by the various authorities.

The project area was divided into three study areas, so as to distinguish between the common water resources within each area:

North Coast: The coastal area between the border of the eThekwini municipality and Thukela River – comprising the metropolitan areas of the Ilembe District Municipal area. These are essentially served as a whole by the Hazelmere Dam. More than 50% of the water purified at the Hazelmere WTW is supplied to Verulam and Phoenix in eThekwini Metro.

Mgeni System: The areas served by the Mgeni River and its dams (Midmar, Albert Falls, Nagel, Inanda). These are the Msunduzi Municipality, the eThekwini Metro, uMgungundlovu District Municipality, Mswati and Mngeni Local Municiaplities.

South Coast: This is the southern coastal part of the eThekwini Metro to the south of Durban, up to uMkomaas. The area is served by a number of smaller dams (Nungwane, EJ Smith, Umzinto). Some river abstractions also supply the area (Mkomazi River through the Craigieburn WTW; Mtwalume River to the Mtwalume WTW). Major floods in the area expedited the commissioning of the South Coast Pipeline and water is now supplied from the Wiggins WTW in Durban (Mgeni system) to the middel South Coast since the middle of 2008, with reservoirs at Park Rynie.

For the infrastructure pertinent to water resources, water supply, waste water disposal/recycling/re-use and irrigation, a number of viable options were studied to determine how to best optimise the use of existing infrastructure so as to obtain maximal use of capacity, by considering:

- Desktop assessment of existing infrastructure design capacities and correlate with current usage.
- Existing reports and discussions with role-players will be utilized to identify problem areas.
- Drawing timeline comparisons between the various projects under consideration.

The adjustment of operational and maintenance procedures, as well as possible maintenance and refurbishment requirements that could lead to an increase in capacity, were discussed with the various role-players. Plans are underway by these institutions to better the situation where appropriate and are taken into account in their development planning, but not addressed in this study.

2.3 EVALUATE UPGRADING, EXPANDING OR NEW INFRASTRUCTURE SYSTEMS

Appendices A.3 and **A.4** are spatial presentations of the water resource development and waste water re-use options investigated.

The focus of the Reconciliation study is to identify the most feasible options where the available water resources can be developed further to add volume to the resources that are already under stress. Hence, a number of schemes were identified as “Intervention Possibilities” that could either as stand-alone schemes, or in combinations - make more water available. These have been summarised and discussed in **Appendix B**.

In December 2006, the Dept. of Water Affairs & Forestry, with the iLembe DM, commissioned a master water services plan for the whole of the iLembe district. The Reconciliation study team partook in discussions where the results of the plan were presented, so as to ensure that cross-pollination takes place between the two studies. The final report was submitted in April 2007 and accepted by the DM’s council. The Reconciliation Study therefore took the proposals of the master plan into account.

In assessing the possible interventions under consideration, the following was done to ensure that the process of intervention selection took account of as many aspects as possible:

- The proposals in available study reports were compared with newly identified options so as to list a selection of "Intervention Possibilities" that would address the water need up to 2030 – at strategic level, but with enough detail to determine and compare unit reference values (URVs).
- Where possible, the phased implementation of long term Intervention was considered, so as to address the water needs for the short to medium term. Projects in detailed planning and execution stage and their impact on decisions pertinent to recommended future solutions, were also accounted for.
- The risks associated with each Development Option were listed, as well as relevant constraints. No effort was made in comparing the advantages and disadvantages of each solution, as this inherently comes to the fore when assessing the risks and constraints.
- Combining solutions for water resource development and waste water re-use into groups of possible solutions for the First Order Reconciliation Strategy.
- Infrastructure solutions can be grouped into basically three categories:
    - Projects where the capital budgets have been approved and of which the implementation is due to start before end 2009, were accepted as a given.
    - Potential projects that could supply water over the medium term (later than 2012, but before 2017/18), so as to serve as interim or permanent solutions.
    - Potential projects that could provide the water requirements for the 2030 demand horizon.
- Compile comparative planning and development timelines for intervention solutions (refer to **Appendix C**).
- The preliminary findings were presented and discussed with stakeholder and role-players on a one-to-one basis, as well as at various fora (Study Technical Committee - STC; Study Steering Committee – SSC and at two public meetings).

The various institutions involved in water supply in the study area were summarised. Although the intention of the study was to include an analysis of the various tariff structures applied throughout the study area, it was decided to refrain from an analysis of this, as this is would side-track the focus of the study, which is to strategise physical water supply solutions.

3 ASSUMPTIONS

In a study of this extent and nature, it is necessary to make certain assumptions so that the work can progress within the scope of the study and conclusions can be reached. If these assumptions were to be verified in course of the study, it would have taken the study to a level of detail not deemed appropriate. It is important to take note of the assumptions made, as it

- Describes what is deemed to be true and accurate at the time that it was formulated, and
- Could contain aspects that warrant need for further study to verify the validity of the assumption.

The following assumptions have a bearing on the Infrastructure part of this reconciliation study:

a) The need for this study is water demand driven. The need for water is furthermore accelerated by the high tempo of development in some areas of the province. Because of this, the local authorities actively plan and implement remedial measures that addresses this need. The Reconciliation Strategy Study started in October 2006 and many of these plans have since come to fruition - some of what were being planned at the start of the study, are now being implemented. It is also important to note that some of the planning directions of a year ago have changed and different approaches are now being considered.

   Because of this dynamism, this report assumes the January 2008 status of the planning and implementation of localised bulk water supply schemes.

b) It is assumed that projects where the capital expenditure has been approved for implementation, are committed projects and that little can be done about altering the scope of these projects. The Reconciliation Strategy Study assumes such projects as given.

   This means that it would be sensible to reconsider the planning of projects that are not to commence with implementation before the end of 2009, by taking into account the recommendations of this report.

c) The nature of this study has resulted in a multi-level approach with some components such as the water demands being considered at a feasibility level, while the engineering and costing is considered at a reconnaissance/pre-feasibility level.

   Costs of previously investigated studies were escalated, while the estimates of all other options were done at a reconnaissance level. The cost base date is September 2007.

d) The infrastructure solutions catered for the resulting “high road” water demand scenarios, so as to portray the worst case scenario.

e) The re-use of water is aimed at satisfying the deficit in supply and demand. The impact on the environmental reserve was not taken into account, as the infrastructure planning in this regard was done as a first order approach, with the assumption that the all-encompassing viability of this option will be tested in detailed studies.

f) It is assumed that the reader has familiarised him/herself with the contents of the other First Stage Strategy reports (e.g. water demand; water quality & re-use etc.) and the explanations and motivations contained therein. The results of these reports were used as basis when considering the various infrastructure solutions.

g) Maintenance costs were included according the Vaal Augmentation Planning Study (VAPS) guidelines. No treatment operation costs were included. It is assumed that this type of detail will be incorporated in proposed feasibility studies, as the First Stage Strategy’s purpose is to get first order values for comparative purposes. Aspects that were common to different schemes, are not included in the estimations.

4 INTERVENTION POSSIBILITIES

The tables in **Appendix B** is a summary of the interventions that were identified as result of the Literature Review exercise. The Literature Review report contains further details of each scheme. A number of further interventions that came to the fore since then, are also discussed. A summarised overview and description of each possible intervention, with comments and motivations for either discarding it as a viable (or plausible) augmentation option, or pursuing it in further detail, are provided.

Note should be taken that the basis of interventions for each of the three study areas differs, as the solutions to water supply problems are driven by the each area’s characteristics. A solution for e.g. the Mgeni system will not necessarily have the same components as does that for the North Coast. The reader should refrain from comparing suggested schemes in differing study areas.

Table 4-1 Summary of Identified Interventions

Ref.	Scheme	Reasons for including/discarding as Development Option
	SOUTH COAST	
B-1/1	South Coast Pipeline (SCP).	Discarded: Already under construction and to be commissioned during 2008.
B-1/2	Ngwadini off-channel storage dam and transfer scheme, Mkomazi River.	Discarded: SAPPI is developing this facility for their SAICCOR mill, has done the detailed design, and is awaiting environmental approval. Construction will probably commence during 2008. The use of this facility and the lower Mkomazi River will be revisited once further studies into the Mkomazi-Mgeni transfer have taken place.
B-1/3	Treated wastewater supply to SAPPI SAICCOR, Umkomaas.	Discarded: Raw water quality is of prime importance to paper mills. The quality of treated wastewater and the acceptability thereof first needs to be confirmed by SAPPI prior to doing any further work on supply options. This is not possible within the time limits of this study.
B-1/4	Mzimkulu off-channel storage and link to SCP.	Discarded: A pipeline of approximately 30km required to link Hibberdene with SCP at Park Rynie. This is an extensive system that would have capacity for middle South Coast over the interim only.
	MGENI SYSTEM	
B-2/1	Mooi-Mgeni transfer scheme Phases 2a & 2b	Included: Even though a decision was taken some time ago to implement Phase 2, the commencement date has been postponed due to a variety of reasons - the most recent being finalising the environmental report for the authorisation. Hence, it is important to include this project in the study, as it's altering implementation date impacts on the Development Scenarios investigated.
B-2/2	Mkomazi-Mgeni transfer scheme	Included: Pre-feasibility studies have shown the first phase of this scheme to be a viable bulk water supply option subsequent to the development of the Spring Grove Dam.
B-2/3	Recycling of Darvill sewage	Indirectly included by testing the concept of water re-use options for

Ref.	Scheme	Reasons for including/discarding as Development Option
	effluent	the North Coast.
B-2/4	Re-use from Hammersdale WWTW	Indirectly included by testing the concept of water re-use options for the North Coast.
B-2/5	Western Aquaduct	Discarded: The aquaduct does not add additional yield to the system and is therefore not considered a Development Option.
B-2/6	Desalination of sea water	Included: In need to compare viability with water re-use possibilities and the development of fresh water resources.
NORTH COAST		
B-3/1	Raising of Hazelmere Dam	Discarded: The project has been approved for implementation. The implementation of the Mdloti environmental reserve will, however, have an effect on effectiveness of the increased dam yield.
B-3/2	Re-use of treated wastewater	Included: The treatment of wastewater to various levels of acceptability could be cost effective and faster to implement to address interim water shortages.
B-3/3	Zinkwazi desalination	Discarded: The scale of this desalination project is limited to the smaller coastal towns and does not address the requirements of the larger demand centres.
B-3/4	Upgrade of existing Mvoti River abstraction	Discarded: The added abstraction volume will not increase the WTW's capacity, but rather make the operation of the plant more sustainable, without adding additional water to the potable supply system.
B-3/5	Mvoti View Scheme	Discarded: Run-off river abstraction until isiThundu Dam is built (low assurance of supply); earlier studies on dams in the river to be reviewed and those results could affect viability of the scheme.
B-3/6	Mvoti River development	Included: Even though the viability of the isiThundu and the Welverdient Dam options need to be reviewed, the development of the Mvoti River is a medium to long term requirement and is thus included as a Development Option.

Ref.	Scheme	Reasons for including/discarding as Development Option
B-3/7	Mvotipoort Dam	Discarded: Long term viability for supply to the metropolitan areas is important, while this dam can only support the upper and middle Mvoti rural areas over the long term.
B-3/8	North Coast pipeline upgrade	Discarded: The project has been approved for implementation, with the detailed design underway and construction due to start in 2008.
B-3/9	Mandeni (Lower Thukela) to KwaDukuza/Stanger transfer	Included: The viability of this scheme needs to be compared with that of the Mvoti River development. (Also refer to 4.1 here-below re the impact of the Ruwaad development and the Ngcebo 3 scheme).

4.1 NGCEBO SCHEMES & THE LOWER THUKELA RIVER

Though the Assumptions (3 above) stipulate that January 2008 is taken as status quo date for the purposes of this report, the proposed $5 000 million AmaZulu World leisure and entertainment development by the Ruwaad Holdings on some 16 500ha to the immediate north of the Thukela River, warrants attention. It is understood that the first phase ($2 000 million) of this five-phase development is due for completion by 2014 (http://www.eprop.co.za/news/article.aspx?idArticle=10604). A report done by Mbona Saunders & Wium and presented to the Ilembe District Municipality in July 2008, deals with the water demand by the proposed development, which has a substantial impact on the availability of water from the Lower Thukela River for KwaDukuza – and hence, the Lower Thukela Scheme as a Development Option. This scheme is currently referred to as “Ngcebo 3”. For clarity, the following as explanation (also refer to the schematic in **Appendix A.1**):

Ngcebo 1: This is a local scheme abstracting water from an existing abstraction works located on the south bank of the Thukela River, just downstream of the Middeldrift pumping station (part of Thukela-Mhlathuze Transfer Scheme). It will serve the Ngcebo area located in southern floodplain of the Thukela River. Umgeni Water is implementing the project on behalf of the Ilembe DM. Water abstraction from this scheme will apparently be very small and does not impact on the regional water supply planning.

Ngcebo 2 (“Maphumulo Bulk Water Supply Scheme”): This scheme is located on the Imvutshane River, a tributary of the Hlimbitwa, tributary of the Mvoti River. The scheme is to be constructed in three phases, of which the (urgent) first - a small abstraction weir on the Imvutshane River with a rising main that includes a WTW and distribution network – is currently being designed by Umgeni Water on behalf of the Ilembe DM. Later phases entail a storage dam on Imvutshane River just

downstream of the abstraction weir and the pumping of water from the Hlimbitwa River to this dam, thus rendering the dam as off-channel storage for the Hlimbitwa. The scheme will deliver water to the Maphumulo and Maqumbi areas, and does therefore not impact directly on the water supplies to metropolitan areas under consideration in the Reconciliation Study.

Ngcebo 3: This is the Thukela (Mandeni) scheme that has been reported on by Mbona Saunders & Wium (MSW) in their report entitled *"Ilembe District Municipality: Ngcebo 3 - Bulk Water Services Planning Report (July 2008)*". The Reconciliation: Infrastructure study team did not have insight into the report, but attended a presentation (Ilembe DM, 30 July 2008) and had access to the MSW presentation material (dated 23 Sept. 2008). The statement is made by MSW that the AmaZulu World is regarded as a discrete nodal development and does not impact on the water supply infrastructure required south of the Thukela River. However:

- A large portion of the "Middle Road" demand scenario of 205 Ml/day (75 million m^3/a) is to taken-up by the AmaZulu World development (2018: 40 million m^3/a).
- This demand will also use most of the available water (77 million m^3/a) in the lower Thukela. This quantity includes 47 million m^3/a that is allocated under license to Mhlathuze Water for future supplies to greater Richards Bay.
- There appears to no/minimal cross-referencing by the MSW report to the (even preliminary) findings of the Reconciliation study. For example, it is stated that the development of the Mvoti River will not take place within the next 20 years, while the Reconciliation study proposes to have a dam on the Mvoti towards the latter half of the 2010's.

Albeit that there is controversy within the local communities about the development, this development might be an opportunity for having the bulk water supply system funded and developed on a concession-basis, but within the guidelines set by the authorities.

Being belated information, this scheme was not included as part of the Development Scenario planning, but should be pursued so as to integrate its planning with of the regional water supply planning for the North Coast.

4.2 DEVELOPMENT OPTIONS

The interventions that were deemed worthy for inclusion in the Development Scenarios, are chosen "Development Options". In the following sections, the cost estimate of each Development Option is reviewed, the net present value (NPV) and the Unit Reference Value (URV) calculated for

three different discount rates. To compare options with each other, the implementation date was set at 2017, which is a method applied in to determine the best combination of options from which the scenarios are derived.

The following Development Options were assessed:

- Mooi-Mgeni transfer scheme, Phase 2
- Mkomazi-Mgeni transfer scheme, Phase 1
- Mvoti-River – isiThundu Dam
- Desalination plant
- Lower Thukela scheme
- Waste water reuse options

4.3 DEVELOPMENT SCENARIOS

The results of the economic and developmental time line assessment were used to as basis for the combination of these Development Options to study three Development Scenarios (1A, 1B and 2). Each of the scenarios were then economically assessed. The results of this assessment are contained in 12 (SCENARIO ANALYSIS).

5 COST ESTIMATES: BASE DATA

5.1 Escalation of Unit Rates

The base date for costing of the Kwazulu-Natal Water Reconciliation Strategy Study is September 2007. For the purpose of this study the scheme/option costs utilised in the various planning reports were escalated to the base year, September 2007. The base date for these previous studies varies from 1996 to 2004.

The information for escalation/inflation data was obtained from Statistics South Africa (SSA).

The formula used in the Civil Engineering Industry for Contract Price Adjustment (CPA) has four parts; Labour, Material, Plant and Fuel. The proportions are set in the contract and will vary

depending upon the nature of the work, whether it is plant intensive for instance. For the purpose of this study the proportions were assumed as follows:

- Labour : 32,5%
- Materials : 25,0%
- Plant : 32,5%
- Fuel : 10,0%

100,0%

5.1.1 SSA Indexes

The statistics are obtained from SSA and the comparison is made from the cost estimate base date used for each study and the new base date as a factor. The formula used the following tables:

Labour

SSA Publication P0141.1 - Consumer Price Index (Metropolitan Areas, excluding VAT):

June 1996	=	77,4
March 1998	=	87,5
April 2001	=	105,3
September 2007	=	146,1

Materials

SSA Publication P0142.1 - Production Price Index (Table 15 – Civil Engineering Materials, All areas):

June 1996	=	76,3
March 1998	=	87,2
April 2001	=	103,7
September 2007	=	178,7

Plant

SSA Publication P0142.1 - Production Price Index (Table 16 – Civil Engineering Plant):

June 1996	=	71,2
March 1998	=	79,3
April 2001	=	108,2
September 2007	=	152,1

Fuel

SSA Production P0142.1 – Price Index (Table 16 – Diesel oil, Coast & Witwatersrand)

June 1996	=	54,0
March 1998	=	46,0
April 2001	=	112,1
September 2007	=	263,8

Calculations

June 1996	32,5% (77,4)+25,0%(76,3)+32,5%(71,2)+10,0%(54,0)	= 72,77
March 1998	32,5%(87,5)+25,0%(87,2)+32,5%(79,3)+10,0%(46,0)	= 80,61
April 2001	32,5%(105,3)+25,0%(103,7)+32,5%(108,2)+10,0(112,1)	= 106,52
Sept 2007	32,5%(146,1)+25,0%(178,7)+32,5%(152,1)+10,0(263,8)	= 167,97

June 1996 to Sept 2007	= 167,97/72,77	= 2,3082	rounded to 2,31
March 1998 to Sept 2007	= 167,97/80,61	= 2,0837	rounded to 2,08
April 2001 to Sept 2007	= 167,97/106,52	= 1,5769	rounded to 1,58

Appropriate Calculation of Escalation Factors

Factors to be used for the Kwazulu-Natal Water Reconciliation Strategy Study are as follows:

- Mvoti – IsiThundu Dam (original cost estimate June 1996) = 2,31
- Mkomazi – Smithfield Dam (original cost estimate March 1998) = 2,08
- Mooi-Mgeni – Spring Grove Dam (original cost estimate April 2001) = 1,58

6 DEVELOPMENT OPTION: MOOI-MGENI TRANSFER SCHEME PHASE 2

This development option is depicted schematically and spatially in **Appendices A.1** and **A.3**. This scheme has been approved for implementation. It is, however, included as a development option as the implementation has been delayed for various reasons and is currently awaiting environmental authorisation. These delays have been factored into the Demand Scenarios investigated in this report.

6.1 INTRODUCTION & BACKGROUND

This study was carried out by Goba Moahloli Keeve Steyn in association with WRP Consulting Engineers and HR Africa Consulting. Final reports were submitted to DWAF and Umgeni Water in January 2004.

The Mgeni Catchment has until recently (2002) been the main water resource from which the Durban metropolitan area and Pietermaritzburg and surrounds have been supplied. The Mgeni River has already been fully developed with 4 major dams, viz. Midmar (1965), Albert Falls (1976), Nagle (1950) and Inanda (1988), apart from numerous farm dams that have been built in the catchment.

In 1983 the Mearns Emergency Transfer Scheme (METS) was constructed over a 4 month crash programme by DWAF, in order to augment the depleting water supplies of the Mgeni System. The scheme transferred water from the Mooi River at Mearns into the Mgeni Catchment. The METS comprised a 3m high abstraction weir and pumping station at Mearns on the Mooi River, just downstream of its confluence with the little Mooi River, a 13,3km steel rising main (1400mmØ) from Mearns via Rosetta to Nottingham Road, followed by an 8,3km steel gravity main (900mmØ)

that discharged directly into the Mpofana River, then into the Lions River and finally into the Mgeni River just upstream of Midmar Dam.

This scheme was later upgraded by the Mooi-Mgeni Transfer Scheme Phase 1 (MMTS—1). The MMTS-1 comprised:

- The construction of a new 8m high Mearns Weir with an initial gross storage capacity of about 4.91 million m³ (net storage of 3.3 million m³ after allowance for 50 years of siltation) at a full supply level of 1381.90 m.a.s.l. (equivalent to the volume of water than can be continuously pumped for about 12 days at a rate of 3.2m³/s), just downstream of the old Mearns Weir;
- The provision of a 1,6m³/s standby pump in the existing Mearns Pumping Station;
- The raising of Midmar Dam by 3,5m and
- The registering of servitudes of aqueduct for about 26km of the receiving rivers.

Construction of the scheme commenced in August 2001 and was essentially complete by December 2002.

It was decided in 1999 by DWAF and UW, to commission the Mooi-Mgeni River Transfer Scheme Phase 2 (MMTS-2) Feasibility Study. The purpose of the MMTS-2 study was to determine:

- The feasibility of constructing a large storage dam on the Mooi River at Spring Grove, and
- The feasibility of transferring water directly from Spring Grove Dam to the Mgeni catchment.

The proposed scheme has subsequently be approved for implementation and consists of:

- 1,2 MAR Spring Grove Dam (FSL 1433,5 m.a.s.l.)
- 4,5m³/s pump station at Spring Grove Dam
- New rising main from the dam to Nottingham Road
- New break/pressure tank at Nottingham Road
- New improved outlet structure into the Mpofana River
- Fish barrier above the Inchbrakie Falls (if required).

6.2 DEMANDS & FLOWS

The yield for Spring Grove dam was determined as 60 million m³/a.

No losses have been assumed for the pipeline and pump stations, which implies that 60 million m^3 must be pumped from Spring Grove pump station per annum. The pump rate is based on a 350 day per year cycle. This takes into account a fifteen days per year downtime for maintenance to pump stations and pipelines.

6.3 STRATEGIC POTENTIAL

The very nature of the Midmar system is strategic, as this dam, along with other dams in the Mgeni River system, provides water to consumers in the upper, middle and lower Mgeni system. Upgrading the supply capacity of Midmar Dam through the Mooi-Mgeni transfer Phases 1 and 2 increases the yield of the Mgeni system.

The Mgeni system will shortly also supply a large part of the south coast via Wiggins WTW over the interim, thereby placing a higher strain on the system. It is therefore essential that the construction of MMTS-2 proceeds as soon as possible, as the average system demand already outstrips the assured yield of the existing system.

6.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. The result is that about 5 years of design, construction and the filling of the Spring Grove Dam lays ahead. Current departmental thinking is that the scheme should be completed by the end of 2011. If one assumes that design is to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by the earliest October 2013, possibly only July 2014.

6.5 RISKS

The following risks could have an effect on the project delivery date:

a) Resource shortages: The implementation of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; Eskom's construction of new power stations; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans) and materials (steel; cement). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required design time and approval

processes. A material shortage could delay the delivery of materials, and therefor construction progress, as suppliers usually work on a first-come-first-serve basis.

Likelihood: 5/5 Impact on project delivery date: 4/5 Score: 20/25 (High risk)

b) Excessive construction costs: Steel prices have increased 100% in 2007/08, while fuel has risen by 60% over the first six months of 2008. To factor such changes into cost estimates, is a science on its own. Section 5.1 (ESCALATION OF UNIT RATES) above shows that the previous cost estimates were adjusted, based on projecting historical tendencies into the future. The likelihood of the actual tender prices exceeding current cost estimates is very real and is exacerbated by the resource shortage mentioned earlier. The award of tenders could be delayed if funds are not readily available to cater for the quoted construction cost.

Likelihood: 4/5 Impact on project delivery date: 3/5 Score: 12/25 (Medium risk)

c) Extended drought: It has been assumed in the delivery dates stated above, that the new dam will fill within a year. If a drought occurs, the filling of the dam could be delayed, thus aggravating the effect of the drought on the consumer-base.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

d) Delayed decision-making: The environmental authorisation for this project is currently pending and has been one of the major factors delaying the project. Further departmental approvals and the scheduling of funds could affect the programme. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

6.6 CONSTRAINTS

Constraints are aspects that limit one's options. The project has been studied in detail, accepted in-principle and is awaiting environmental approval. It is assumed that constraints that could limit the project's options at a strategic level and at this stage of the project life-cycle, have already been dealt with.

6.7 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.1**.

6.7.1 Capital

The capital costs of the scheme are shown in **Table 6-1.** The April 2001 costs were escalated to September 2007 (Factor = 1,58).

Table 6-1 Cost Summary: Mooi-Mgeni Transfer Scheme Phase 2

Component	Type	Name	Characteristics		Total Capital Cost – April 2001	Total Escalated Capital Cost – Sept 2007
Outlet Structure	Concrete	Mpofana Outlet Structure	No	1	R 3,091,000	R 4,883,780
Pipelines			Dia	Length		
		New Gravity Pipe Line	600	7.875km	R 5,274,000	R 8,332,920
		Existing pipelines Gravity & Rising mains	1400/900	21.025km	R 4,931,000	R 7,790,980
		New Rising Main	1400mm	6.18km	R 29,742,0000	R 46,992,360
			FSL			
Dam	Earth fill	Spring Grove Dam Pump Station	1433.5M		R 99,655,000	R 157,454,900
Dam – Fish Barrier	Concrete	Fish Barrier			R 4,959,000	R 7,835,220
New Pump Station		Spring Grove Dam Pump Station	Cap	4.5m³/s	R 23,909,000	R 37,776,220
Break Pressure Tank		Nottingham Road Break Pressure Tank			R 3,150,000	R 4,977,000
Advance infrastructure		Relocate Existing Infrastructure			R 4,450,000	R 7,031,000
Sub-Total					R 179,161,000	R 283,074,380
Engineering Fees	12%					R 33,968,926
Land Acquisitions and Relocations						R 36,355,800
Social and Environmental	Sum					R 4,005,300
Sub-Total						R 357,404,406
VAT	14%					R 50,036,617
Total						R 407,441,022

6.7.2 Operation and Maintenance

Annual operation and maintenance (O&M) costs are based on percentages of capital cost as laid out hereunder:

- 0,5% of the pipeline capital cost;
- 4% of the electrical and mechanical installation of a pump station;
- 0,25% of the capital cost civil structures including the civil portion of pump stations.

When determining the O&M costs, the cost of replacement of infrastructure, land acquisition, compensation, design and supervision must be excluded. The calculation of the electricity costs for the pump stations is based on the Miniflex Tariff Structure.

6.7.3 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

6.7.4 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system

To compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

6.7.5 Net present cost

The net present cost calculations are detailed in **Appendix D.1** and summarised in **Table 6-2**. The economic life of all the components was taken as 45 years.

Table 6-2 Summary of NPVs (ZAR) for the Spring Grove Dam Scheme

Discount Rate (%)	Capital	O&M	TOTAL
6%	237 752 321	46 019 535	283 771 857
8%	208 610 582	29 778 463	238 389 044
10%	183 672 279	20 103 257	203 775 535

6.7.6 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results are shown in **Table 6-3**.

Table 6-3 Unit Reference Values for the Spring Grove Scheme

Discount Rate (%)	Net Present Costs (Rand)	Demand million m^3	URV Rands/m^3
6%	283 771 857	451	0,63
8%	238 389 044	285	0,84
10%	203 775 535	187	1,09

7 DEVELOPMENT OPTION: MKOMAZI-MGENI TRANSFER SCHEME PHASE 1

This development option is depicted schematically and spatially in **Appendices A.1** and **A.3**.

7.1 INTRODUCTION & BACKGROUND

In January 1997, the Department of Water Affairs and Forestry and Umgeni Water initiated a pre-feasibility study for a scheme to transfer water from the upper Mkomazi River to the Mgeni System. The study followed on from the Mgeni River System Analysis' Study carried out between 1991 and 1994.

The study was carried out by a multi-disciplinary team led by Ninham Shand.

The scheme consists of an initial dam on the Mkomazi River near Smithfield, with a pump station and transfer tunnel to the Mlazi River near Baynesfield and conveyance and treatment and infrastructure supplying potable water to a proposed reservoir at Umlaas Road.

A second dam will be constructed at the Impendle site as the topography of the Smithfield site limits the size of dam that can be constructed there and sufficient storage cannot be provided there to maximise the utilization of the Mkomazi.

For the purpose of this study only the first phase, being the construction of the Smithfield dam and related infrastructure were reviewed as this dam, delivers the required amount of water up to 2030 which is the end of the design horizon for the study.

7.2 DEMANDS & FLOWS

The yield for Smithfield dam as part of the Water Reconciliation Strategy Study was determined as 147 million m^3/a. The spatial component was accounted for. A water balance was conducted and it was established that the upper Mgeni is in balance up to 2030 with Spring Grove in place. The shortfalls thus exist in the eThekwini region which the Mkomazi-Mgeni scheme will support.

No losses have been assumed for the pipeline and pump stations, which implies that 147 million m^3 must be pumped from the pump station per annum. The pump rate is based on a 350 day per year cycle. This takes into account a fifteen days per year downtime for maintenance to pump stations and pipelines.

7.3 STRATEGIC POTENTIAL

The construction of the Mkomazi-Mgeni transfer has, over and above the direct augmentation of the Mgeni system, also the effect of:

a) Increasing the assurance of supply in the middle and lower Mkomazi. This, in turn, makes it a sustainable source for the South Coast Pipeline (and SAPPI SAICCOR), thereby alleviating the load on the Wiggins WTW, the current source for the pipeline. The knock-on effect of this, is that the demand on the Mgeni system will reduce. This will extend the useful life of existing infrastructure, thus postponing costly upgrades and capital expenditure.

b) Serving as potential source for the middle and lower South Coast, possibly augmenting the proposed Mzimkulu River off-channel supply system.

7.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. The result is that about 10½ years of feasibility studies, design, construction and the filling of the Smithfield Dam lays ahead. Current departmental thinking is that the scheme should be completed by the end of 2017. If one assumes that feasibility studies are to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by the earliest December 2018, possibly only a year later.

7.5 RISKS

The following risks could affect the project delivery date:

a) Resource shortages: The planning and design of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. The development of Eskom's new power stations follows basically the same time-line as that for the dam. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required planning & design time and approval processes.

   It is assumed that a cooler economy will prevail over the next 10 years and that this will result in lesser developments, which could counter the effect of the shortage of skills:

   Likelihood: 4/5 Impact on project delivery date: 4/5 Score: 16/25 (Medium risk)

a) Implementation of the environmental reserve: A comprehensive reserve is yet to be determined on the Mkomazi River. The resulting flow requirements will affect the net quantity of water available from any dam on the river. Although its is assumed that the reserve determination will run concurrently with the dam planning processes, any delay in the results thereof would have a direct impact on obtaining of environmental authorisation.

   Likelihood: 2/5 Impact on project delivery date: 4/5 Score: 8/25 (Low risk)

b) Environmental approval unduly delayed: Dams are not favoured in the environmental community, understandably, as their impact on the environment can be significant. The

environmental impact assessment should start rather sooner than later, so as to make a allowance for undue delays in the approval process.

Likelihood: 4/5 Impact on project delivery date: 5/5 Score: 20/25 (High risk)

c) Unexpected variances in demand patterns: The actual demands could differ widely from those that were projected for this study, and could hasten the need for a dam, or postpone it. During the planning process, it is recommended that the demand projects for the Mgeni system are regularly reviewed (every three years?).

Likelihood: 3/5 Impact on project delivery date: 3/5 Score: 9/25 (Low risk)

d) Delayed decision-making: Certain governmental approvals are be required throughout the planning stage of the project. This could be influenced by the availability of funds in a specific budget year. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

7.6 CONSTRAINTS

Constraints are aspects that limits one's options. Constraints that are pertinent to this option, are:

a) Shortage of skilled and experienced staff to drive the planning processes.

b) Budgetary requirements and availability. This could limit the planning and design processes.

7.7 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.2.**

7.7.1 Capital

The capital costs of the scheme is shown in **Table 7-1**. The March 1998 costs were escalated to September 2007 (Factor = 2,08).

7.7.2 Operation and Maintenance

Annual operation and maintenance (O&M) costs are based on percentages of capital cost as laid out hereunder:

- 0,5% of the pipeline capital cost;
- 4% of the electrical and mechanical installation of a pump station;
- 0,25% of the capital cost civil structures including the civil portion of pump stations.

Table 7-1: Cost Summary: Mkomazi-Mgeni Transfer Scheme Phase 1

Component	Type	Name	Characteristics		Total Cost March 1998	Total Escalated Capital Cost - Sept 2007
			Dia	Length		
Tunnel		Smithfield-Baynesfield	3.5m	32.9km	R 543,291,659	R 1,130,046,651
Pipelines			**Dia**	**Length**		
		WW to Umlaas Road Res	1900mm	21.1km	R 172,367,509	R 358,524,419
		Baynesfield Dam to WW	1900mm	3.0km	R 23,975,735	R 49,869,528
		Tunnel to Baynesfield Dam	1800mm	2.2km	R 16,097,536	R 33,482,875
			FSL	**Cap**		
Dam	Rockfill	Smithfield	915m	137 mil	R 221,606,000	R 460,940,480
Dam		Baynesfield (raising)			R 5,990,674	R 12,460,602
Pumpstation and IntakeTower		Smithfield			R 68,022,490	R 141,486,780
Reservoir		Umlaas Road	**Cap**	200Ml	R 40,824,333	R 84,914,612
Advance infrastructure		Access and Elect to Site			R 13,860,000	R 28,828,800
Sub-Total					**R 1,106,035,936**	**R 2,300,554,747**
Engineering Fees	12%					**R 276,066,569.64**
Land Acquisitions and relocations						**R 4,000,000.00**
Social and Environmental	1%					**R 23,005,547.47**
Sub-Total						**R 2,603,626,864.11**
VAT	14%					**R 364,507,760.98**
Total						**R 2,968,134,625.09**

**Note: The water treatment works was not included in the analyses for equitable comparison purposes. Whether raw water, or purified water is pumped to Umlaas Road needs to be determined at feasibility level, as it can be compared with the alternative of upgrading existing WTWs in the Mgeni system.*

When determining the O&M costs, the cost of replacement of infrastructure, land acquisition, compensation, design and supervision must be excluded. The calculation of the electricity costs for the pump stations is based on the Miniflex Tariff Structure.

7.7.3 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

7.7.4 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system to compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

7.7.5 Net present cost

The net present cost calculations are detailed in **Appendix D.2** and summarised in **Table 7-2**. The economic life of all the components was taken as 45 years.

Table 7-2 Summary of NPVs (ZAR) for the Smithfield Dam Scheme

Discount Rate (%)	Capital	O&M	TOTAL
6%	1 645 040 280	114 239 692	1 759 279 972
8%	1 419 573 288	73 893 904	1 493 467 192
10%	1 228 932 105	49 980 043	1 278 912 149

7.7.6 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results are shown in **Table 7-3**.

Table 7-3 Unit Reference Values for the Smithfield Dam Scheme

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	1 759 279 972	781	2,25
8%	1 493 467 192	463	3,23
10%	1 278 912 149	287	4,45

8 DEVELOPMENT OPTION: MVOTI RIVER - ISITHUNDU DAM

This development option is depicted schematically and spatially in **Appendices A.1** and **A.3**.

8.1 INTRODUCTION & BACKGROUND

The Mvoti River Dam Feasibility Study was initiated in 1995 by DWAF and Umgeni Water. The objective of the study was to find and develop an acceptable proposal to provide storage for all users on the Mvoti River. The study concluded that the development of a 51 million m³ gross storage capacity dam at IsiThundu be constructed. This would be designed to be raised by 15m as a Phase 2 Development.

Soon after the completion of the 1995-1997 study, three significant changes occurred viz. the closing down of the Glendale Mill, the introduction of the new National Water Act, Umgeni Water's North Coast Bulk Water Supply Master Plan.

In 2000, a study extension was initiated to investigate the implications of the above-mentioned changes on the various water users, and Ninham Shand concluded as follows:

- A flow gauge must be constructed in the Mvoti otherwise it will not be possible to improve the unacceptably low level of confidence in the hydrological modelling.
- Unless declared, a Government Water Scheme abstraction for industrial and irrigation use is expected to drop radically as soon as any tariff is applied.
- Until such time as Umgeni Water have completed their North Coast Bulk Water Supply Master Plan and the reserve for the Mvoti River has been properly determined, the dam feasibility study cannot be completed.

There is presently no major impoundment on the Mvoti system. However, there is presently a run-of-river abstraction facility for the Stanger WTW.

The following scheme configuration was used in the Water Reconciliation Strategy study.

- Construct an isiThundu Dam up to the raised level with a capacity of 102 million m³.
- Upgrade the abstraction works and use existing tunnel at Mvoti View together with a new pipeline to convey water to a new off-channel storage dam.
- A new raw water pump station from the off-channel storage dam to a water treatment works at Fawsley Park.

8.2 DEMANDS & FLOWS

The yield for isiThundu Dam as part of the Water Reconciliation Strategy Study was determined as 46,3 million m³/a. The full yield was used for all the development options in the Northern Coast. Once the options are implemented, the majority of the yields are immediately required due to the significant deficits in this area. With the development options supporting the Mgeni system, the actual demand curve was used, as the total yield is generally not immediately required. The URVs for the development options supporting the Mgeni System and the development options supporting the North Coast have thus always been presented in separate charts/tables, as they are not directly comparable.

No losses have been assumed for the pipeline and pump stations, which implies that 46,3 million m³ must be pumped from the pump station per annum. The pump rate is based on a 350 day per year cycle. This takes into account a fifteen days per year downtime for maintenance to pump stations and pipelines.

8.3 STRATEGIC POTENTIAL

The construction of a dam on the Mvoti has a strategic impact in both a local and a regional context:

a) Locally, the dam will benefit the Ilembe district by providing a sustainable source for rural water supply schemes and also provide a controlled flow for abstraction for the new Fawsley Park WTW.

b) On a regional basis, the supply from the isiThundu Dam will link to North Coast pipeline, which could then convey water southwards to the Avondale reservoir, thus relieving the demand on the Hazelmere Dam. This dam could then be utilised to supply more water to Verulam through its existing link. Verulam is also supplied by the Durban Heights WTW via the Northern Aquaduct. The demand on the Mgeni system can therefore be reduced with a continual supply from Hazelmere Dam.

c) By using the bi-directional design of the upgraded North Coast pipeline, water can be supplied from either the Hazelmere, or the isiThundu Dams This would further the ideal of optimising the use of and protecting these two resources. The timing and manner in which the environmental reserve of the Mdloti River will be implemented, will also impact on the management of such bi-directional transfers.

8.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. The result is that about 10 years of design, construction and the filling of the isiThundu Dam lays ahead. If it is assumed that planning is to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by the earliest July 2018, possibly only July 2019.

8.5 RISKS

The following risks could affect the project delivery date:

a) Lack of river run-off information: The gauging station U4H002 at Mistley is located in the upper reaches of the Mvoti River, close to Greytown. The need for a gauging station in the lower reaches of the Mvoti River has been advocated for many years now, but to no avail. The lack of flow records leads to a low confidence in calculated yield figures for a dam. Building an important and expensive dam on the Mvoti with this uncertainty is not advisable. The urgent implementation of the Mvoti development needs to be considered in the feasibility studies against the lack of flow data.

Likelihood: 4/5 Impact on project delivery date: 5/5 Score: 20/25 (High risk)

a) Implementation of the environmental reserve: A comprehensive reserve is yet to be determined on the Mvoti River. The resulting flow requirements will affect the net quantity of water available from any dam on the river. Although its is assumed that the reserve

determination will run concurrently with the dam planning processes, any delay in the results thereof would have a direct impact on obtaining of environmental authorisation.

Likelihood: 2/5 Impact on project delivery date: 4/5 Score: 8/25 (Low risk)

b) Resource shortages: The planning and design of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. The development of Eskom's new power stations follows basically the same time-line as that for the dam. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required planning & design time and approval processes.

It is assumed that a cooler economy will prevail over the next 10 years and that this will result in lesser developments, which could counter the effect of the shortage of skills:

Likelihood: 4/5 Impact on project delivery date: 4/5 Score: 16/25 (Medium risk)

c) Unexpected variances in demand patterns: The actual demands could differ widely from those that were projected for this study, and could hasten the need for a dam, or postpone it. During the planning process, it is recommended that the demand projects for the Mgeni system are regularly reviewed (every three years?).

Likelihood: 3/5 Impact on project delivery date: 3/5 Score: 9/25 (Low risk)

d) Delayed decision-making: Certain governmental approvals are be required throughout the planning stage of the project. This could be influenced by the availability of funds in a specific budget year. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

8.6 CONSTRAINTS

Constraints are aspects that limit one's options. Constraints that are pertinent to this option, are:

a) Lack of river run-off information

b) Implementation of the environmental reserve.

c) Shortage of skilled and experienced staff to drive the planning processes.

d) Budgetary requirements and availability. This could limit the planning and design processes.

8.7 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.3**.

8.7.1 Capital

The capital costs of the scheme is shown in **Table 8-1**. The June 1998 costs were escalated to September 2007 (Factor = 1,58).

Table 8-1 Cost Summary: Mvoti River - IsiThundu Dam Option

Component	Type	Name	Characteristics		Total Cost June 1998	Total Escalated Capital Cost - Sept 2007
Dam		Isithundu Dam	**CAP**	102 Mm³	R 306,588,000	R 708,218,280
		Off Channel Dam			R 11,128,000	R 25,705,680
Weir		Upgrade Exist Mvoti Weir	**No**	1	R 3,125,000	R 7,218,750
Pipelines			**Dia**	**Length**		
		Tunnel to Off Channel Dam	700mm	875	R 623,000	R 1,439,130
		Off Channel Dam to Fawsley Park	700/900	500/1600	R 6,272,925	R 14,490,457
Raw Water Pumpstation		River Pump Station			R 8,050,000	R 18,595,500
Raw Water Pumpstation		Off Channel Dam to Fawsley Park			R 6,785,000	R 15,673,350
Treatment Works		Fawsley Park			R 74,880,000	R 172,972,800
		Access and Elect to Site	included			R -
Sub-Total					**R 417,451,925**	**R 964,313,947**
Engineering Fees	12%					**R 115,717,673.61**
Land Acquisitions and relocations						**R 16,170,000.00**
Social and Environmental	1%					**R 9,643,139.47**
Sub-Total						**R 1,105,844,759.83**
VAT	14%					**R 154,818,266.38**
Total						**R 1,260,663,026.20**

8.7.2 Operation and Maintenance

Annual operation and maintenance (O&M) costs are based on percentages of capital cost as laid out hereunder:

- 0,5% of the pipeline capital cost;
- 4% of the electrical and mechanical installation of a pump station;

- 0,25% of the capital cost civil structures including the civil portion of pump stations.

When determining the O&M costs, the cost of replacement of infrastructure, land acquisition, compensation, design and supervision must be excluded. The calculation of the electricity costs for the pump stations is based on the Miniflex Tariff Structure.

8.7.3 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

8.7.4 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system

To compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

8.7.5 Net present cost

The net present cost calculations are detailed in **Appendix D.3** and summarised in **Table 8-2**. The economic life of all the components was taken as 45 years.

Table 8-2 Summary of NPVs (ZAR) for the isiThundu Dam Scheme

Discount Rate (%)	Capital	O&M	TOTAL
6%	719 626 915	149 704 626	869 331 541
8%	627 603 916	99 121 675	726 725 590
10%	549 160 921	68 448 199	617 609 120

8.7.6 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results are shown in **Table 8-3**.

Table 8-3 Unit Reference Values for the isiThundu Dam Scheme

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	869 331 541	424	2,05
8%	726 725 590	280	2,59
10%	617 609 120	194	3,19

9 DEVELOPMENT OPTION: DESALINATION OF SEA WATER

9.1 INTRODUCTION & BACKGROUND

Umgeni Water is currently investigating a desalination option with the objective to compare the capital and operational costs of desalination with the development of the Smithfield Dam on the Mkomazi River, by using the assured yield of the dam (147 million m³/a) as common supply volume. This study is still underway and no results are available, as yet.

For the purpose of this study, the desalination of sea water was considered as alternative to the re-sue of water (Section 11). Hence, it was decided to cost, at a reconnaissance level, a desalination plant supplying 50 million m³/a.

A first order capital cost estimate and operation and maintenance cost was determined by Golder Africa to be used in the economic analyses. These costs do not include bulk pipelines to distribute the water to the demand centres. It was assumed that the bulk supply network would negatively impact on the URV values, thus rending this option even less feasible. The subsequent URV calculations (**Appendix D4**) supported this assumption. Had the URV figures proven more favorable, then this would have been included in the Development Scenarios and possibly studied further at feasibility level (by others).

9.2 DEMANDS & FLOWS

The desalination plant was sized and costed to supply 50 million m³/a. With the development options supporting the Mgeni system, the actual demand curve was used, as the total yield is generally not immediately required.

9.3 STRATEGIC POTENTIAL

The desalination of sea water is, from a locality point of view, an attractive option. Tapping this resource add flexibility to the use of the existing fresh water resources and could postpone some of the suggested long term solutions. The desalination option is mooted for dealing shortages on the Mgeni system. If it were to implemented and, for example postpone the Mkomazi-Mgeni transfer scheme, it would imply that it will serve as water sources for the upper and middel South Coast, as well.

In a general context, water to Durban and environs is supplied from dams in the higher altitudes of the Mgeni River system. Being located on the coastal plan, the supply from a desalination plant could imply that certain components of the existing bulk supply infrastructure might have to be modified to accommodate supplies pumped generally “uphill”.

On the downside, desalination is not only expensive to develop, but needs also a high energy input. The supply of electricity is currently a national crisis, with not enough power generation capacity being available to provide even in the short term demands of South Africa. A desalination plant inherently requires a high energy input and its possible development therefor needs to be coordinated with the development of future power stations.

9.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. The result is that some 8,5 years of the planning and implementation work lays ahead. If it is assumed that planning is to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by the end of 2016.

9.5 RISKS

The risks that could delay the development of this option, are the following:

a) Need for electricity: Nationally, there is not enough power generation capacity to provide even in the short term demands of South Africa. The construction of a large scale desalination plant will also depend on securing a sustainable source of electrical power. Such arrangements could have a negative impact on the development of this option.

Likelihood: 4/5 Impact on project delivery date: 5/5 Score: 20/25 (Medium risk)

b) Resource shortages: The planning and design of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. The development of Eskom's new power stations follows basically the same time-line as that for the dam. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required planning & design time and approval processes.

It is assumed that a cooler economy will prevail over the next 10 years and that this will result in lesser developments, which could counter the effect of the shortage of skills:

Likelihood: 4/5 Impact on project delivery date: 4/5 Score: 16/25 (Medium risk)

c) Delayed decision-making: Certain governmental approvals are be required throughout the planning stage of the project. This could be influenced by the availability of funds in a specific budget year. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

9.6 CONSTRAINTS

Constraints are aspects that limit one's options. Constraints that are pertinent to this option, are:

a) Shortage of skilled and experienced staff to drive the planning processes.

b) Budgetary requirements and availability. This could limit the planning and design processes.

c) The location of the desalination plant being on the coastal plain.

9.7 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.4**.

9.7.1 Capital

The capital costs are shown in **Table 9-1**.

Table 9-1: Cost Summary: Desalination Plant

Component	Type	Name	Characteristics		Total Cost Sept 07	Total Capital Cost
Deslination Plant		Deslination Plant	**Cap**	50Mm³/a	R 926,000,000	R 926,000,000
Brine Outfall and Intake		Brine Outfall and Intake			R 926,000,000	R 926,000,000
Sub-Total					**R 1,852,000,000**	**R 1,852,000,000**
Engineering Fees	12%					**R 222,240,000.00**
Land Acquisitions and relocations						**R 5,000,000.00**
Social and Environmental	1%					**R 9,260,000.00**
Sub-Total						**R 2,088,500,000.00**
VAT	14%					**R 292,390,000.00**
Total						**R 2,380,890,000.00**

9.7.2 Operation and Maintenance

Annual operation and maintenance costs was determined as R343 000 000/a.

9.7.3 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system

To compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

9.7.4 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

9.7.5 Net present cost

The net present cost calculations are detailed in **Appendix D.4** and summarized in **Table 9-2**. The economic life of all the components was taken as 45 years.

Table 9-2 Summary of NPVs (ZAR) for the Desalination Plant

Discount Rate (%)	Capital	O&M	TOTAL
6%	1 369 108 561	3 137 861 161	4 506 969 722
8%	1 197 085 610	2 077 624 864	3 274 710 473
10%	1 049 857 595	1 434 698 113	2 484 555 708

9.7.6 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results are shown in **Table 9-3**.

Table 9-3 Unit Reference Values for the Desalination Plant

Discount Rate (%)	Net Present Costs (Rand)	Demand million m^3	URV Rands/m^3
6%	4 506 969 722	391	11,54
8%	3 274 710 473	249	13,17
10%	2 484 555 708	165	15,05

NOTE: The desalination URVs reflect the costly nature of desalinating sea water in bulk, when compared to other possible supply solutions.

10 DEVELOPMENT OPTION: LOWER THUKELA SCHEME

This development option is depicted schematically and spatially in **Appendices A.1** and **A.3**.

10.1 INTRODUCTION & BACKGROUND

The lower Thukela River (for this report defined as the river section between Kranskop and the Thukela Mouth), has for many years been the subject of river development studies. The three largest abstractions in this part of the river, are:

- The Middeldrift abstraction, from where water can be conveyed over the watershed into the Mhlathuze River catchment and thereby serve the needs of greater Richards Bay.

- The Sundumbili abstraction upstream of Mandeni, and serves as source for a water treatment works that serves Sundumbili and surrounds.

- The SAPPI abstraction that provides water for the Thukela paper mill of SAPPI, as well as potable water to the town of Mandeni.

Mhlathuze Water has suggested the development of a water supply system that abstracts water at the existing gauging weir at Mandeni, pumping it to an upgraded Sundumbili water treatment works and conveying it southwards to serve the north coast estate developments, towns en route, as well as KwaDukuza town. This was declined by the Ilembe District Municipality at the time, but has recently become the object of a study by the municipality itself, with the view of also supplying the Mandeni local municipal area to the north of the Thukela River.

The current thinking is that this could serve as an interim measure – until such time as the Mvoti River is developed. The estimated cost of such a scheme, though, indicates it to be sizable and expensive enough to warrant comparison with the building of a dam on the Mvoti River, thus serving the purpose of a long term solution.

The scheme was costed at a recon level and need to be further investigated at pre-feasibility and feasibility levels. The proposed scheme consists of:

- Using the existing gauging weir at Mandeni as abstraction point on the Thukela River and constructing an abstraction works.

- Raw water pump station and rising main to Fawsley Park WTW.

- Water Treatment works at Fawsley Park.

Being one of the two most prominent options to supply the North Coast study area, it was assumed that the WTW will be located at one point common of raw water delivery to this option and the Mvoti/isiThundu scheme, i.e. at Fawsley Park. Further to this, the position of the WTW does not impact so much on the strategic level of this study, but needs to be confirmed once the feasibility of these options are studied.

10.2 DEMANDS & FLOWS

The yield for the Thukela scheme as part of the Water Reconciliation Strategy Study was determined for various scenarios. The maximum available for use to supply south of the Thukela River was determined as 36,8 million m³/a. The full yield was used for all the development options in the North Coast. Once the options are implemented, the majority of the yields are immediately required due to the significant deficits in the North Coast.

No losses have been assumed for the pipeline and pump stations, which implies that 36,8 million m³ must be pumped from the Thukela River annually. The pump rate is based on a 350 day per year cycle. This takes into account a fifteen days per year downtime for maintenance to pump stations and pipelines.

10.3 STRATEGIC POTENTIAL

a) Locally, the dam will benefit the Ilembe district by providing a sustainable source for rural water supply to the north of the Thukela River.

b) On a regional basis, the supply from the lower Thukela River will link to North Coast pipeline, via the WTW at Fawsley Park, which could then convey potable water southwards to the Avondale reservoir, thus relieving the demand on the Hazelmere Dam. This dam could then be utilised to supply more water to Verulam through its existing link. Verulam is also supplied by the Durban Heights WTW via the Northern Aquaduct. The demand on the Mgeni system can therefor be reduced with a continual supply from Hazelmere Dam.

c) By using the bi-directional design of the upgraded North Coast pipeline, water can be supplied from either the Hazelmere, or the lower Thukela River. This would further the ideal of optimising the use of and protecting these two resources.

d) The lack of flow records on the Mvoti River leads to a low confidence in calculated yield figures for any suggested dam. Constructing a gauging station on the Mvoti River soon will still imply that a number of years' flow data needs to be generated to have any sensible data base on which to build a stochastic analysis. The building of a flow record on the Mvoti in conjunction with an increase in demand, could make the construction of the Lower Thukela Scheme a feasible option, when considering the confidence in assured supplies.

10.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. The result is that about 5 years of the planning and implementation work lays ahead. If it is assumed that planning is to commence in July 2008 along with approval processes and annual budget allocations, then it is estimated that the scheme will be able to produce water by the earliest July 2013, possibly only three years later.

10.5 RISKS

The following risks could affect the project delivery date:

a) Resource shortages: The planning and design of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. The development of Eskom's new power stations follows basically the same time-line as that for the dam. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required planning & design time and approval processes.

   It is assumed that a cooler economy will prevail over the next 10 years and that this will result in lesser developments, which could counter the effect of the shortage of skills:

   Likelihood: 4/5 Impact on project delivery date: 4/5 Score: 16/25 (Medium risk)

b) Delayed decision-making: Certain governmental approvals are be required throughout the planning stage of the project. This could be influenced by the availability of funds in a specific budget year. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

   Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

10.6 CONSTRAINTS

Constraints are aspects that limit one's options. Constraints that are pertinent to this option, are:

a) The control of flows to the lower reaches of the Thukela River. Existing dams are located in the upper reaches of the Thukela River. Releases are subject to losses and a few days of river flow.

b) Shortage of skilled and experienced staff to drive the planning processes.

c) Budgetary requirements and availability. This could limit the planning and design processes.

10.7 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.5**.

10.7.1 Capital

The capital costs are shown in **Table 10-1**.

Table 10-1: **Cost Summary: Lower Thukela Scheme**

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Capital Cost - Sept 2007
Weir and Abstraction Works		Weir in Tugela River			R 33,858,825	R 33,858,825
Treatment Works		Fawsley Park	**Cap**		R 172,972,800	R 172,973,520
Pipelines			**Dia**	**Length**		
		Absraction Works to Fawsley Park W	1200	27km	R 237,391,560	R 237,391,560
Pumpstation		Tugela River			R 29,000,000	R 29,000,000
Advance infrastructure		Access and Elect to Site			R 10,000,000	R 10,000,000
Sub-Total					**R 483,223,185**	**R 483,223,905**
Engineering Fees	12%					**R 57,986,868.60**
Land Acquisitions and relocations						**R 5,000,000.00**
Social and Environmental	1%					**R 4,832,239.05**
Sub-Total						**R 551,043,012.65**
VAT	14%					**R 77,146,021.77**
Total						**R 628,189,034.42**

10.7.2 Operation and Maintenance

Annual operation and maintenance (O&M) costs were based on percentages of capital cost as laid out hereunder:

- 0,5% of the pipeline capital cost;
- 4% of the electrical and mechanical installation of a pump station;
- 0,25% of the capital cost civil structures including the civil portion of pump stations.

When determining the O&M costs, the cost of replacement of infrastructure, land acquisition, compensation, design and supervision must be excluded. The calculation of the electricity costs for the pump stations is based on the Miniflex Tariff Structure.

10.7.3 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

10.7.4 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system

To compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

10.7.5 Net present cost

The net present cost calculations are detailed in **Appendix D.5** and summarized in **Table 10-2**. The economic life of all the components was taken as 45 years.

Table 10-2 Summary of NPVs (ZAR) for the Lower Thukela Scheme

Discount Rate (%)	Capital	O&M	TOTAL
6%	340 769 682	114 653 624	455 423 306
8%	291 972 349	75 913 881	367 886 230
10%	250 964 038	52 422 121	303 386 159

10.7.6 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results are shown in **Table 10-3**.

Table 10-3 Unit Reference Values for the Lower Thukela Scheme

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	455 423 306	337	1,35
8%	367 886 230	223	1,65
10%	303 386 159	154	1,97

11 DEVELOPMENT OPTION: WASTE WATER REUSE OPTIONS

This development option is depicted spatially in **Appendix A.4**.

11.1 INTRODUCTION & BACKGROUND

Due to the long implementation periods of some of the development options identified, the possibility to implement sewage re-use options were investigated to bridge the gap as these schemes can be implemented in a shorter period. The pipe routes conveying treated sewage to the dams were done at desktop (strategic) level and eventually found to be worth further consideration. Feasibility studies will identify the practicalities of the various re-use options.

The study started by investigating three types of re-use being:

11.1.1 Direct Use – Potable Water

Direct re-use of treated sewage effluent for potable use. This requires the inclusion of nano/ultra-filtration step to act as a barrier to pathogens, removal of some salts and toxics. The assumption was made that the filtration system can recover 80% of the inflow and 20% will be a dilute brine. It is recommended that the brine be disposed of by pipeline to the sea or one of the existing sea outfalls. This option was not further investigated as part of this study because of the cost implications constructing the brine outfall pipes and sea outfalls.

11.1.2 Indirect Use – Into a Dam

The additional treatment to remove phosphorus which allows the treated effluent to be discharged into a dam such as Hazelmere Dam for storage and re-use. The limit of available phosphorus removal technology has been adopted which is the use of ferric chloride and tertiary clarification to remove phosphorus. In determining the costs, it has been assumed that the sewage treatment plants are performing to the plant specifications. The settled sludge will be disposed with the sewage treatment plant sludge. The feasibility of the re-use of water by discharge into a dam will have to be checked by assessing the impact of the additional phosphorus loading on the trophic status of the dam. This option was further investigated as part of this study.

11.1.3 Indirect Use – For Irrigation

Re-use of sewage effluent for irrigation. Additional treatment is required for sand filtration and disinfection for the protection of farm workers. This option was not further investigated.

The following waste water treatment works (WWTW) were considered to be used in the scenarios:

- KwaMashu
- Northern
- Tongaat
- Verulam
- Phoenix.

11.2 DEMANDS & FLOWS

The treatment works were utilised in various combinations in the scenario analysis and also as stand-alone options to be directly compared against previously identified options.

Demand curves for each of the treatment works were determined and utilised in the economic analyses. The re-use options were also directly compared to other development options with adjusted demand patterns whereby the full capacity was utilised from the first year (Referred to as Block Demand).

During the investigation it became apparent that the water of Phoenix WWTW might not be available for re-use. The scenarios were therefore also analysed to also exclude Phoenix Waste

Water Treatment Works. The outflows of the Tongaat and Verulam WWTWs are also earmarked for augmenting the Mdloti environmental reserve, but were included (for the time being) as water re-use options. Due to the significant deficits, all possible re-use options were included to minimize the deficits as much as possible. A reconciliation scenario was investigated in the "Reconciliation Strategy" report (Scenario IV) where Verulam and Tongaat WWTW were excluded from the re-use options and were assumed to supply the EWR.

Table 11-1 Water re-use scenarios

Scenario 1A	Scenario 1B	Scenario 2
KwaMashu WWTW to Hazelmere Dam – 23 million m³/a	KwaMashu WWTW to Hazelmere Dam (14 million m³/a) and Inanda Dam (9 million m³/a)	KwaMashu WWTW to Hazelmere Dam (10 million m³/a) and Inanda Dam (13 million m³/a)
Northern to Inanda Dam – 19,7 million m³/a		
North Coast (all outflows to Hazelmere Dam): - Tongaat (2,9 million m³/a) - Verulam (2,4 million m³/a) - Phoenix (5,1 million m³/a)		

11.3 STRATEGIC POTENTIAL

a) The most obvious benefit of the re-use of waste water, is the reduction of demand for fresh water, thus postponing further development and capital expenditure.

b) Another implication of waste water recycling/re-use, is that it will reduce return flows to the system, which is, in the case of the Mhlanga estuary, preferable.

c) All the other estuaries in the eThekwini Metro area, have been shown to benefit from an increase in the return flow of treated effluent – in other words, a decrease, or removal of the return flows, will be to the detriment of those estuaries.

11.4 DEVELOPMENT TIME FRAME

Development time frame for this option was reviewed – refer to **Appendix C** for a breakdown of the estimate. If it is assumed that planning is to commence in July 2008 along with approval

processes and annual budget allocations, then it is estimated that these schemes should be able to produce water within 5½ tot 8 years. For this study end 2014 was assumed.

11.5 RISKS

The risks that could delay the development of this option, are the following:

a) Community acceptance: Experience elsewhere, has indicated that communities have different reasons for frowning on the potable use of recycled waste water, citing religious, health and the general "yucky!" objections. A preliminary (cursory?) study by eThekwini Water & Sanitation in the vicinity of Phoenix has, however, indicated minimal objection to the thought. This aspect could delay the environmental authorisation of these projects.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 12/25 (Medium risk)

b) Environmental impact: The transfer of treated waste water into impoundments such as the Inanda and Hazelmere Dams, could have an impact on the dams' water quality, as well as on the inflows at the estuaries, and needs to managed carefully. This aspect could delay the environmental authorisation of these projects.

Likelihood: 3/5 Impact on project delivery date: 4/5 Score: 12/25 (Medium risk)

c) Resource shortages: The planning and design of this project will be running concurrent to other major infrastructure projects in South Africa, such as the Gautrain project; the construction of the Dube Trade Port north of Durban and stadium construction and other preparations for Soccer 2010. The development of Eskom's new power stations follows basically the same time-line as that for the dam. This has already lead to shortages in resources such as skills (engineering; institutional and construction management; artisans). A shortage in skills at all levels of the supply chain (client, consultant, contractor and supplier) could extend the required planning & design time and approval processes.

It is assumed that a cooler economy will prevail over the next 10 years and that this will result in lesser developments, which could counter the effect of the shortage of skills:

Likelihood: 4/5 Impact on project delivery date: 4/5 Score: 16/25 (Medium risk)

d) Delayed decision-making: Certain governmental approvals are be required throughout the planning stage of the project. This could be influenced by the availability of funds in a specific budget year. Further approval of designs and tenders, if not managed tightly, could also impact negatively on the project delivery date.

Likelihood: 3/5 Impact on project delivery date: 5/5 Score: 15/25 (Medium risk)

11.6 CONSTRAINTS

Constraints are aspects that limit one's options. Constraints that are pertinent to this option, are:

a) Detrimental effect that reduced return flows will have on most estuaries in the eThekwini Metro area.

b) Shortage of skilled and experienced staff to drive the planning processes.

c) Budgetary requirements and availability. This could limit the planning and design processes.

d) Negative community perceptions of using recycled waste water.

e) The quality of waste water received. It has been determined that it is practical to recycle waste water for potable use, more than 90% of the waste water received is from domestic sources. In the case of the eThekwini Metro, most of the waste water drained to its WWTWs contain portions of industrial effluent that exceed this limitation.

f) Need to manage recycling processes responsibly to prevent the build-up of salts in potable water.

g) The impact that the re-use of water has on estuarine health because of reduced inflows.

11.7 COSTING

The costs to upgrade the existing waste water treatment works was determined by Golder Africa. The bulk supply pipelines and pump stations were costed at a reconnaissance level.

All cost stream, including capital, operation and maintenance costs can be seen in more detail in **Appendix D.6**.

The following cost summaries indicate the capital costs used for each treatment works in the different scenarios.

11.7.1 Capital

11.7.1.1 KwaMashu Waste Water Treatment Works

Table 11-2: Scenario 1A Capex: KwaMashu WWTW To Hazelmere Dam (23 million m³/a)

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Kwamashu WWTW		Kwamashu WWTW			R	29,000,000
Pipelines			**Dia**	**Length**		
		Kwamashu WWTW to Hazlemere	900	20km	R	78,649,200
Pumpstation		At Kwamashu WWTW			R	53,000,000
Sub-Total					**R**	**160,649,200**
Engineering Fees	12%				**R**	**19,277,904.00**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**1,606,492.00**
Sub-Total					**R**	**186,533,596.00**
VAT	14%				**R**	**26,114,703.44**
Total					**R**	**212,648,299.44**

Table 11-3 Scenario 1B Capex: KwaMashu WWTW to Hazelmere (14 million m³/a) and Inanda Dams (9 million m³/a)

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing KwaMashu WWTW		KwaMashu WWTW	**No**	1	R	29,000,000
Pipelines			**Dia**	**Length**		
		Kwamashu to Hazelmere Dam	700mm	20km	R	61,790,400
		Kwamashu to Inanda Dam	600mm	30km	R	75,600,000
Pumpstation to Hazelmere Dam		Hazelmere Pump Station			R	9,767,646
Pumpstation to Inanda Dam		Inanda Pump Station			R	12,672,576
Sub-Total					**R**	**188,830,622**
Engineering Fees	12%				**R**	**22,659,674.64**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**1,888,306.22**
Sub-Total					**R**	**218,378,602.86**
VAT	14%				**R**	**30,573,004.40**
Total					**R**	**248,951,607.26**

Table 11-4 Scenario 2 Capex: KwaMashu WWTW to Hazelmere (10 million m³/a) and Inanda Dams (13 million m³/a)

Component	Type	Name	Characteristics		Total Capital	
Upgrade Existing KwaMashu WWTW		KwaMashu WWTW	**No**	1	R	29,000,000
Pipelines			**Dia**	**Length**		
		Kwamashu to Hazelmere Dam	600mm	20km	R	50,400,000
		Kwamashu to Inanda Dam	700mm	30km	R	92,685,600
Pumpstation to Hazelmere Dam		Hazelmere Pump Station			R	7,640,388
Pumpstation to Inanda Dam		Inanda Pump Station			R	20,916,000
Sub-Total					**R**	**200,641,988**
Engineering Fees	12%				**R**	**24,077,038.56**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**2,006,419.88**
Sub-Total					**R**	**231,725,446.44**
VAT	14%				**R**	**32,441,562.50**
Total					**R**	**264,167,008.94**

11.7.1.2 Northern Waste Water Treatment Works

The same configuration was used for Scenarios 1A, 1B and 2.

Table 11-5 Capex: Northern WWTW to Inanda Dam (19,7 million m³/a)

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Northern WWTW		Northern WWTW			R	26,100,000
Pipelines			**Dia**	**Length**		
		Northern WWTW to Inanda Dam	800	22km	R	123,464,000
Pumpstation		At Northern WWTW			R	22,500,000
Sub-Total					**R**	**172,064,000**
Engineering Fees	12%				**R**	**20,647,680.00**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**1,720,640.00**
Sub-Total					**R**	**199,432,320.00**
VAT	14%				**R**	**27,920,524.80**
Total					**R**	**227,352,844.80**

11.7.1.3 Tongaat-, Verulam- and Phoenix Waste Water Treatment Works

As stated previously, the scenarios were also analysed excluding Phoenix Waste Water Treatment Works. Following are capital cost summaries for both scenarios. The same configuration was used for Scenario 1A, 1B and 2.

Table 11-6 Capex: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix WWTW (5,1 million m³/a) to Hazelmere Dam.

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R	6,800,000
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R	5,900,000
Upgrade Existing Phoenix WWTW		Phoenix WWTW	**No**	1	R	10,100,000
Pipelines			**Dia**	**Length**		
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R	7,650,720
		Verulam to Hazelmere Dam	500mm	8km	R	14,001,120
		Phoenix to Verulam	400mm	6km	R	8,406,720
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R	3,913,938
Pumpstation to Hazelmere Dam		Verulam Pump Station			R	6,491,898
Pumpstation to Hazelmere Dam		Phoenix Pump Station			R	3,913,938
Sub-Total					**R**	**67,178,334**
Engineering Fees	12%				**R**	**8,061,400.08**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**671,783.34**
Sub-Total					**R**	**80,911,517.42**
VAT	14%				**R**	**11,327,612.44**
Total					**R**	**92,239,129.86**

Table 11-7 Capex: Tongaat (2,9 million m³/a) and Verulam (2,4 million m³/a) WWTW to Hazelmere Dam.

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R	6,800,000
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R	5,900,000
Pipelines			**Dia**	**Length**		
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R	7,650,720
		Verulam to Hazelmere Dam	300mm	8km	R	9,283,680
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R	3,913,938
Pumpstation to Hazelmere Dam		Verulam Pump Station			R	2,359,728
Sub-Total					**R**	**35,908,066**
Engineering Fees	12%				**R**	**4,308,967.92**
Land Acquisitions and relocations					**R**	**3,000,000.00**
Social and Environmental	1%				**R**	**359,080.66**
Sub-Total					**R**	**43,576,114.58**
VAT	14%				**R**	**6,100,656.04**
Total					**R**	**49,676,770.62**

11.7.2 Operation and Maintenance

Annual operation and maintenance (O&M) costs are based on percentages of capital cost as laid out hereunder:

- 0,5% of the pipeline capital cost;
- 4% of the electrical and mechanical installation of a pump station;
- 0,25% of the capital cost civil structures including the civil portion of pump stations.

When determining the O&M costs, the cost of replacement of infrastructure, land acquisition, compensation, design and supervision must be excluded. The calculation of the electricity costs for the pump stations is based on the Miniflex Tariff Structure. Operation and maintenance cost of the treatment works were determined by Golder Africa.

11.7.3 Existing infrastructure

Costs incurred by making use of the existing infrastructure to distribute the water have not been determined as part of this study and should be addressed in future studies.

Additional treatment costs at existing Water Treatment works was not taken into account in this study and should be included in future studies.

11.7.4 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system

To compare options with each other the implementation date was set at 2017. In the scenario analysis the implementation dates were driven by shortfalls in the system.

11.7.5 Net present values

The net present cost calculations of all the re-use options are detailed in **Appendix D.6** and summarised in the following tables. The economic life of all the components: 45 years.

11.7.5.1 Block Demands - NPVs

Table 11-8: **NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (23 million m³/a) – Block Demand**

Discount Rate (%)	Capital	O&M	TOTAL
6%	115 378 532	63 814 285	179 192 817
8%	98 475 003	42 252 394	140 727 394
10%	84 362 521	29 177 274	113 539 795

11.7.5.2 Scenario 1A - NPVs

Table 11-9: **NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (23 million m³/a)**

Discount Rate (%)	Capital	O&M	TOTAL
6%	115 378 532	54 794 046	170 172 579
8%	98 475 003	35 598 538	134 073 542
10%	84 362 521	24 191 245	108 553 766

Table 11-10: NPV (ZAR) for Northern to Inanda Dam (19.7 million m³/a)

Discount Rate (%)	Capital	O&M	TOTAL
6%	122 814 020	81 875 131	204 689 151
8%	104 960 301	53 836 592	158 786 893
10%	89 997 070	36 916 167	126 913 237

Table 11-11: **NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam**

Discount Rate (%)	Capital	O&M	TOTAL
6%	50 056 054	27 065 865	77 121 919
8%	42 800 179	17 920 714	60 720 893
10%	36 722 727	12 375 100	49 097 826

Table 11-12: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam

Discount Rate (%)	Capital	O&M	TOTAL
6%	26 945 726	14 987 137	41 932 864
8%	23 048 568	9 923 208	32 971 776
10%	19 781 537	6 852 444	26 633 981

11.7.5.3 Scenario 1B - NPVs

Table 11-13: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (14 million m³/a) and Inanda Dam (9 million m³/a)

Discount Rate (%)	Capital	O&M	TOTAL
6%	134 570 011	69 913 476	204 483 488
8%	115 052 673	45 841 221	160 893 893
10%	98 687 381	31 376 029	130 063 410

Table 11-14: NPV (ZAR) for Northern to Inanda Dam (19,7 million m³/a)

Discount Rate (%)	Capital	O&M	TOTAL
6%	122 814 020	81 875 131	204 689 151
8%	104 960 301	53 836 592	158 786 893
10%	89 997 070	36 916 167	126 913 237

Table 11-15: NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam

Discount Rate (%)	Capital	O&M	TOTAL
6%	50 056 054	27 065 865	77 121 919
8%	42 800 179	17 920 714	60 720 893
10%	36 722 727	12 375 100	49 097 826

Table 11-16: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam

Discount Rate (%)	Capital	O&M	TOTAL
6%	26 945 726	14 987 137	41 932 864
8%	23 048 568	9 923 208	32 971 776
10%	19 781 537	6 852 444	26 633 981

11.7.5.4 Scenario 2 - NPVs

Table 11-17: NPVs (ZAR) for KwaMashu WWTW to Hazelmere Dam (10 million m³/a) and Inanda Dam (13 million m³/a)

Discount Rate (%)	Capital	O&M	TOTAL
6%	142 859 493	79 502 568	222 362 061
8%	122 117 481	52 259 903	174 377 384
10%	104 733 771	35 836 250	140 570 021

Table 11-18: NPV (ZAR) for Northern to Inanda Dam (19,7 million m³/a)

Discount Rate (%)	Capital	O&M	TOTAL
6%	122 814 020	81 875 131	204 689 151
8%	104 960 301	53 836 592	158 786 893
10%	89 997 070	36 916 167	126 913 237

Table 11-19: NPV (ZAR) for North Coast: Tongaat (2,9 Million m³/a), Verulam (2,4 million m³/a) & Phoenix (5,1 million m³/a) WWTW to Hazelmere Dam

Discount Rate (%)	Capital	O&M	TOTAL
6%	50 056 054	27 065 865	77 121 919
8%	42 800 179	17 920 714	60 720 893
10%	36 722 727	12 375 100	49 097 826

Table 11-20: NPV (ZAR) for North Coast: Tongaat (2,9 million m³/a) & Verulam WWTW (2,4 million m³/a) to Hazelmere Dam

Discount Rate (%)	Capital	O&M	TOTAL
6%	26 945 726	14 987 137	41 932 864
8%	23 048 568	9 923 208	32 971 776
10%	19 781 537	6 852 444	26 633 981

11.7.6 Unit Reference Values

The unit reference value of water has been determined for discount rates of 6%, 8% and 10%, and is based on water transferred for a 45 year period. The results of the block demand scenarios are shown in the following tables:

11.7.6.1 Block Demands – URVs

Table 11-21: URV - KwaMashu WWTW to Hazelmere Dam (23 million m³/a) – Block Demand

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	179 192 817	210	0,85
8%	140 727 397	139	1,01
10%	113 539 795	96	1,18

11.7.6.2 Scenario 1A – URVs

Table 11-22: URV for KwaMashu WWTW to Hazelmere Dam (23 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	170 172 579	102	1,66
8%	134 073 542	60	2,25
10%	108 553 766	36	2,98

Table 11-23: URV for Northern to Inanda Dam (19.7 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand/m³
6%	204 689 151	171	1,20
8%	158 796 893	112	1,42
10%	126 913 237	76	1,67

Table 11-24: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	77 121 919	95	0,81
8%	60 720 893	63	0,96
10%	49 097 826	44	1,13

Table 11-25: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	41 932 864	48	0,86
8%	32 971 776	32	1,03
10%	26 633 981	22	1,20

11.7.6.3 Scenario 1B – URVs

Table 11-26: URV for KwaMashu WWTW to Hazelmere Dam (14 million m³/a) and Inanda Dam (9 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	204 483 488	166	1,23
8%	160 893 893	105	1,54
10%	130 063 410	69	1,88

Table 11-27: URV for Northern to Inanda Dam (19.7 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand/m³
6%	204 689 151	171	1,20
8%	158 796 893	112	1,42
10%	126 913 237	76	1,67

Table 11-28: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	77 121 919	95	0,81
8%	60 720 893	63	0,96
10%	49 097 826	44	1,13

Table 11-29: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	41 932 864	48	0,86
8%	32 971 776	32	1,03
10%	26 633 981	22	1,20

11.7.6.4 Scenario 2 - URVs

Table 11-30: URV for KwaMashu WWTW to Hazelmere Dam (10 million m³/a) and Inanda Dam (13 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	222 362 061	185	1,20
8%	174 377 384	119	1,46
10%	140 570 021	80	1,75

Table 11-31: URV for Northern to Inanda Dam (19.7 million m³/a)

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand/m³
6%	204 689 151	171	1,20
8%	158 796 893	112	1,42
10%	126 913 237	76	1,67

Table 11-32: URV for North Coast: Tongaat (2,9 million m³/a), Verulam (2,4 million m³/a) and Phoenix (5,1 million m³/a) to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	77 121 919	95	0,81
8%	60 720 893	63	0,96
10%	49 097 826	44	1,13

Table 11-33: URV for North Coast: Tongaat (2,9 Million m³/a) & Verulam (2,4 million m³/a) WWTW to Hazelmere Dam

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³/a	URV Rand /m³
6%	41 932 864	48	0,86
8%	32 971 776	32	1,03
10%	26 633 981	22	1,20

12 SCENARIO ANALYSIS

12.1 INTRODUCTION & BACKGROUND

All development Options identified during the investigation was utilised in the scenario analysis. The following scenarios were investigated and used in the economic analysis. This was done in cross-reference to the development of the Reconciliation Strategy and background to the motivation for each scenario is contained in that report. The economic impact of including and excluding the re-use of water from the Phoenix WWTW, was also studied.

Table 12-1: Development Scenario 1A

Description	Implementation Date	Max Yield From Option Utilised (million m³/a)
Lower Thukela Option	2012	27,8
North Coast: Tongaat WWTW to Hazelmere Dam	2012	2,9
Verulam WWTW to Hazelmere Dam	2012	2,4
Phoenix WWTW to Hazelmere Dam	2012	5,1
KwaMashu WWTW to Hazelmere Dam	2012	23,0
Spring Grove Dam	2012	60,0
Northern WWTW to Inanda Dam	2017	19,7
Smithfield Dam	2020	147,0

Table 12-2: Development Scenario 1B

Description	Implementation Date	Max Yield From Option Utilised (million m²/a)
Lower Thukela Option	2012	36,8
North Coast: Tongaat WWTW to Hazelmere Dam	2012	2,9
Verulam WWTW to Hazelmere Dam	2012	2,4
Phoenix WWTW to Hazelmere Dam	2012	5,1
KwaMashu WWTW to Hazelmere Dam	2012	14,0
KwaMashu WWTW to Inanda Dam	2017	9,0
Spring Grove Dam	2012	60,0
Northern WWTW to Inanda Dam	2018	19,7
Smithfield Dam	2021	147,0

Table 12-3: Development Scenario 2

Description	Implementation Date	Max Yield From Option Utilised (million m²/a)
North Coast: Tongaat WWTW to Hazelmere Dam	2012	2,9
Verulam WWTW to Hazelmere Dam	2012	2,4
Phoenix WWTW to Hazelmere Dam	2012	5,1
KwaMashu WWTW to Hazelmere Dam	2012	10,0
KwaMashu WWTW to Inanda Dam	2017	13,0
Spring Grove Dam	2012	60,0
Northern WWTW to Inanda Dam	2019	19,7
Smithfield Dam	2021	147,0

12.2 DEMANDS & FLOWS

Flows for each of the options were calculated and used in the economic analyses as indicated in **Appendix D.7**.

12.3 COSTING

All cost streams, including capital, operation and maintenance costs can be seen in **Appendix D.7**.

12.3.1 Cash flow of capital expenditure

The capital expenditure of the various components of the scenarios have been based on time required for their construction and the dates by which they need to be completed in order to ensure that the required quantities of water can be delivered to the system.

12.3.2 Net present cost

The net present cost calculations are detailed in **Appendix D.7** and summarised in the following tables. The economic life of all the components was taken as 45 years.

Table 12-4 Summary of NPVs (ZAR) for Scenario 1 – INCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 743 494 393	517 566 802	3 260 971 195
8%	2 384 458 050	355 049 907	2 739 507 957
10%	2 082 460 391	254 283 054	2 336 743 445

Table 12-5 Summary of NPVs (ZAR) for Scenario 1A – EXCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 712 477 562	509 482 768	3 221 960 330
8%	2 355 436 453	349 172 971	2 704 609 424
10%	2 055 176 435	249 834 806	2 305 011 241

Table 12-6 Summary of NPVs (ZAR) for Scenario 1B – INCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 642 588 775	521 003 369	3 163 592 144
8%	2 274 385 245	354 574 130	2 628 959 375
10%	1 968 636 299	251 996 180	2 220 632 479

Table 12-7 Summary of NPVs (ZAR) for Scenario 1B – EXCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 611 661 943	512 919 335	3 124 581 278
8%	2 245 363 649	348 697 194	2 594 060 843
10%	1 941 352 343	247 547 931	2 188 900 275

Table 12-8 Summary of NPVs (ZAR) for Scenario 2 – INCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 897 615 776	525 096 639	3 422 712 415
8%	2 466 648 935	350 035 389	2 816 684 325
10%	2 107 501 614	243 245 549	2 350 747 163

Table 12-9 Summary of NPVs (ZAR) for Scenario 2 – EXCLUDING Phoenix WWTW

Discount Rate (%)	Capital	O&M	TOTAL
6%	2 866 688 944	517 012 605	3 383 701 549
8%	2 437 627 339	344 158 453	2 781 785 792
10%	2 080 217 658	238 797 301	2 319 014 958

12.3.3 Unit Reference Value

The unit reference value of water has been determined for discount rates of 6%, 8% and 10% and is based on water transferred for a 45 year period. The results for the scenarios are shown in the following tables:

Table 12-10 Unit Reference Values for Scenario 1A – INCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m^3	URV Rands/m^3
6%	3 260 971 195	1987	1,64
8%	2 739 507 957	1317	1,08
10%	2 336 743 445	917	2,55

Table 12-11 Unit Reference Values for Scenario 1A – EXCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	3 221 960 330	1924	1,67
8%	2 704 609 424	1272	2,13
10%	2 305 011 241	882	2,61

Table 12-12 Unit Reference Values for Scenario 1B – INCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	3 163 592 144	2012	1,57
8%	2 628 959 357	1332	1,97
10%	2 220 632 479	926	2,40

Table 12-13 Unit Reference Values for Scenario 1B – EXCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	3 124 581 278	1949	1,60
8%	2 594 060 843	1287	2,02
10%	2 188 900 275	892	2,45

Table 12-14 Unit Reference Values for Scenario 2 – INCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	**3 422 712 415**	2011	1,70
8%	**2 816 684 325**	1319	2,14
10%	**2 350 747 163**	907	2,59

Table 12-15 Unit Reference Values for Scenario 2 – EXCLUDING Phoenix WWTW

Discount Rate (%)	Net Present Costs (Rand)	Demand million m³	URV Rands/m³
6%	3 383 701 549	1949	1,74
8%	2 781 785 792	1273	2,18
10%	2 319 014 958	872	2,66

13 INSTITUTIONAL ARRANGEMENTS & TARIFF STRUCTURES

The following is a brief summary of information currently at hand.

13.1 INSTITUTIONAL ARRANGEMENTS

The following institutions are established in the study area.

13.1.1 Water services authorities (WSAs)

In terms of the Water Services Act 1997 and related government notices, the following municipalities are water services authorities in the study area, and are responsible for the planning and management of water services (water supply, sanitation and waste water services):

- eThekwini Municipality
- Ilembe District Municipality

- uMgungundlovu District Municipality
- Msunduzi Municipality
- uMzinyathi District Municipality

13.1.2 Catchment Management Agencies (CMAs)

In terms of the National Water Act 1998 and related government notices, the following catchment management agencies have been established to manage the water resources within the study area:

- Mvoti-Mzimkulu Catchment Management Agency (draft establishment in May 2005)
- Thukela Catchment Management Agency (established in September 2006)

The former CMA is yet to be formally established (only a draft establishment Government notice has been issued). The Thukela CMA is not operational as yet, as its governing board is in the process of being formed. The Regional Office of the Dept. of Water Affairs & Forestry therefor serves as de facto CMA over the interim.

13.1.3 Water Services Providers (WSPs)

- Umgeni Water, a statutory water board serving as bulk water supplier to the mentioned water services authorities.
- Siza Water, is the result of a public-private partnership with a 30-year concession between the French Saur Group and the Ilembe District Municipality to provide water services to the greater Ballito area.
- Water and Sanitation Services Africa (WSSA) is a private company that has agreements with various water services authorities to operate and maintain certain water services installations, such as WTWs and WWTWs and bulk reticulation systems.

13.1.4 Other institutional work yet to be researched and reported on

- Institutional: Determine the current arrangements re water services authorities and water services providers, as well as the status of the “Section 78” assessments (“s78 reports” - in terms of the Local Government: Municipal Systems Act 2000).

- Assess the impact that recommendations arising from completed s78 reports would have on the affected institutions and water services tariff structures.
- Determine the potential impact that the results of incomplete s78 reports would have on the affected institutions and water services tariff structures.
- Determine what effect the recommended infrastructure developments would have on the results of the s78 reports and water services tariff structures.
- Implementation of alternative institutional arrangements (DWAF staff transfers; concessions; greater use of water boards; privatization; establishment of regional water utilities etc.)

13.2 WATER SERVICES TARIFF STRUCTURES

The water tariff structures used throughout the study area need to be researched and reported on. This will entail summarising existing tariff structures (irrigation water, untreated water, treated water, treated sewerage) and determine whether there are any impending adjustment of these.

14 CONCLUSIONS

The objectives of the Reconciliation Study are to identify, evaluate and prioritize interventions to reconcile the water requirements with the available water resource up to the year 2030.

14.1 The following table is a summary of the economic analyses of the scenarios investigated at a discount rate of 8%, excluding the re-use water from Phoenix WWTW.

Table 14-1 Summary: Results of Scenario Economic Analyses

Description	Capital Cost (Rand)	O & M (Rand)	Total Cost (Rand)	URV R/m³
Scenario 1A	2 355 436 453	349 172 971	2 704 609 424	2,13
Scenario 1B	2 245 363 649	348 697 194	2 594 060 843	2,02
Scenario 2	2 437 627 339	344 158 453	2 781 785 792	2,18

From an engineering economic viewpoint it can be seen from the summary that Scenario 1B is preferred. When making the final decision, other aspects such as social and environmental issues must also be considered.

It should be noted that the purpose of the study was to identify and prioritise possible options. This was done through rough cost estimates to support the decisions that must be further investigated to ensure that the assumptions made are valid.

14.2 Waste water re-use needs to be studied in further detail as it has comparable URVs and development time frames which can synchronise with that of the development of water resources in cells. Further to this, there is the obvious saving in the use of fresh water.

14.3 There are a number of risks common to all of the identified development options:

a) Resource shortages:

The studies, design and construction of the various water supply projects will be running concurrent to other major infrastructure projects in South Africa (Gautrain, Eskom's expansion program, Dube Trade Port, soccer stadium for Soccer 2010, etc.). This has already led to shortages in skills and materials and could delay the delivery of water if not proactively dealt with.

b) Implementation of the environmental reserve:

It is assumed that the environmental reserves for the affected rivers will be determined concurrently with the planning and design of the various projects. The practical implementation of these reserves is a contentious issue – as yet to be resolved by the DWA&F. The uncertainty caused by the delayed implementation of the environmental reserve is carried through to the yield of proposed schemes, and their viability.

c) Delayed decision making:

Authority approvals are required throughout all stages of the projects, and are affected by role-player involvement processes and the budgetary allocations. Delayed project approvals, if not well-managed, could impact negatively on project delivery dates.

15 RECOMMENDATIONS

The following activities are recommended for further action. These are discussed in greater detail elsewhere and are listed here for summary purposes.

15.1 From an engineering economic viewpoint, Scenario 1B appears to be the most favourable. The various development options that make up this Scenario, thus need to be scrutinised and investigated to a higher level of detail before a final decision is made concerning the implementation of the proposed strategy.

15.2 Commence with the raising of Hazelmere Dam and associated upgrade of the Hazelmere WTW.

15.3 Finality on the implementation of the Mdloti River ecological reserve.

15.4 Commence construction of the Spring Grove Dam and associated works.

15.5 Conduct studies to compare the viability of the isiThundu and the Welverdient Dams, also considering conveying water from the lower Thukela River.

15.6 The construction of a gauging weir in the middle to lower Mvoti River.

15.7 Mvoti River: Commence with the comprehensive determination of the environmental reserve.

15.8 Mkomazi River: Commence with the comprehensive determination of the environmental reserve.

15.9 Arrive at a common approach of developing the proposed “Ngcebo 3” scheme (driven by the AmaZulu World development), in combination with the Lower Thukela scheme.

16 ACKNOWLEDGEMENTS

Appreciation is expressed to the following people for sharing information, their time and knowledge, and giving guidance to the Infrastructure Team:

Umgeni Water:	Steve Gillham Kevin Meier Dave Stephen Mark Bremner
eThekwini Water & Sanitation:	Bill Pfaff Speedy Moodliar
Dept. of Water Affairs & Forestry:	James Perkins Norman Ward Johann Geringer Kobus Bester
SAPPI SAICCOR:	Gary Bowles David Airy
Ilembe District Municipality:	Jogie Naidoo
Ugu District Municipality:	Sli Hadebe Danny Govender Maxwell Pawandiwa Paul Watson Noncedo Gidimisane
Msunduzi Local Municipality:	Mike Greatwood Jutta Dedekind
uMhlathuze Municipality	Frik Bosman
Mhlathuze Water:	Lawrence Sithole Gary Maistry Vic Botes Morton du Preez Phil Berridge
Mbona Saunders & Wium:	Frans Klopper Don Hodgkinson

Bigen Africa:	Thinus Potgieter
Stemele Bosch Africa:	Mohammed Vawda
Ninham Shand:	Duncan Shaw
UWP Consulting:	Sandra Munnik
Jeffares Green Consultants:	Roshan Roopchund

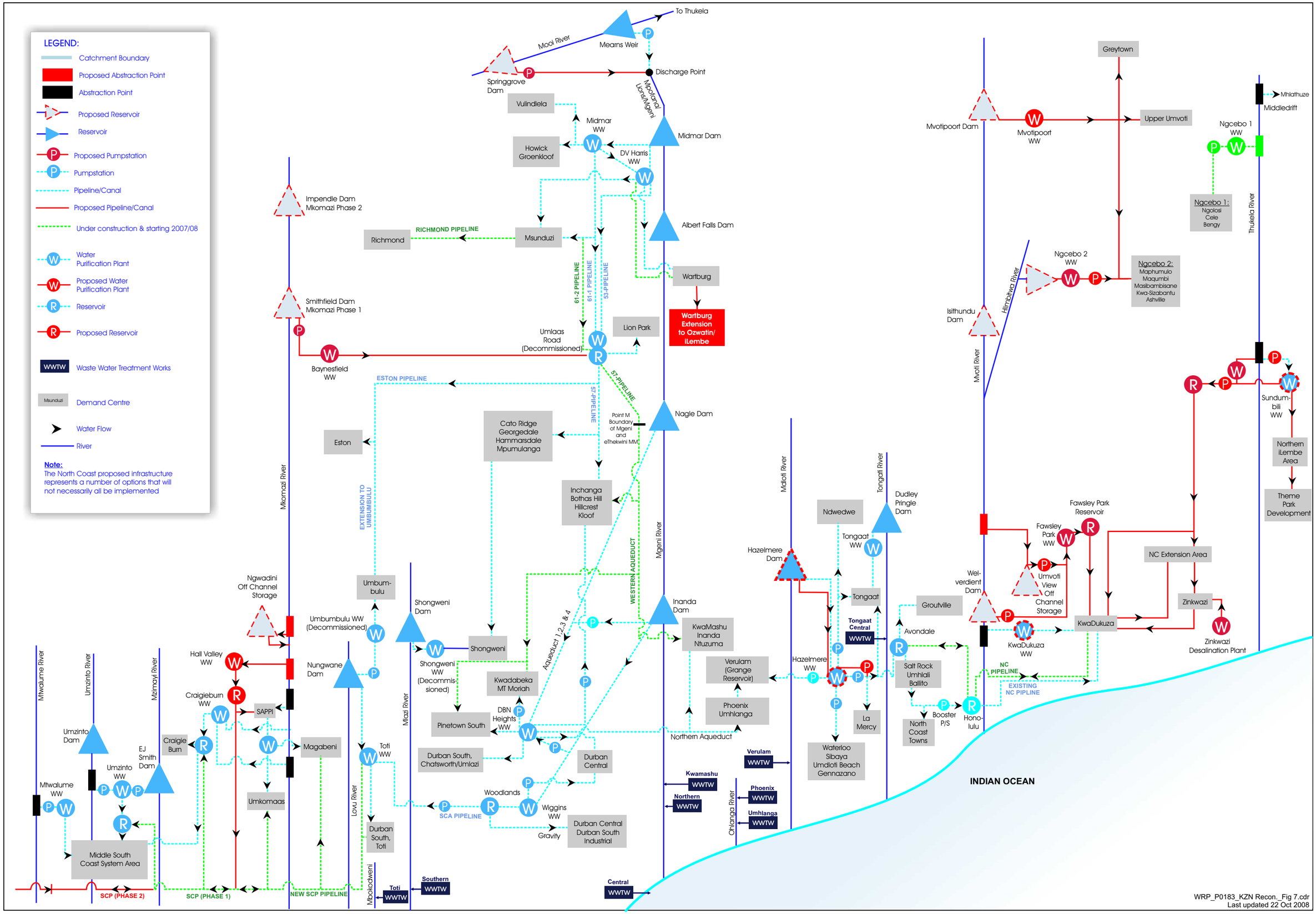
Appendix A

Infrastructure: Drawings

Appendix A.1

Schematic Layout:

Existing & Planned Infrastructure



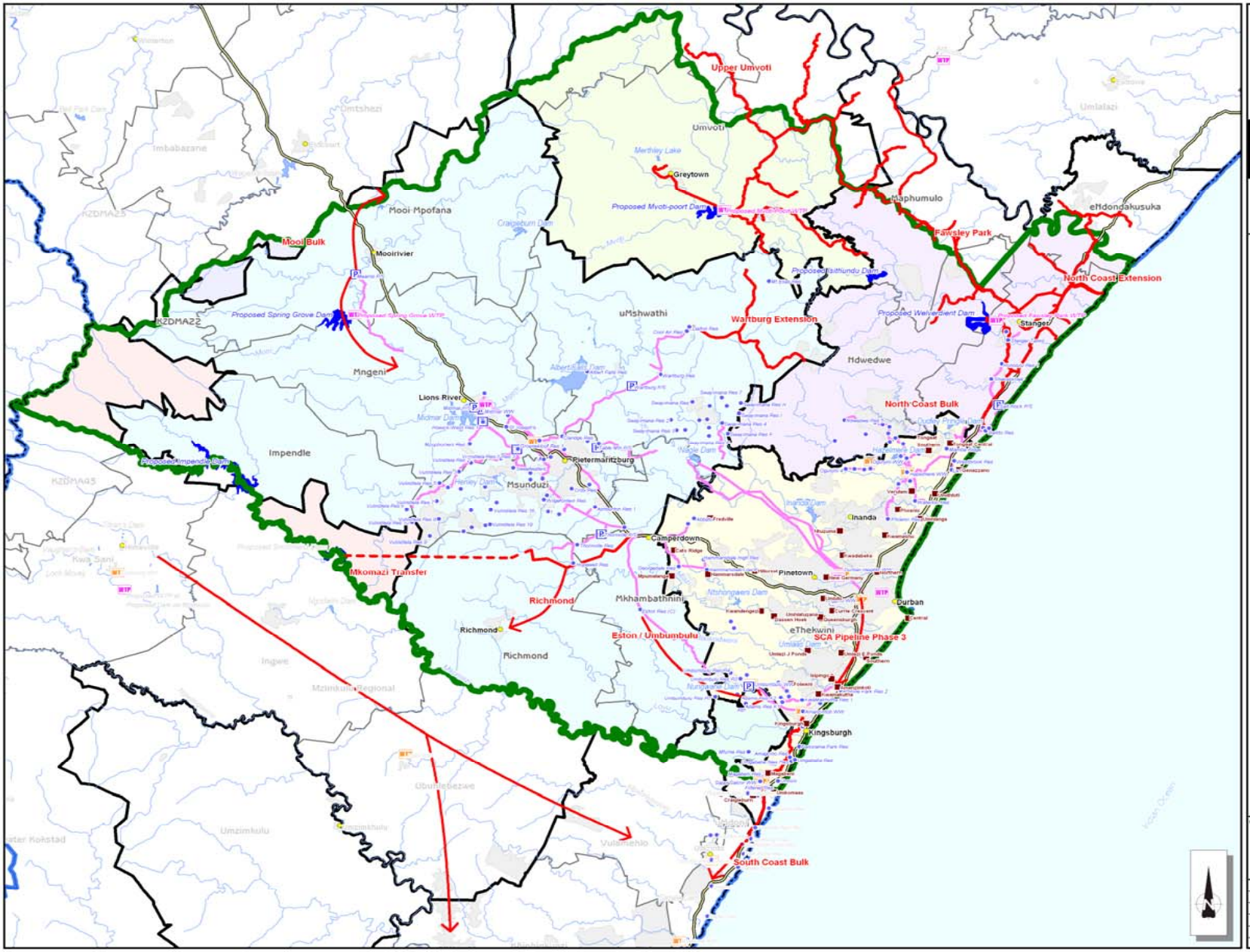
WRP_P0183_KZN Recon._Fig 7.cdr
Last updated 22 Oct 2008

Appendix A.2

Spatial Layout:

Existing & Planned Infrastructure

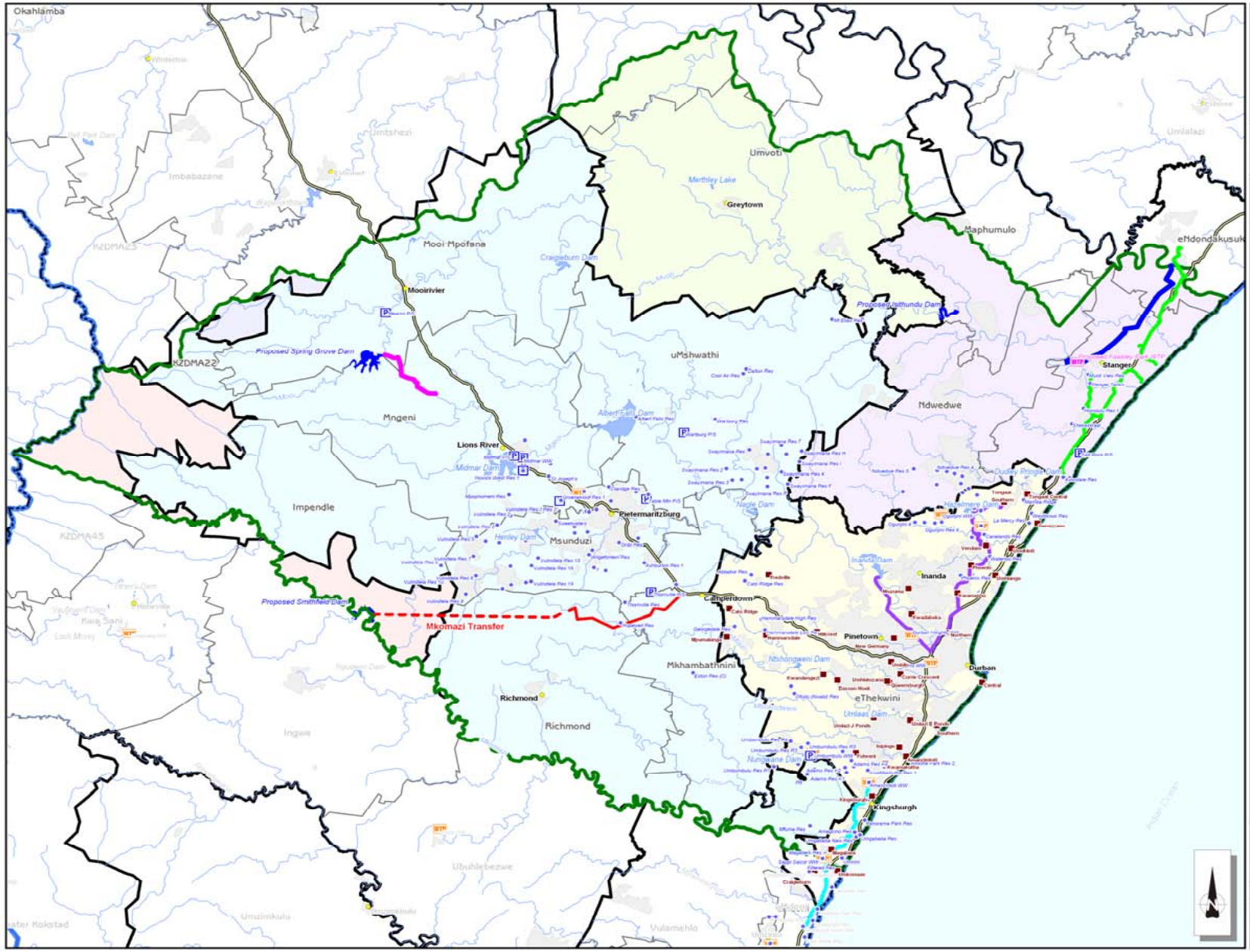
(with acknowledgement to Umgeni Water)


Upper Umvoti
Umvoti
Greytown
Merthley Lake
Proposed Mvoti-poort Dam
Maphumulo
eMdondakusuka
Mooi Mpofana
Craigieburn Dam
Mooi Bulk
Mooirivier
Fawsley Park
North Coast Extension
Proposed Spring Grove Dam
KZDMA22
uMshwathi
Wartburg Extension
Proposed Welverdient Dam
Stanger
Hdwedwe
Mngeni
Lions River
North Coast Bulk
Impendle
Pietermaritzburg
Msunduzi
Inanda
Camperdown
Mkomazi Transfer
Richmond
Pinetown
Durban
Mkhambathini
eThekwini
Eston / Umbumbulu
SCA Pipeline Phase 3
Kingsburgh
South Coast Bulk
Water Reconciliation Strategy Study for the Kwazulu Natal Coastal Metropolitan Areas
PROPOSED & EXISTING BULK INFRASTRUCTURE
LEGEND
Provincial Boundary
District Municipality
Local Municipality
Built-up Areas
Existing Dams
Proposed Dams
New Study Area
Rivers
District Municipalites
Alfred Nzo
eThekwini Metropolitan
King Shaka
Sisonke
Ugu
Umgungundlovu
Umkhanyakude
Umzinyathi
Uthukela
uThungulu
Existing Water Installations
Reservoirs
Pump Stations
Water Works
Proposed Water Treatment Works
Existing Bulk Infrastructure
Proposed Bulk Infrastructure
Proposed Tunnel
National Roads
Waste Water Treatment Works
CLIENT:
DEPARTMENT: WATER AFFAIRS AND FORESTRY
Drawn: S.Schwabe
Date: November 2007
Project: 219290 KZN WRSS
File: 0711_EntitProp Infra_A0L.wor
Projection: Lat/Long (WGS84)
Scale: 1:700 000 (approx)

Appendix A.3

Spatial Layout:

Development Options



Water Reconciliation Strategy Study for the Kwazulu Natal Coastal Metropolitan Areas

PROPOSED DEVELOPMENT OPTIONS

LEGEND

- Provincial Boundary
- District Municipality
- Local Municipality
- Built-up Areas
- Existing Dams
- Proposed Dams
- Study Area

River

- Perennial
- National Road

Existing Water Installations

- Reservoirs
- Pump Stations
- Water Works

- Waste Water Treatment Works
- Proposed Tunnel (Smithfield)
- Re-Use Pipeline
- Proposed Pipeline (Tugela)
- Proposed Pipeline (Umvoti Extraction)
- Proposed Pipeline (Spring Grove)
- Proposed Pipeline (Smithfield)
- South Coast Pipeline
- North Coast Pipeline

CLIENT

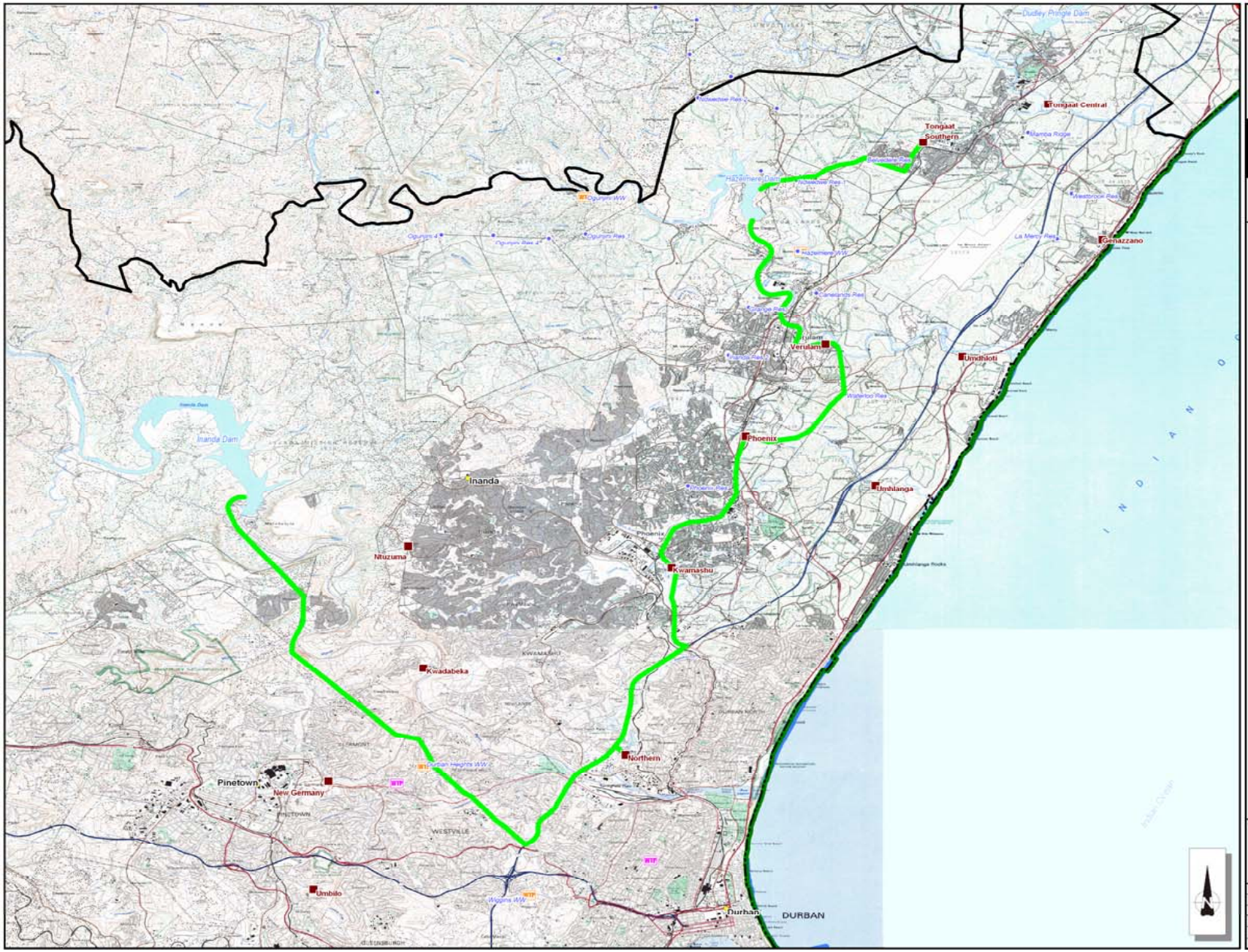
DEPARTMENT: WATER AFFAIRS AND FORESTRY

Drawn	S.Schwabe
Date	February 2008
Project	219290 KZN WRSS
File	0802_PropDevOptions_A0L.wor
Projection	Lat/Long (WGS84)
Scale	1:650 000 (approx)

Appendix A.4

Spatial Layout:

Waste Water Re-use Options



in association with KWEZI V3 ENGINEERS

Water Reconciliation Strategy Study for the Kwazulu Natal Coastal Metropolitan Areas

SEWAGE RE-USE OPTIONS

LEGEND

- Provincial Boundary
- District Municipality
- Local Municipality
- New Study Area

Existing Water Installations

- Reservoirs
- Pump Stations
- Water Works

- Proposed Water Treatment Works
- Waste Water Treatment Works
- Proposed Pipeline (Inanda)

CLIENT

DEPARTMENT: WATER AFFAIRS AND FORESTRY

Drawn	S.Schwabe
Date	February 2008
Project	219290 KZN WRSS
File	0802_SewageRe-use_A0L.wor
Projection	Lat/Long (WGS84)
Scale	1:100 000 (approx)

Appendix B

Details of Intervention Possibilities

Table B-1: INTERVENTION POSSIBILITIES – SOUTH COAST

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
B-1/1	**SOUTH COAST PIPELINE (SCP)**	Infrastructure Master Plan	2004	First phase is a pipeline from Amanzimtoti to Park Rynie with a capacity of 65 Ml/day (24 million m^3/annum). Possible further extension of the pipeline to Hibberdene is planned to serve the middle South Coast. The SCP Ph 1 is designed to cater for bi-directional flow.
	Reconciliation Study Assessments			**Comments:**
	Pipe line has Wiggins WTW as source and thus adds to stress on Mgeni system.			This is, strictly speaking, not an augmentation pipeline (in the sense of adding yield to the resource), and was therefor not evaluated economically. However, the Mgeni system (via the Wiggins WTW) is its current source.
B-1/2	**NGWADINI OFF-CHANNEL STORAGE DAM AND TRANSFER SCHEME, MKOMAZI RIVER**	Various planning studies	Latest study 2005 (SAPPI SAICCOR)	Purpose is to establish a sustainable source for the SCP, thus relieving the demand on the Mgeni System (via Wiggins WTW). Abstraction from the Mkomazi River and transferred to proposed Ngwadini off-channel storage dam. Water to be treated at new Hull Valley WTW and linked to SAPPI SAICCOR and the South Coast Pipeline.
	Reconciliation Study Assessments			**Comments:**
	Once further studies on the development of Mkomazi River have been conducted, the possible use of this facility and other abstraction options in lower parts of river, will be assessed.			Target supply area could include Ugu DM, Southern eThekwini and SAPPI/SAICCOR. The proposed dam site should be used for the benefit of the users in the supply area. Discussion with SAPPI and Umgeni Water indicated that SAPPI SAICCOR's detailed design and environmental approval, is in advanced stage. Construction probably starting in 2008. Dam will supply in needs of only SAPPI.

Table B-1: INTERVENTION POSSIBILITIES – SOUTH COAST

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
B-1/3	**TREATED WASTEWATER SUPPLY TO SAPPI/SAICCOR, UMKOMAAS**	Concept	2006	Exchange freshwater supply to SAPPI/SAICCOR with treated wastewater and in turn supply the Ugu DM with the fresh water.
	Reconciliation Study Assessments			**Comments:**
	Recognisance level assessment. First determine if SAPPI/SAICCOR can use the treated wastewater.			Not considered as an option re the Recon study: Raw water quality is of prime importance to paper mills. The quality of treated wastewater and the acceptability thereof first needs to be confirmed by SAPPI prior to doing any further work on supply options. This is not possible within the time limits of this study.
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features of the Option**
B-1/4	**MZIMKULU OFF-CHANNEL STORAGE & LINK TO SCP**	Pre-feasibility study of Mzimkulu off-channel storage.	Dec. 2007	Two viable off-channel storage sites identified on Mzimkulu River. Water to be to serve Port Shepstone and the lower south coast, and possibly northwards to Hibberdene. A 30km link between Park Rynie (terminating point of SCP Ph1) needs to be installed.
	Reconciliation Study Assessments			**Comments:**
	A pipeline of approximately 30km required to link Hibberdene with SCP at Park Rynie. System would have capacity for middle South Coast over the interim only.			Not considered as an option re the Recon study.

Table B-2: INTERVENTION POSSIBILITIES – MGENI SYSTEM

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
B-2/1	**MOOI-MGENI TRANSFER SCHEME PHASES 2a AND 2b**	Feasibility Study	Various, the latest being 2004.	Phase 2a: Construction of Spring Grove Dam, Additional gravity main – 600 mm Ø, Second outlet on Mpofana River. Phase 2b: 4.5 m³/s pump station at Spring Grove Dam and new rising main – 1400 Ø.
	Reconciliation Study Assessments			**Comments:**
	Cost estimates escalated and URVs recalculated. Implementation programme updated.			Recent water balance projections of the Mgeni River System indicate that augmentation is required and it was decided that Phases 2a and 2b of the Mooi-Mgeni Transfer scheme be implemented. Considered in further detail in the Recon study as a DEVELOPMENT OPTION, due to implementation delays.
No.	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-2/2	**MKOMAZI-MGENI TRANSFER SCHEME**	Pre-feasibility Study	May 1999	The construction of Smithfield Dam (137 million m^3), tunnel and WTW, from where treated water will be pumped to the reservoirs at Umlaas Road. The second phase provides for the construction of a dam at Impendle (5 different sizes).
	Reconciliation Study Assessments			**Comments:**
	Use existing engineering data, assess scheme layout in context of bulk infrastructure planning, escalate costs, update implementation programme and recalculate Unit Reference Values. Umgeni Water and DWA&F due to start with feasibility studies in 2008/9.			Cost estimates escalated and URVs recalculated. Implementation programme updated. Considered in further detail in the Recon study as a DEVELOPMENT OPTION.

Table B-2: INTERVENTION POSSIBILITIES – MGENI SYSTEM

No.	Name of option	Level of Assessment	Date of Assessment	Key Features
B-2/3	**RECYCLING OF DARVILL SEWAGE EFFLUENT**	Reconnaissance level.	October 2006	Reuse of 60 Ml/d, Treat to potable standards, Located relatively close to Umgeni Water supply infrastructure.
	Reconciliation Study Assessments			**Comments:**
	Included in the strategies to determine the impact on system yield of recycling and to put the additional treatment costs in perspective.			Public perceptions are an issue with direct recycling. These will have to be brought into consideration if this option is found to be technically and economically attractive. The waste water from Darvill flows into Inanda Dam and is therefore already indirectly used. Indirectly considered in the Recon study by testing the concept of water re-use for the North Coast.
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-2/4	**RE-USE FROM HAMMERSDALE WWTW**	Concept identified by eThekwini MM	2006	Conveyance infrastructure, secondary treatment and infrastructure to divert more domestic effluent to Hammersdale. *Purpose*: Use treated wastewater to supply industries.
	Reconciliation Study Assessments			**Comments:**
	Reconnaissance level investigations.			Additional domestic effluent need to be diverted to Hammersdale in order for the options to be feasible. Indirectly considered in the Recon study by testing the concept of water re-use for the North Coast.

Table B-2: INTERVENTION POSSIBILITIES – MGENI SYSTEM

B-2/5	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
	WESTERN AQUADUCT	Feasibility studies, no reports. Detailed design has commenced.	2007	Installation of additional pipeline between Umlaas Road reservoir and Ntuzuma to relieve stress on Northern Aquaduct. Implies upgrading of supply systems upstream of Umlaas Road.
	Reconciliation Study Assessments			**Comments:**
	Internal reorganisation of water distribution systems.			Not considered further in Recon study (does not result in additional yield).
B-2/6	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
	DESALINATION OF SEA WATER	Pre-feasibility study.	2008	Umgeni Water has commenced with a study to compare the cost and feasibility of desalinating sea water for the metropolitan areas in volumes similar to the yield of the proposed Smithfield Dam on the Mkomazi River.
	Reconciliation Study Assessments			**Comments:**
	The study is underway, with results expected in 2009. Preliminary desktop planning & 1ste order cost estimates calculated and URVs determined.			Considered in further detail in the Recon study as a DEVELOPMENT OPTION.

Table B-3: INTERVENTION POSSIBILITIES – NORTH COAST

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
B-3/1	**RAISING OF HAZELMERE DAM**	Feasibility study	Sept. 2003	7m dam wall raising required to increase capacity from $24x10^6$ m^3 to $44x10^6$ m^3 (1975 'virgin' conditions). Sedimentation projections indicate that the effect of raising would result in the 2015 storage being $28x10^6$ m^3, with a 99,5% assured yield of 29 million m^3/a. Recommended that raising be done by means of radial gates at cost of R11 million (March 2000 prices). Upgrading of the treatment works and conveyance infrastructure also form part of the options. Construction due in 2008/9.
	Reconciliation Study Assessments			**Comments:**
	Review of cost estimates, update the implementation programme, determine and implementation programme for the Ecological Water Requirements and revise the projected water balance.			The decision has been taken to proceed with implementing the raising of the dam, as it is key to augmenting the supplies of the area over the medium term. Immediate implementation of the ecological reserve will negate additional yield brought about by dam raising. Not considered further in Recon study - implementation a fact.
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/2	**RE-USE OF TREATED WASTEWATER**	Concept	2006	Various concepts of reuse schemes have been identified: Reuse by Industries, direct purification to potable quality and feed into supply system, transfer of treated effluent into Hazelmere Dam for indirect reuse and exchange of fresh water supply for irrigation with treated wastewater.
	Reconciliation Study Assessments			**Comments:**
	Reconnaissance level investigation of alternative reuse options. In addition to enhancing maximising the use of water, also protecting some estuaries against excess water supplies.			Preliminary desktop planning & 1ste order cost estimates calculated and URVs determined. Implementation programme updated. Considered in further detail in the Recon study as a DEVELOPMENT OPTION.

Table B-3: INTERVENTION POSSIBILITIES – NORTH COAST

B-3/3	**ZINKWAZI DESALINATION**	Pre-feasibility study by Umgeni Water.	February 2005	Treat 1.5 Ml/d to supply the town of Zinkwazi. Water to be abstracted from the beach sand as the sand provides filtration. The URV for desalination is lower than the Thukela-Mandini transfer and the North Coast Supply System (Supply of potable water from Stanger) options.
	Reconciliation Study Assessments			**Comments:**
	This type of scheme should be considered as an option for the smaller coastal towns where extensive water supply infrastructure is required to connect to the Umgeni Water network.			Electricity supply constraints may limit the application of desalination as an augmentation option in certain areas. Not considered further in the Recon study.
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/4	**UPGRADE OF EXISTING MVOTI RIVER ABSTRACTION**	Feasibility Study (Geophysical & geotechnical report)	June 2005	The extension involves the installation of a river sand point abstraction system at the Stanger WTW that will add 6 Ml/day to the WTW abstraction volume. Ilembe DM not considering upgrading the capacity of the WTW at this stage.
	Reconciliation Study Assessments			**Comments:**
	Not to be addressed in any further detail.			This option will reduce the supply required from Hazelmere Dam and could over the long term be supported with releases from a large storage dam in the Mvoti River. Local development – not considered further in Recon study - the capacity of the WTW will remain at 10 Ml/d.

Table B-3: INTERVENTION POSSIBILITIES – NORTH COAST

No:	Name of option	Level of Assessment	Date of Assessment	Key Features
B-3/5	**MVOTI VIEW SCHEME**	Umgeni Water Pre-feasibility Study	April 1997	Abstraction of water is from the existing diversion weir on the Mvoti River and delivering via a tunnel to a proposed off channel storage dam on the other side of the mountain. Water is then pumped to a new water treatment plant at Fawsley Park for distribution to the surrounding areas, including KwaDukuza.
	Reconciliation Study Assessments			**Comments:**
	Not to be addressed in any further detail.			This option will reduce the supply required from Hazelmere Dam and could over the long term be supported with releases from a large storage dam in the Mvoti River. Not considered further in Recon study: Run-off river abstraction until isiThundu Dam is built (low assurance of supply); earlier studies on dams in the river to be reviewed and those results could affect viability of the Mvoti View scheme.
No.	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/6	**MVOTI RIVER DEVELOPMENT**	Feasibility Studies	1996 & 2000	The most feasible option for supply to the North Coast Supply Area that has been studied, is isiThundu Dam. Various changes since the original study begs the reconsideration of the Welverdient option.
	Reconciliation Study Assessments			**Comments:**
	Use existing information to escalate the costs, review the layout in context of option 2 above, review the hydrological database, review and if required update upstream water use and development, review status of Reserve estimations, update the programme and recalculate URVs. Linking this system to the (upgraded bi-directional flow) North Coast Pipeline provides the opportunity of optimally managing the Mdloti and Mvoti Rivers as water resources for the			Upstream abstractions and water resource developments could impact on the available water to this scheme. Uncertainties such as the hydrology and Reserve need to be clarified. . Considered in further detail in the Recon study as a DEVELOPMENT OPTION – the isiThundu Dam in conjunction with the development of the Mvoti View scheme.

Table B-3: INTERVENTION POSSIBILITIES – NORTH COAST

	area north of eThekwini.			
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/7	**MVOTIPOORT DAM**	Reconnaissance study.	1998	The construction of a dam in the upper reaches of the Mvoti River (near Greytown). Capacity: 34 million m^3 and yield (unconfirmed assurance) of 44 million m^3/a. Will over the long term be able to supply only the upper and middle Mvoti areas.
	Reconciliation Study Assessments			**Comments:**
	Not assessed in any further detail, as the dam's supply area is the rural areas in the inland parts of the Ilembe DM and does not have an advantage for the coastal metropolitan areas.			Long term viability for supply to the metropolitan areas is important, which this dam cannot give. Not considered as a viable Development Option.
No.	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/8	**NORTH COAST PIPELINE UPGRADE**	Umgeni Water Proposed Improvements to the North Coast Supply System	2006	Duplicate the Ballito-Honolulu-Stanger pipeline. The intention is to design the pipeline for bi-directional flow in order to be able to convey water from the Mvoti River scheme (see options 2 and 4 above) or Thukela (see option 3) to the North Coast Metropolitan Area over the long term.
	Reconciliation Study Assessments			**Comments:**
	This option may already be included in capital budgets of Umgeni Water and would therefore be considered as a given. The planning status will be assessed.			This is, strictly speaking, not an augmentation pipeline in the sense that it adds yield to the resource, and was therefor not evaluated economically. This option is strategically significant since it could alleviate the load on the Mgeni River system if the Mdloti River System could be used to supply larger portions of the northern area of eThekwini. Not considered further in Recon

Table B-3: INTERVENTION POSSIBILITIES – NORTH COAST

				study (implementation to take place in 2008/9).
No:	**Name of option**	**Level of Assessment**	**Date of Assessment**	**Key Features**
B-3/9	**MANDENI (LOWER THUKELA) TO KWADAKUZA/STANGER TRANSFER**	Feasibility study by Mhlathuze Water has commenced (existing planning report was not made available). Effect of the belated "Ngcebo 3" scheme.	2006 & Jul. 08	A river abstraction and de-siltation works at the Mandeni. Providing a link line to the Sundumbili water treatment plant, which is to be upgraded from 27 Ml/day to 90 Ml/day (9,85 million m^3/annum tot 32,85 million m^3/annum). High lift (Mandeni) and booster (Stanger) pump stations. Rising main at Mandeni and Stanger and gravity mains between Mandeni & Stanger. Reservoir at New Guelderland (7 Ml). Ngcebo 3 scheme: refer to text in report.
	Reconciliation Study Assessments			**Comments:**
	Use existing information to calculate URVs and update the implementation programme. Need to consider allocation to Mhlathuze Water for future augmentation of Mhlathuze system.			Use of non-allocated water. Ilembe DM initially discarded MW's proposal, but is now reconsidering it. Considered in further detail in the Recon study as a DEVELOPMENT OPTION.

Appendix C

Intervention Time Frames

INTERVENTION PROGRAMMES	Pre-Feasibility (Years)				Feasibility (Years)					Construction / Implementation (Years)							Zero Yield at Start (Years)				Due dates if 01 Jul 2008			
	Maximum		Max Time		Maximum		Concurrent			Maximum			Concurrent					Warm up / First Filling		Minimum Time to Develop Yield (Fastracked)		Maximum Time to develop Yield		Closest delivery date to develop yield (Fastracked)		Latest delivery date to develop yield	
Scheme	Lag Time		TOR/Appoint Consultant	Pre-feasibility	Lag Time		TOR/Appoint Consultant	Feasibility Study/EIA	DWAF Reserve Determination	TOTAL DURATION OF CONCURRENT ACTIVITIES	Lag Time		TOR/Appoint Consultant	DWAF Licensing Process	DAEA&DP Approval Process	Design/Tender Prepar. & Award	TOTAL DURATION OF CONCURRENT ACTIVITIES	Construct/ Implement/ Council Bylaw								
	Decision	Budget year			Decision	Budget year		Overlap included. Only nett addtnl time.			Decision	Budget year		Overlap included. Only nett addtnl time.					Start	End	Start	End	Start	End	Start	End
Mooi-Mgeni Transfer Scheme Ph2										-	0,25	1,00	0,25	-	-	1,33	**1,33**	2,50	-	1,00	4,33	5,33	5,08	6,08	Oct 2012	Oct 2013	Jul 2013	Dec 2014
Mkomazi-Mgeni Transfer Scheme Ph1					0,50	1,00	0,25	1,50	0,50	**2,00**	0,50	1,00	0,25	1,50	-	1,50	**3,00**	3,00		1,00	9,50	10,50	10,50	11,50	Dec 2017	Dec 2018	Dec 2018	Dec 2019
Isithundu Dam (Mvoti)					0,50	1,00	0,25	1,50	0,50	**2,00**	0,50	1,00	0,25	1,00	0,50	1,50	**3,00**	2,50		1,00	9,00	10,00	10,00	11,00	Jul 2017	Jul 2018	Jul 2018	Jul 2019
Desalination of sea water	0,50	1,00	0,25	0,50	0,25	1,00	0,25	1,00	-	**1,00**	0,25	1,00	0,25	-	0,50	1,00	**1,50**	1,50		-	5,00	5,00	8,25	8,25	Jul 2013	Jul 2013	Sep 2016	Sep 2016
Lower Thukela	0,50	1,00	0,25	0,50	0,25	1,00	0,25	0,50	0,50	**1,00**	0,25	1,00	0,25	0,50	0,50	0,50	**1,50**	1,50	-	-	5,00	5,00	8,25	8,25	Jul 2013	Jul 2013	Sep 2016	Sep 2016
Waste water re-use	0,50	1,00	0,25	0,50	0,25	1,00	0,25	1,00	-	**1,00**	0,25	1,00	0,25	1,00	0,50	0,50	**2,00**	1,50		-	5,50	5,50	8,75	8,75	Dec 2013	Dec 2013	Mar 2017	Mar 2017

Appendix D

Cost, NPV and URV Calculation Sheets

Appendix D.1

Economic Analyses:

Mooi-Mgeni Transfer Scheme Phase 2

Component	Type	Name	Characteristics		Total Capital Cost		Total Capital Cost	
					April 2001		Sept 2007	
Outlet Structure	concrete	Mpofana Outlet Structure	**No**	**1**	R	3,091,000	R	4,883,780
Pipelines			**Dia**	**Length**				
		New Gravity Pipe Line	600	7.875km	R	5,274,000	R	8,332,920
		Existing pipelines Gravity & Rising mains	1400/900	21.025km	R	4,931,000	R	7,790,980
		New Rising Main	1400mm	6.18km	R	29,742,000	R	46,992,360
			FSL					
Dam	Earth fill	Springrove Dam	1433.5m		R	99,655,000	R	157,454,900
Dam - Fish Barrier	Concrete	Fish Barrier			R	4,959,000	R	7,835,220
New Pumpstation		Spring Grove Dam Pump station	**Cap**	4.5m³/s	R	23,909,000	R	37,776,220
Break Pressure Tank		Nottingham Road Break Pressure Tank			R	3,150,000	R	4,977,000
Advance infrastructure		Relocate Existing Infrastructure			R	4,450,000	R	7,031,000
Sub-Total					**R**	**179,161,000**	**R**	**283,074,380**
Engineering Fees	12%						**R**	**33,968,926**
Land Acquisitions and relocations							**R**	**36,355,800**
Social and Environmental	Sum						**R**	**4,005,300**
Sub-Total							**R**	**357,404,406**
VAT	14%						**R**	**50,036,617**
Total							**R**	**407,441,022**

Spring Grove Pump Station

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SPRING GROVE SCHEME
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	4.500	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	6.00	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	4.500	
Peak factor	1.04			
Average head pumped		m	73.30	**73.30**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	3.8	**3.8**
power absorbed at Qd: (Pd / Pf)		MVA	3.9	**3.9**
		MVAh	94.1	**94.1**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	5.2	**5.2**
head pumped (Hd)		m	73.30	**73.3**
Energy consumed over 24 hours (continuous use)	24	MWh	90.3	**90**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	6,230,184.84	**R**	**6,230,184.84**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	627,379.61	**R**	**627,379.61**
Transmission surcharge (< 300 km)	%		1.00%	R	62,301.85	**R**	**62,301.85**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	470,977.95	**R**	**470,977.95**
Network Charge	R/MVA	R	6,340.00	R	33,135.37	**R**	**33,135.37**
Total annual cost				**R**	**7,436,827.62**	**R**	**7,436,827.62**

Spring Grove Pump Station

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SPRING GROVE SCHEME
DATE: NOV 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	1.500	m3/s	Pump Station Capacity
Total flow	4.500	m3/s	136.08 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	1.39	4	3	5	361,688	45,983	27,342	630,996	1,066,010
2	2018	2.61	4	3	10	677,592	45,983	51,223	634,156	1,408,954
3	2019	4.22	4	3	16	1,094,220	45,983	82,719	638,322	1,861,244
4	2020	6.10	4	3	23	1,584,100	45,983	119,752	643,221	2,393,056
5	2021	7.28	4	3	27	1,890,848	45,983	142,941	646,288	2,726,061
6	2022	8.48	4	3	32	2,202,174	45,983	166,476	649,401	3,064,035
7	2023	9.66	4	3	36	2,508,922	45,983	189,665	652,469	3,397,039
8	2024	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
9	2025	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
10	2026	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
11	2027	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
12	2028	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
13	2029	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
14	2030	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
15	2031	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
16	2032	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
17	2033	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
18	2034	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
19	2035	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
20	2036	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
21	2037	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
22	2038	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
23	2039	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
24	2040	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
25	2041	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
26	2042	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
27	2043	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
28	2044	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
29	2045	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
30	2046	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
31	2047	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
32	2048	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
33	2049	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
34	2050	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
35	2051	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
36	2052	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
37	2053	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
38	2054	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
39	2055	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
40	2056	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
41	2057	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
42	2058	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
43	2059	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
44	2060	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
45	2061	10.58	4	3	40	2,746,995	45,983	207,662	654,850	3,655,490
	TOTAL					**114,705,358**	**2,069,252**		**29,379,136**	**154,825,028**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	1.39
2018	14.800	0.00%	14.80	0.489	0.000	2.61
2019	23.900	0.00%	23.90	0.790	0.000	4.22
2020	34.600	0.00%	34.60	1.144	0.000	6.10
2021	41.300	0.00%	41.30	1.366	0.000	7.28
2022	48.100	0.00%	48.10	1.591	0.000	8.48
2023	54.800	0.00%	54.80	1.812	0.000	9.66
2024	60.000	0.00%	60.00	1.984	0.000	10.58
2025	60.000	0.00%	60.00	1.984	0.000	10.58
2026	60.000	0.00%	60.00	1.984	0.000	10.58
2027	60.000	0.00%	60.00	1.984	0.000	10.58
2028	60.000	0.00%	60.00	1.984	0.000	10.58
2029	60.000	0.00%	60.00	1.984	0.000	10.58
2030	60.000	0.00%	60.00	1.984	0.000	10.58
2031	60.000	0.00%	60.00	1.984	0.000	10.58
2032	60.000	0.00%	60.00	1.984	0.000	10.58
2033	60.000	0.00%	60.00	1.984	0.000	10.58
2034	60.000	0.00%	60.00	1.984	0.000	10.58
2035	60.000	0.00%	60.00	1.984	0.000	10.58
2036	60.000	0.00%	60.00	1.984	0.000	10.58
2037	60.000	0.00%	60.00	1.984	0.000	10.58
2038	60.000	0.00%	60.00	1.984	0.000	10.58
2039	60.000	0.00%	60.00	1.984	0.000	10.58
2040	60.000	0.00%	60.00	1.984	0.000	10.58
2041	60.000	0.00%	60.00	1.984	0.000	10.58
2042	60.000	0.00%	60.00	1.984	0.000	10.58
2043	60.000	0.00%	60.00	1.984	0.000	10.58
2044	60.000	0.00%	60.00	1.984	0.000	10.58
2045	60.000	0.00%	60.00	1.984	0.000	10.58
2046	60.000	0.00%	60.00	1.984	0.000	10.58
2047	60.000	0.00%	60.00	1.984	0.000	10.58
2048	60.000	0.00%	60.00	1.984	0.000	10.58
2049	60.000	0.00%	60.00	1.984	0.000	10.58
2050	60.000	0.00%	60.00	1.984	0.000	10.58
2051	60.000	0.00%	60.00	1.984	0.000	10.58
2052	60.000	0.00%	60.00	1.984	0.000	10.58
2053	60.000	0.00%	60.00	1.984	0.000	10.58
2054	60.000	0.00%	60.00	1.984	0.000	10.58
2055	60.000	0.00%	60.00	1.984	0.000	10.58
2056	60.000	0.00%	60.00	1.984	0.000	10.58
2057	60.000	0.00%	60.00	1.984	0.000	10.58
2058	60.000	0.00%	60.00	1.984	0.000	10.58
2059	60.000	0.00%	60.00	1.984	0.000	10.58
2060	60.000	0.00%	60.00	1.984	0.000	10.58
2061	60.000	0.00%	60.00	1.984	0.000	10.58

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Mooi-Mgeni Transfer Study

Spring Grove Dam Scheme

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	MPOFANA OUTLET STRUCTURE		PIPELINE: New Gravity pipeline		PIPELINE: Mod to Existing Pipelines		PIPELINE: New Rising Main		SPRING GROVE DAM		FISH BARRIER		BREAK PRESSURE TANK		ADVANCED INFRASTRUCTURE		PUMP STATION SPRING GROVE					MEARNS PUMP STATION
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY - Spring Grove	ELECTRICITY - Mearns
2007																									
2008																									
2009																									
2010																									
2011	8,492,231																								
2012	8,492,231											52,484,967													
2013	8,492,231											52,484,967													
2014	8,492,231											52,484,967		7,835,220											
2015		18,177,900	2,002,650			4,166,460		3,895,490		23,496,180										4,994,016	13,894,094				
2016		18,177,900	2,002,650	4,883,780		4,166,460		3,895,490		23,496,180						4,977,000		7,031,000		4,994,016	13,894,094				
2017					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	1,066,010	
2018					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	1,408,954	
2019					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	1,861,244	
2020					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	2,393,056	
2021					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	2,726,061	
2022					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,064,035	
2023					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,397,039	
2024					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2025					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2026					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2027					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2028					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2029					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2030					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2031					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0	1,699,930	0	1,136,498	3,655,490	
2032					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2033					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2034					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2035					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2036					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2037					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2038					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2039					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2040					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2041					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2042					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2043					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2044					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2045					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2046					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0	1,699,930	0	1,136,498	3,655,490	
2047					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2048					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2049					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2050					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2051					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2052					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2053					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2054					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2055					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2056					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2057					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2058					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2059					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2060					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
2061					12,209		41,665		38,955		234,962	0	393,637		19,588		12,443		17,578	0		0	1,136,498	3,655,490	
TOTAL	33,968,926	36,355,800	4,005,300	4,883,780	549,425	8,332,920	1,874,907	7,790,980	1,752,971	46,992,360	10,573,281	157,454,900	17,713,676	7,835,220	881,462	4,977,000	559,913	7,031,000	790,988	9,988,033	31,188,047	0	51,142,391	154,825,028	0

Mooi-Mgeni Transfer Study

Spring Grove Dam Scheme

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	8,492,231	0	6,726,643	0	6,242,044	0	5,800,308	0
2012	60,977,198	0	45,565,710	0	41,500,056	0	37,862,042	0
2013	60,977,198	0	42,986,519	0	38,425,978	0	34,420,039	0
2014	68,812,418	0	45,764,188	0	40,151,385	0	35,311,651	0
2015	70,626,790	0	44,312,122	0	38,157,457	0	32,947,919	0
2016	87,518,570	0	51,802,107	0	43,781,074	0	37,116,417	0
2017	0	2,973,543	0	1,660,411	0	1,377,226	0	1,146,430
2018	0	3,316,488	0	1,747,085	0	1,422,385	0	1,162,409
2019	0	3,768,777	0	1,872,967	0	1,496,633	0	1,200,849
2020	0	4,300,590	0	2,016,284	0	1,581,318	0	1,245,728
2021	0	4,633,594	0	2,049,443	0	1,577,558	0	1,220,170
2022	0	4,971,569	0	2,074,462	0	1,567,246	0	1,190,154
2023	0	5,304,573	0	2,088,125	0	1,548,354	0	1,154,430
2024	0	5,563,024	0	2,065,909	0	1,503,513	0	1,100,615
2025	0	5,563,024	0	1,948,971	0	1,392,141	0	1,000,559
2026	0	5,563,024	0	1,838,652	0	1,289,020	0	909,599
2027	0	5,563,024	0	1,734,577	0	1,193,537	0	826,908
2028	0	5,563,024	0	1,636,394	0	1,105,127	0	751,735
2029	0	5,563,024	0	1,543,767	0	1,023,265	0	683,395
2030	0	5,563,024	0	1,456,384	0	947,468	0	621,268
2031	1,699,930	5,563,024	419,846	1,372,948	268,078	877,285	172,586	564,789
2032	0	5,563,024	0	1,296,177	0	812,301	0	513,445
2033	0	5,563,024	0	1,222,808	0	752,131	0	466,768
2034	0	5,563,024	0	1,153,593	0	696,417	0	424,335
2035	0	5,563,024	0	1,088,295	0	644,831	0	385,759
2036	0	5,563,024	0	1,026,694	0	597,066	0	350,690
2037	0	5,563,024	0	968,579	0	552,838	0	318,809
2038	0	5,563,024	0	913,754	0	511,887	0	289,826
2039	0	5,563,024	0	862,032	0	473,970	0	263,478
2040	0	5,563,024	0	813,237	0	438,861	0	239,526
2041	0	5,563,024	0	767,205	0	406,353	0	217,751
2042	0	5,563,024	0	723,778	0	376,253	0	197,955
2043	0	5,563,024	0	682,810	0	348,382	0	179,959
2044	0	5,563,024	0	644,160	0	322,576	0	163,599
2045	0	5,563,024	0	607,698	0	298,681	0	148,727
2046	1,699,930	5,563,024	175,187	573,300	84,509	276,557	41,316	135,206
2047	0	5,563,024	0	540,849	0	256,071	0	122,915
2048	0	5,563,024	0	510,235	0	237,103	0	111,741
2049	0	5,563,024	0	481,354	0	219,540	0	101,582
2050	0	5,563,024	0	454,108	0	203,278	0	92,348
			0					
2051	0	5,563,024	0	428,403	0	188,220	0	83,952
2052	0	5,563,024	0	404,154	0	174,278	0	76,320
2053	0	5,563,024	0	381,277	0	161,368	0	69,382
2054	0	5,563,024	0	359,696	0	149,415	0	63,075
2055	0	5,563,024	0	339,336	0	138,347	0	57,341
2056	0	5,563,024	0	320,128	0	128,099	0	52,129
2057	0	5,563,024	0	302,007	0	118,611	0	47,389
2058	0	5,563,024	0	284,913	0	109,825	0	43,081
2059	0	5,563,024	0	268,786	0	101,689	0	39,164
2060	0	5,563,024	0	253,571	0	94,157	0	35,604
2061	0	5,563,024	0	239,218	0	87,182	0	32,367
TOTAL	**360,804,265**	**240,664,042**	**237,752,321**	**46,019,535**	**208,610,582**	**29,778,463**	**183,672,279**	**20,103,257**

NET PRESENT COST

Discounted at 6%	283,771,857
Discounted at 8%	238,389,044
Discounted at 10%	203,775,535

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Spring Grove Dam Scheme
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R 8,492,231	0	R 6,726,643	0	R 6,242,044	0	R 5,800,308
2012	0	R 60,977,198	0	R 45,565,710	0	R 41,500,056	0	R 37,862,042
2013	0	R 60,977,198	0	R 42,986,519	0	R 38,425,978	0	R 34,420,039
2014	0	R 68,812,418	0	R 45,764,188	0	R 40,151,385	0	R 35,311,651
2015	0	R 70,626,790	0	R 44,312,122	0	R 38,157,457	0	R 32,947,919
2016	0	R 87,518,570	0	R 51,802,107	0	R 43,781,074	0	R 37,116,417
2017	7.9	R 2,973,543	4	R 1,660,411	4	R 1,377,326	3	R 1,146,430
2018	14.8	R 3,316,488	8	R 1,747,085	6	R 1,422,385	5	R 1,162,409
2019	23.9	R 3,768,777	12	R 1,872,967	9	R 1,496,633	8	R 1,200,849
2020	34.6	R 4,300,590	16	R 2,016,284	13	R 1,581,318	10	R 1,245,728
2021	41.3	R 4,633,594	18	R 2,049,443	14	R 1,577,558	11	R 1,220,170
2022	48.1	R 4,971,569	20	R 2,074,462	15	R 1,567,246	12	R 1,190,154
2023	54.8	R 5,304,573	22	R 2,088,125	16	R 1,548,354	12	R 1,154,430
2024	60	R 5,563,024	22	R 2,065,909	16	R 1,503,513	12	R 1,100,615
2025	60	R 5,563,024	21	R 1,948,971	15	R 1,392,141	11	R 1,000,559
2026	60	R 5,563,024	20	R 1,838,652	14	R 1,289,020	10	R 909,599
2027	60	R 5,563,024	19	R 1,734,577	13	R 1,193,537	9	R 826,908
2028	60	R 5,563,024	18	R 1,636,394	12	R 1,105,127	8	R 751,735
2029	60	R 5,563,024	17	R 1,543,767	11	R 1,023,265	7	R 683,395
2030	60	R 5,563,024	16	R 1,456,384	10	R 947,468	7	R 621,268
2031	60	R 7,262,954	15	R 1,793,794	9	R 1,145,363	6	R 737,376
2032	60	R 5,563,024	14	R 1,296,177	9	R 812,301	6	R 513,445
2033	60	R 5,563,024	13	R 1,222,808	8	R 752,131	5	R 466,768
2034	60	R 5,563,024	12	R 1,153,593	8	R 696,417	5	R 424,335
2035	60	R 5,563,024	12	R 1,088,295	7	R 644,831	4	R 385,759
2036	60	R 5,563,024	11	R 1,026,694	6	R 597,066	4	R 350,690
2037	60	R 5,563,024	10	R 968,579	6	R 552,838	3	R 318,809
2038	60	R 5,563,024	10	R 913,754	6	R 511,887	3	R 289,826
2039	60	R 5,563,024	9	R 862,032	5	R 473,970	3	R 263,478
2040	60	R 5,563,024	9	R 813,237	5	R 438,861	3	R 239,526
2041	60	R 5,563,024	8	R 767,205	4	R 406,353	2	R 217,751
2042	60	R 5,563,024	8	R 723,778	4	R 376,253	2	R 197,955
2043	60	R 5,563,024	7	R 682,810	4	R 348,382	2	R 179,959
2044	60	R 5,563,024	7	R 644,160	3	R 322,576	2	R 163,599
2045	60	R 5,563,024	7	R 607,698	3	R 298,681	2	R 148,727
2046	60	R 7,262,954	6	R 748,487	3	R 361,066	1	R 176,522
2047	60	R 5,563,024	6	R 540,849	3	R 256,071	1	R 122,915
2048	60	R 5,563,024	6	R 510,235	3	R 237,103	1	R 111,741
2049	60	R 5,563,024	5	R 481,354	2	R 219,540	1	R 101,582
2050	60	R 5,563,024	5	R 454,108	2	R 203,278	1	R 92,348
2051	60	R 5,563,024	5	R 428,403	2	R 188,220	1	R 83,952
2052	60	R 5,563,024	4	R 404,154	2	R 174,278	1	R 76,320
2053	60	R 5,563,024	4	R 381,277	2	R 161,368	1	R 69,382
2054	60	R 5,563,024	4	R 359,696	2	R 149,415	1	R 63,075
2055	60	R 5,563,024	4	R 339,336	1	R 138,347	1	R 57,341
2056	60	R 5,563,024	3	R 320,128	1	R 128,099	1	R 52,128
2057	60	R 5,563,024	3	R 302,007	1	R 118,611	1	R 47,389
2058	60	R 5,563,024	3	R 284,913	1	R 109,825	0	R 43,081
2059	60	R 5,563,024	3	R 268,786	1	R 101,689	0	R 39,164
2060	60	R 5,563,024	3	R 253,571	1	R 94,157	0	R 35,604
2061	60	R 5,563,024	3	R 239,218	1	R 87,182	0	R 32,367
TOTAL	**2505.4**	**R 601,468,307**	**451**	**R 283,771,857**	**285**	**R 238,389,044**	**187**	**R 203,775,535**
URV				**R 0.63**		**R 0.84**		**R 1.09**

Appendix D.2

Economic Analyses:

Mkomazi-Mgeni Transfer Scheme Phase 1

Project Name: Mkomazi-Mgeni Transfer Study
Option: Smithfield Scheme - Excluding WTW
Base year of study cost: March 1998
Escalation Factor 2.08 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 147.00 m³/a

Component	Type	Name	Characteristics		Total Cost March 1998	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing		Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
										Start	End			
			Dia	Length										
Tunnel		Smithfield-Baynesfield	3.5m	32.9km	R 543,291,659	R 1,130,046,651	R 1,125,886,651	R 4,160,000	R 1,130,046,651	2013	2016	4	R 281,471,663	R 1,040,000
Pipelines			**Dia**	**Length**										
		WW to Umlaas Road Res	1900mm	21.1km	R 172,367,509	R 358,524,419	R 354,288,187	R 4,236,232	R 358,524,419	2014	2016	3	R 118,096,062	R 1,412,077
		Baynesfield Dam to WW	1900mm	3.0km	R 23,975,735	R 49,869,529	R 48,149,671	R 1,719,857	R 49,869,528	2016	2016	1	R 48,149,671	R 1,719,857
		Tunnel to Baynesfield Dam	1800mm	2.2km	R 16,097,536	R 33,482,875	R 32,328,146	R 1,154,729	R 33,482,875	2016	2016	1	R 32,328,146	R 1,154,729
			FSL	**Cap**										
Dam	Rockfill	Smithfield	915m	137 mil	R 221,606,000	R 460,940,480	R 438,241,682	R 22,698,798	R 460,940,480	2014	2016	3	R 146,080,561	R 7,566,266
Dam		Baynesfield (raising)			R 5,990,674	R 12,460,602	R 7,317,131	R 5,143,471	R 12,460,602	2016	2016	1	R 7,317,131	R 5,143,471
Pumpstation and IntakeTower		Smithfield			R 68,022,490	R 141,486,779	R 77,500,052	R 63,986,728	R 141,486,780	2015	2016	2	R 38,750,026	R 31,993,364
Reservoir		Umlaas Road	**Cap**	200Ml	R 40,824,333	R 84,914,613	R 79,543,807	R 5,370,805	R 84,914,612	2015	2016	2	R 39,771,904	R 2,685,403
Advance infrastructure		Access and Elect to Site			R 13,860,000	R 28,828,800	R 28,828,800	R -	R 28,828,800	2016	2016	1	R 28,828,800	R -
Sub-Total					**R 1,106,035,936**	**R 2,300,554,747**	**R 2,192,084,127**	**R 108,470,620**	**R 2,300,554,747**					
Engineering Fees	12%								**R 276,066,569.64**			2	138,033,284.82	
Land Acquisitions and relocations									**R 4,000,000.00**			2	2,000,000.00	
Social and Environmental	1%								**R 23,005,547.47**			2	11,502,773.74	
Sub-Total									**R 2,603,626,864.11**					
VAT	14%								**R 364,507,760.98**					
Total									**R 2,968,134,625.09**					

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SMITHFIELD SCHEME
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	4.861	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	6.48	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	4.861	
Peak factor	1.04			
Average head pumped		m	47.60	**47.60**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	2.6	**2.6**
power absorbed at Qd: (Pd / Pf)		MVA	2.7	**2.7**
		MVAh	66.0	**66.0**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	3.7	**3.7**
head pumped (Hd)		m	47.60	**47.6**
Energy consumed over 24 hours (continuous use)	24	MWh	63.4	**63**

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	4,370,457.93	**R**	**4,370,457.93**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	440,105.11	**R**	**440,105.11**
Transmission surcharge (< 300 km)	%		1.00%	R	43,704.58	**R**	**43,704.58**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	330,389.77	**R**	**330,389.77**
Network Charge	R/MVA	R	6,340.00	R	23,244.37	**R**	**23,244.37**
Total annual cost				**R**	**5,220,749.76**	**R**	**5,220,749.76**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SMITHFIELD SCHEME
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	1.620	m3/s	Pump Station Capacity
Total flow	4.861	m3/s	147 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	1.29	4	3	3	234,875	36,092	17,756	442,454	731,177
2	2018	2.42	4	3	6	440,019	36,092	33,264	444,505	953,880
3	2019	3.90	4	3	10	710,571	36,092	53,716	447,211	1,247,591
4	2020	5.65	4	3	15	1,028,693	36,092	77,765	450,392	1,592,942
5	2021	6.74	4	3	18	1,227,891	36,092	92,824	452,384	1,809,191
6	2022	7.85	4	3	21	1,430,061	36,092	108,107	454,406	2,028,667
7	2023	8.95	4	3	24	1,629,259	36,092	123,166	456,398	2,244,915
8	2024	10.04	4	3	27	1,828,457	36,092	138,224	458,390	2,461,163
9	2025	11.15	4	3	29	2,030,628	36,092	153,508	460,411	2,680,639
10	2026	12.16	4	3	32	2,214,960	36,092	167,442	462,255	2,880,749
11	2027	13.18	4	3	35	2,399,292	36,092	181,377	464,098	3,080,860
12	2028	14.19	4	3	37	2,583,624	36,092	195,312	465,941	3,280,970
13	2029	15.20	4	3	40	2,767,957	36,092	209,247	467,785	3,481,081
14	2030	16.21	4	3	43	2,952,289	36,092	223,182	469,628	3,681,191
15	2031	17.65	4	3	47	3,213,922	36,092	242,960	472,244	3,965,219
16	2032	18.79	4	3	50	3,422,039	36,092	258,693	474,326	4,191,150
17	2033	19.93	4	3	53	3,630,156	36,092	274,426	476,407	4,417,081
18	2034	21.08	4	3	56	3,838,273	36,092	290,159	478,488	4,643,012
19	2035	22.20	4	3	59	4,043,417	36,092	305,667	480,539	4,865,715
20	2036	23.35	4	3	62	4,251,534	36,092	321,400	482,620	5,091,646
21	2037	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
22	2038	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
23	2039	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
24	2040	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
25	2041	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
26	2042	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
27	2043	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
28	2044	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
29	2045	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
30	2046	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
31	2047	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
32	2048	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
33	2049	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
34	2050	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
35	2051	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
36	2052	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
37	2053	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
38	2054	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
39	2055	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
40	2056	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
41	2057	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
42	2058	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
43	2059	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
44	2060	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
45	2061	24.00	4	3	63	4,370,458	36,092	330,390	483,810	5,220,750
	TOTAL					**155,139,364**	**1,624,157**		**21,356,124**	**189,847,582**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	1.29
2018	14.800	0.00%	14.80	0.489	0.000	2.42
2019	23.900	0.00%	23.90	0.790	0.000	3.90
2020	34.600	0.00%	34.60	1.144	0.000	5.65
2021	41.300	0.00%	41.30	1.366	0.000	6.74
2022	48.100	0.00%	48.10	1.591	0.000	7.85
2023	54.800	0.00%	54.80	1.812	0.000	8.95
2024	61.500	0.00%	61.50	2.034	0.000	10.04
2025	68.300	0.00%	68.30	2.259	0.000	11.15
2026	74.500	0.00%	74.50	2.464	0.000	12.16
2027	80.700	0.00%	80.70	2.669	0.000	13.18
2028	86.900	0.00%	86.90	2.874	0.000	14.19
2029	93.100	0.00%	93.10	3.079	0.000	15.20
2030	99.300	0.00%	99.30	3.284	0.000	16.21
2031	108.100	0.00%	108.10	3.575	0.000	17.65
2032	115.100	0.00%	115.10	3.806	0.000	18.79
2033	122.100	0.00%	122.10	4.038	0.000	19.93
2034	129.100	0.00%	129.10	4.269	0.000	21.08
2035	136.000	0.00%	136.00	4.497	0.000	22.20
2036	143.000	0.00%	143.00	4.729	0.000	23.35
2037	147.000	0.00%	147.00	4.861	0.000	24.00
2038	147.000	0.00%	147.00	4.861	0.000	24.00
2039	147.000	0.00%	147.00	4.861	0.000	24.00
2040	147.000	0.00%	147.00	4.861	0.000	24.00
2041	147.000	0.00%	147.00	4.861	0.000	24.00
2042	147.000	0.00%	147.00	4.861	0.000	24.00
2043	147.000	0.00%	147.00	4.861	0.000	24.00
2044	147.000	0.00%	147.00	4.861	0.000	24.00
2045	147.000	0.00%	147.00	4.861	0.000	24.00
2046	147.000	0.00%	147.00	4.861	0.000	24.00
2047	147.000	0.00%	147.00	4.861	0.000	24.00
2048	147.000	0.00%	147.00	4.861	0.000	24.00
2049	147.000	0.00%	147.00	4.861	0.000	24.00
2050	147.000	0.00%	147.00	4.861	0.000	24.00
2051	147.000	0.00%	147.00	4.861	0.000	24.00
2052	147.000	0.00%	147.00	4.861	0.000	24.00
2053	147.000	0.00%	147.00	4.861	0.000	24.00
2054	147.000	0.00%	147.00	4.861	0.000	24.00
2055	147.000	0.00%	147.00	4.861	0.000	24.00
2056	147.000	0.00%	147.00	4.861	0.000	24.00
2057	147.000	0.00%	147.00	4.861	0.000	24.00
2058	147.000	0.00%	147.00	4.861	0.000	24.00
2059	147.000	0.00%	147.00	4.861	0.000	24.00
2060	147.000	0.00%	147.00	4.861	0.000	24.00
2061	147.000	0.00%	147.00	4.861	0.000	24.00

Major overhaul every 15 years:	15.00%	of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00%	of electrical/mechanical cost
Maintenance cost (civil)	0.25%	of civil cost
Maintenance cost (pipelines)	0.50%	of pipeline cost

Mkomazi-Mgeni Transfer Study

Smithfield Dam Scheme

YEAR	EXISTING INFRASTRUCTURE COSTS	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	TUNNEL		TREATMENT WORKS			PIPELINE: Tunnel to Baynesfield Dam		PIPELINE: Baynesfield Dam to WW		PIPELINE: WW to Umlaas Road Res		SMITHFIELD DAM		BAYNESFIELD DAM		UMLAAS ROAD RESEVOIR		ADVANCED INFRASTRUCTURE		PUMP STATION AND INTAKE TOWER COSTS				
	ENERGY COSTS				CAPITAL	MAINTENANCE & OPERATION	CAPITAL - CIVIL	CAPITAL - MECH & ELECT	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANC E & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007																											
2008																											
2009																											
2010																											
2011																											
2012																											
2013					282,511,663																						
2014					282,511,663									119,508,140		153,646,827											
2015		138,033,285	2,000,000	11,502,774	282,511,663		0	0						119,508,140		153,646,827				42,457,306				38,750,026	31,993,364		
2016		138,033,285	2,000,000	11,502,774	282,511,663		0	0		33,482,875		49,869,528		119,508,140		153,646,827		12,460,602		42,457,306		28,828,800		38,750,026	31,993,364		
2017						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	731,177
2018						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	953,880
2019						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	1,247,591
2020						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	1,592,942
2021						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	1,809,191
2022						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	2,028,667
2023						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	2,244,915
2024						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	2,461,163
2025						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	2,680,639
2026						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	2,880,749
2027						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	3,080,860
2028						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	3,280,970
2029						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	3,481,081
2030						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	3,681,191
2031						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0	6,366,905	0	2,753,219	3,965,219
2032						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	4,191,150
2033						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	4,417,081
2034						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	4,643,012
2035						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	4,865,715
2036						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,091,646
2037						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2038						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2039						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2040						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2041						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2042						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2043						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2044						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2045						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2046						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0	6,366,905	0	2,753,219	5,220,750
2047						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2048						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2049						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2050						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2051						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2052						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2053						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2054						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2055						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2056						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2057						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2058						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2059						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2060						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
2061						2,825,117			0		167,414		249,348		1,792,622	0	1,152,351		31,152		212,287		72,072	0		0	2,753,219	5,220,750
TOTAL	0	276,066,570	4,000,000	23,005,547	1,130,046,651	127,130,248	0	0	0	33,482,875	7,533,647	49,869,528	11,220,644	358,524,419	80,667,994	460,940,480	51,855,804	12,460,602	1,401,818	84,914,612	9,552,894	28,828,800	3,243,240	77,500,052	76,720,538	0	123,894,866	189,847,582

Mkomazi-Mgeni Transfer Study

Smithfield Dam Scheme

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	282,511,663	0	199,159,574	0	178,030,269	0	159,470,469	0
2014	555,666,629	0	369,550,044	0	324,226,141	0	285,144,842	0
2015	820,403,384	0	514,731,232	0	443,238,421	0	382,724,233	0
2016	946,045,189	0	559,370,795	0	472,757,880	0	400,791,414	0
2017	0	9,986,758	0	5,576,554	0	4,625,801	0	3,850,328
2018	0	10,209,462	0	5,378,217	0	4,378,663	0	3,578,354
2019	0	10,503,172	0	5,219,755	0	4,170,954	0	3,346,634
2020	0	10,848,524	0	5,086,211	0	3,988,980	0	3,142,431
2021	0	11,064,772	0	4,893,959	0	3,767,124	0	2,913,700
2022	0	11,284,248	0	4,708,522	0	3,557,266	0	2,701,359
2023	0	11,500,496	0	4,527,128	0	3,356,885	0	2,502,843
2024	0	11,716,744	0	4,351,182	0	3,166,672	0	2,318,095
2025	0	11,936,220	0	4,181,781	0	2,987,028	0	2,146,834
2026	0	12,136,331	0	4,011,215	0	2,812,134	0	1,984,387
2027	0	12,336,441	0	3,846,561	0	2,646,761	0	1,833,733
2028	0	12,536,551	0	3,687,694	0	2,490,458	0	1,694,071
2029	0	12,736,662	0	3,534,489	0	2,342,788	0	1,564,648
2030	0	12,936,772	0	3,386,812	0	2,203,330	0	1,444,755
2031	6,366,905	13,220,800	1,572,489	3,265,254	1,004,057	2,084,911	646,404	1,342,250
2032	0	13,446,731	0	3,133,070	0	1,963,463	0	1,241,079
2033	0	13,672,662	0	3,005,388	0	1,848,568	0	1,147,211
2034	0	13,898,593	0	2,882,123	0	1,739,921	0	1,060,152
2035	0	14,121,296	0	2,762,551	0	1,636,852	0	979,218
2036	0	14,347,228	0	2,647,878	0	1,539,852	0	904,441
2037	0	14,476,331	0	2,520,476	0	1,438,619	0	829,618
2038	0	14,476,331	0	2,377,807	0	1,332,055	0	754,188
2039	0	14,476,331	0	2,243,215	0	1,233,384	0	685,634
2040	0	14,476,331	0	2,116,240	0	1,142,022	0	623,304
2041	0	14,476,331	0	1,996,453	0	1,057,428	0	566,640
2042	0	14,476,331	0	1,883,446	0	979,100	0	515,127
2043	0	14,476,331	0	1,776,836	0	906,574	0	468,297
2044	0	14,476,331	0	1,676,260	0	839,420	0	425,725
2045	0	14,476,331	0	1,581,378	0	777,241	0	387,023
2046	6,366,905	14,476,331	656,145	1,491,866	316,521	719,668	154,744	351,839
2047	0	14,476,331	0	1,407,421	0	666,359	0	319,853
2048	0	14,476,331	0	1,327,755	0	616,999	0	290,776
2049	0	14,476,331	0	1,252,599	0	571,295	0	264,342
2050	0	14,476,331	0	1,181,697	0	528,977	0	240,311
2051	0	14,476,331	0	1,114,809	0	489,794	0	218,464
2052	0	14,476,331	0	1,051,707	0	453,513	0	198,604
2053	0	14,476,331	0	992,176	0	419,919	0	180,549
2054	0	14,476,331	0	936,015	0	388,814	0	164,135
2055	0	14,476,331	0	883,033	0	360,013	0	149,214
2056	0	14,476,331	0	833,050	0	333,345	0	135,649
2057	0	14,476,331	0	785,896	0	308,653	0	123,317
2058	0	14,476,331	0	741,412	0	285,790	0	112,107
2059	0	14,476,331	0	699,445	0	264,620	0	101,915
2060	0	14,476,331	0	659,854	0	245,019	0	92,650
2061	0	14,476,331	0	622,503	0	226,869	0	84,227
TOTAL	**2,616,360,674**	**606,348,737**	**1,645,040,280**	**114,239,692**	**1,419,573,288**	**73,893,904**	**1,228,932,105**	**49,980,043**

NET PRESENT COST

Discounted at 6%	1,759,279,972
Discounted at 8%	1,493,467,192
Discounted at 10%	1,278,912,149

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Smithfield Dam Scheme
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm^3/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R 282,511,663	0	R 199,159,574	0	R 178,030,269	0	R 159,470,469
2014	0	R 555,666,629	0	R 369,550,044	0	R 324,226,141	0	R 285,144,842
2015	0	R 820,403,384	0	R 514,731,232	0	R 443,238,421	0	R 382,724,233
2016	0	R 945,045,189	0	R 559,370,795	0	R 472,757,880	0	R 400,791,414
2017	7.9	R 9,986,758	4	R 5,576,554	4	R 4,625,801	3	R 3,850,328
2018	14.8	R 10,209,462	8	R 5,378,217	6	R 4,378,663	5	R 3,578,354
2019	23.9	R 10,503,172	12	R 5,219,755	9	R 4,170,954	8	R 3,346,634
2020	34.6	R 10,848,524	16	R 5,086,211	13	R 3,988,980	10	R 3,142,431
2021	41.3	R 11,064,772	18	R 4,893,959	14	R 3,767,124	11	R 2,913,700
2022	48.1	R 11,284,248	20	R 4,708,522	15	R 3,557,266	12	R 2,701,359
2023	54.8	R 11,500,496	22	R 4,527,128	16	R 3,356,885	12	R 2,502,843
2024	61.5	R 11,716,744	23	R 4,351,182	17	R 3,166,672	12	R 2,318,095
2025	68.3	R 11,936,220	24	R 4,181,781	17	R 2,987,028	12	R 2,146,834
2026	74.5	R 12,136,331	25	R 4,011,215	17	R 2,812,134	12	R 1,984,387
2027	80.7	R 12,336,441	25	R 3,846,561	17	R 2,646,761	12	R 1,833,733
2028	86.9	R 12,536,551	26	R 3,687,694	17	R 2,490,458	12	R 1,694,071
2029	93.1	R 12,736,662	26	R 3,534,489	17	R 2,342,788	11	R 1,564,648
2030	99.3	R 12,936,772	26	R 3,386,812	17	R 2,203,330	11	R 1,444,755
2031	108.1	R 19,587,705	27	R 4,837,743	17	R 3,088,968	11	R 1,988,653
2032	115.1	R 13,446,731	27	R 3,133,070	17	R 1,963,463	11	R 1,241,079
2033	122.1	R 13,672,662	27	R 3,005,388	17	R 1,848,568	10	R 1,147,211
2034	129.1	R 13,898,593	27	R 2,882,123	16	R 1,739,921	10	R 1,060,152
2035	136	R 14,121,296	27	R 2,762,551	16	R 1,636,852	9	R 979,218
2036	143	R 14,347,228	26	R 2,647,878	15	R 1,539,852	9	R 904,441
2037	147	R 14,476,331	26	R 2,520,476	15	R 1,438,619	8	R 829,618
2038	147	R 14,476,331	24	R 2,377,807	14	R 1,332,055	8	R 754,198
2039	147	R 14,476,331	23	R 2,243,215	13	R 1,233,384	7	R 685,634
2040	147	R 14,476,331	21	R 2,116,240	12	R 1,142,022	6	R 623,304
2041	147	R 14,476,331	20	R 1,996,453	11	R 1,057,428	6	R 566,640
2042	147	R 14,476,331	19	R 1,883,446	10	R 979,100	5	R 515,127
2043	147	R 14,476,331	18	R 1,776,836	9	R 906,574	5	R 468,297
2044	147	R 14,476,331	17	R 1,676,260	9	R 839,420	4	R 425,725
2045	147	R 14,476,331	16	R 1,581,378	8	R 777,241	4	R 387,023
2046	147	R 20,843,236	15	R 2,148,011	7	R 1,036,188	4	R 506,583
2047	147	R 14,476,331	14	R 1,407,421	7	R 666,359	3	R 319,853
2048	147	R 14,476,331	13	R 1,327,755	6	R 616,999	3	R 290,776
2049	147	R 14,476,331	13	R 1,252,599	6	R 571,295	3	R 264,342
2050	147	R 14,476,331	12	R 1,181,697	5	R 528,977	2	R 240,311
2051	147	R 14,476,331	11	R 1,114,809	5	R 489,794	2	R 218,464
2052	147	R 14,476,331	11	R 1,051,707	5	R 453,513	2	R 198,604
2053	147	R 14,476,331	10	R 992,176	4	R 419,919	2	R 180,549
2054	147	R 14,476,331	10	R 936,015	4	R 388,814	2	R 164,135
2055	147	R 14,476,331	9	R 883,033	4	R 360,013	2	R 149,214
2056	147	R 14,476,331	8	R 833,050	3	R 333,345	1	R 135,649
2057	147	R 14,476,331	8	R 785,896	3	R 308,653	1	R 123,317
2058	147	R 14,476,331	8	R 741,412	3	R 285,790	1	R 112,107
2059	147	R 14,476,331	7	R 699,445	3	R 264,620	1	R 101,915
2060	147	R 14,476,331	7	R 659,854	2	R 245,019	1	R 92,650
2061	147	R 14,476,331	6	R 622,503	2	R 226,869	1	R 84,227
TOTAL	**5218.1**	**R 3,222,709,412**	**781**	**R 1,759,279,972**	**463**	**R 1,493,467,192**	**287**	**R 1,278,912,149**
URV				**R 2.25**		**R 3.23**		**R 4.45**

Appendix D.3

Economic Analyses:

Mvoti River Development – Isithundu Dam

Project Name: Mvoti Transfer Study
Option: Isithundu Dam and Mvoti View Abstraction Works - Incl Fawsley Park Treatment Works
Base year of study cost: Jun-96
Escalation Factor 2.31 **Sep-07**

Phase 1 **Commision year:** 2017 **Output:** 1.53 m³/s

Component	Type	Name	Characteristics		Total Cost June 1998	Total Cost Ecalated-Sep 2007	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Dam		Isithundu Dam	**CAP**	102 Mm³	R 306,588,000	R 708,218,280	R 708,218,280		R 708,218,280	2013	2016	4	R 177,054,570	R -
		Off Channel Dam			R 11,128,000	R 25,705,680	R 25,705,680		R 25,705,680			2	R 12,852,840	
Weir		Upgrade Exist Mvoti Weir	**No**	1	R 3,125,000	R 7,218,750	R 7,218,750		R 7,218,750	2016	2016	1	R 7,218,750	R -
Pipelines			**Dia**	**Length**										
		Tunnel to Off Channel Dam	700mm	875	R 623,000	R 1,439,130	R 1,439,130		R 1,439,130	2016	2016	1	R 1,439,130	R -
		Off Channel Dam to Fawsley Park	700/900	500/1600	R 6,272,925	R 14,490,457	R 14,490,457		R 14,490,457	2016	2016	1	R 14,490,457	R -
Raw Water Pumpstation		River Pump Station			R 8,050,000	R 18,595,500	R 5,341,875	R 13,253,625	R 18,595,500	2016	2016	1	R 5,341,875	R 13,253,625
Raw Water Pumpstation		Off Channel Dam to Fawsley Park			R 6,785,000	R 15,673,350	R 2,102,100	R 13,571,250	R 15,673,350	2016	2016	1	R 2,102,100	R 13,571,250
Treatment Works		Fawsley Park			R 74,880,000	R 172,972,800	R 82,162,080	R 90,810,720	R 172,972,800	2015	2016	2	R 41,081,040	R 45,405,360
		Access and Elect to Site	included						R -					
Sub-Total					**R 417,451,925**	**R 964,313,947**	**R 846,678,352**	**R 117,635,595**	**R 964,313,947**					
Engineering Fees	12%								**R 115,717,673.61**			3	R 38,572,558	
Land Acquisitions and relocations									**R 16,170,000.00**			2	R 8,085,000	
Social and Environmental	1%								**R 9,643,139.47**			3	R 3,214,380	
Sub-Total									**R 1,105,844,759.83**					
VAT	14%								**R 154,818,266.38**					
Total									**R 1,260,663,026.20**					

PROJECT: **KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY**
OPTION: **Mvoti Transfer Study**
DATE: **SEP 2007**

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	1.531	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	2.04	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	1.531	
Peak factor	1.04			
Average head pumped		m	40.00	**40.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.7	**0.7**
power absorbed at Qd: (Pd / Pf)		MVA	0.7	**0.7**
		MVAh	17.5	**17.5**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	1.0	**1.0**
head pumped (Hd)		m	40.00	**40.0**
Energy consumed over 24 hours (continuous use)	24	MWh	16.8	**17**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	1,156,761.00	**R**	**1,156,761**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	116,485.83	**R**	**116,486**
Transmission surcharge (< 300 km)	%		1.00%	R	11,567.61	**R**	**11,568**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	87,446.67	**R**	**87,447**
Network Charge	R/MVA	R	6,340.00	R	6,152.26	**R**	**6,152**
Total annual cost				**R**	**1,391,261.37**	**R**	**1,391,261**

PUMP STATION AT WEIR: RIVER PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Mvoti Transfer Study
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.510	m3/s	Pump Station Capacity
Total flow	1.531	m3/s	46.3 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS	NUMBER OF PUMPS		MWh	ANNUAL ELECTRICITY COST FOR PUMP STATIONS				
		PUMPED	INSTALLED	ACTIVE	per day	ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
2	2018	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
3	2019	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
4	2020	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
5	2021	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
6	2022	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
7	2023	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
8	2024	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
9	2025	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
10	2026	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
11	2027	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
12	2028	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
13	2029	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
14	2030	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
15	2031	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
16	2032	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
17	2033	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
18	2034	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
19	2035	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
20	2036	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
21	2037	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
22	2038	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
23	2039	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
24	2040	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
25	2041	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
26	2042	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
27	2043	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
28	2044	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
29	2045	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
30	2046	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
31	2047	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
32	2048	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
33	2049	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
34	2050	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
35	2051	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
36	2052	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
37	2053	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
38	2054	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
39	2055	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
40	2056	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
41	2057	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
42	2058	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
43	2059	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
44	2060	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
45	2061	24.00	4	3	17	1,156,761	19,000	87,447	128,053	1,391,261
	TOTAL					**52,054,245**	**855,012**		**5,762,405**	**62,606,762**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	46.300	0.00%	46.30	1.531	0.000	24.00
2018	46.300	0.00%	46.30	1.531	0.000	24.00
2019	46.300	0.00%	46.30	1.531	0.000	24.00
2020	46.300	0.00%	46.30	1.531	0.000	24.00
2021	46.300	0.00%	46.30	1.531	0.000	24.00
2022	46.300	0.00%	46.30	1.531	0.000	24.00
2023	46.300	0.00%	46.30	1.531	0.000	24.00
2024	46.300	0.00%	46.30	1.531	0.000	24.00
2025	46.300	0.00%	46.30	1.531	0.000	24.00
2026	46.300	0.00%	46.30	1.531	0.000	24.00
2027	46.300	0.00%	46.30	1.531	0.000	24.00
2028	46.300	0.00%	46.30	1.531	0.000	24.00
2029	46.300	0.00%	46.30	1.531	0.000	24.00
2030	46.300	0.00%	46.30	1.531	0.000	24.00
2031	46.300	0.00%	46.30	1.531	0.000	24.00
2032	46.300	0.00%	46.30	1.531	0.000	24.00
2033	46.300	0.00%	46.30	1.531	0.000	24.00
2034	46.300	0.00%	46.30	1.531	0.000	24.00
2035	46.300	0.00%	46.30	1.531	0.000	24.00
2036	46.300	0.00%	46.30	1.531	0.000	24.00
2037	46.300	0.00%	46.30	1.531	0.000	24.00
2038	46.300	0.00%	46.30	1.531	0.000	24.00
2039	46.300	0.00%	46.30	1.531	0.000	24.00
2040	46.300	0.00%	46.30	1.531	0.000	24.00
2041	46.300	0.00%	46.30	1.531	0.000	24.00
2042	46.300	0.00%	46.30	1.531	0.000	24.00
2043	46.300	0.00%	46.30	1.531	0.000	24.00
2044	46.300	0.00%	46.30	1.531	0.000	24.00
2045	46.300	0.00%	46.30	1.531	0.000	24.00
2046	46.300	0.00%	46.30	1.531	0.000	24.00
2047	46.300	0.00%	46.30	1.531	0.000	24.00
2048	46.300	0.00%	46.30	1.531	0.000	24.00
2049	46.300	0.00%	46.30	1.531	0.000	24.00
2050	46.300	0.00%	46.30	1.531	0.000	24.00
2051	46.300	0.00%	46.30	1.531	0.000	24.00
2052	46.300	0.00%	46.30	1.531	0.000	24.00
2053	46.300	0.00%	46.30	1.531	0.000	24.00
2054	46.300	0.00%	46.30	1.531	0.000	24.00
2055	46.300	0.00%	46.30	1.531	0.000	24.00
2056	46.300	0.00%	46.30	1.531	0.000	24.00
2057	46.300	0.00%	46.30	1.531	0.000	24.00
2058	46.300	0.00%	46.30	1.531	0.000	24.00
2059	46.300	0.00%	46.30	1.531	0.000	24.00
2060	46.300	0.00%	46.30	1.531	0.000	24.00
2061	46.300	0.00%	46.30	1.531	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Mvoti Transfer Study
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	1.531	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	2.04	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	1.531	
Peak factor	1.04			
Average head pumped		m	235.00	**235.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	4.1	**4.1**
power absorbed at Qd: (Pd / Pf)		MVA	4.3	**4.3**
		MVAh	102.6	**102.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	5.7	**5.7**
head pumped (Hd)		m	235.00	**235.0**
Energy consumed over 24 hours (continuous use)	24	MWh	98.5	**99**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	6,795,970.89	**R**	**6,795,971**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	684,354.27	**R**	**684,354**
Transmission surcharge (< 300 km)	%		1.00%	R	67,959.71	**R**	**67,960**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	513,749.19	**R**	**513,749**
Network Charge	R/MVA	R	6,340.00	R	36,144.51	**R**	**36,145**
Total annual cost				**R**	**8,111,026.57**	**R**	**8,111,027**

PUMP STATION AT OFF CHANNEL STORAGE DAM

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Mvoti Transfer Study
DATE: SEP 2007

Number of pumps	3 (excluding standby)		
Standby pumps	1		
Flow per pump	0.510 m3/s		Pump Station Capacity
Total flow	1.531 m3/s		46.3 million m³
Pumps active	350 days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
2	2018	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
3	2019	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
4	2020	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
5	2021	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
6	2022	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
7	2023	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
8	2024	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
9	2025	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
10	2026	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
11	2027	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
12	2028	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
13	2029	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
14	2030	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
15	2031	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
16	2032	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
17	2033	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
18	2034	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
19	2035	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
20	2036	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
21	2037	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
22	2038	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
23	2039	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
24	2040	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
25	2041	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
26	2042	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
27	2043	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
28	2044	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
29	2045	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
30	2046	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
31	2047	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
32	2048	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
33	2049	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
34	2050	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
35	2051	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
36	2052	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
37	2053	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
38	2054	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
39	2055	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
40	2056	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
41	2057	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
42	2058	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
43	2059	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
44	2060	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
45	2061	24.00	4	3	99	6,795,971	48,993	513,749	752,314	8,111,027
	TOTAL					**305,818,690**	**2,204,663**		**33,854,129**	**364,996,196**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	46.300	0.00%	46.30	1.531	0.000	24.00
2018	46.300	0.00%	46.30	1.531	0.000	24.00
2019	46.300	0.00%	46.30	1.531	0.000	24.00
2020	46.300	0.00%	46.30	1.531	0.000	24.00
2021	46.300	0.00%	46.30	1.531	0.000	24.00
2022	46.300	0.00%	46.30	1.531	0.000	24.00
2023	46.300	0.00%	46.30	1.531	0.000	24.00
2024	46.300	0.00%	46.30	1.531	0.000	24.00
2025	46.300	0.00%	46.30	1.531	0.000	24.00
2026	46.300	0.00%	46.30	1.531	0.000	24.00
2027	46.300	0.00%	46.30	1.531	0.000	24.00
2028	46.300	0.00%	46.30	1.531	0.000	24.00
2029	46.300	0.00%	46.30	1.531	0.000	24.00
2030	46.300	0.00%	46.30	1.531	0.000	24.00
2031	46.300	0.00%	46.30	1.531	0.000	24.00
2032	46.300	0.00%	46.30	1.531	0.000	24.00
2033	46.300	0.00%	46.30	1.531	0.000	24.00
2034	46.300	0.00%	46.30	1.531	0.000	24.00
2035	46.300	0.00%	46.30	1.531	0.000	24.00
2036	46.300	0.00%	46.30	1.531	0.000	24.00
2037	46.300	0.00%	46.30	1.531	0.000	24.00
2038	46.300	0.00%	46.30	1.531	0.000	24.00
2039	46.300	0.00%	46.30	1.531	0.000	24.00
2040	46.300	0.00%	46.30	1.531	0.000	24.00
2041	46.300	0.00%	46.30	1.531	0.000	24.00
2042	46.300	0.00%	46.30	1.531	0.000	24.00
2043	46.300	0.00%	46.30	1.531	0.000	24.00
2044	46.300	0.00%	46.30	1.531	0.000	24.00
2045	46.300	0.00%	46.30	1.531	0.000	24.00
2046	46.300	0.00%	46.30	1.531	0.000	24.00
2047	46.300	0.00%	46.30	1.531	0.000	24.00
2048	46.300	0.00%	46.30	1.531	0.000	24.00
2049	46.300	0.00%	46.30	1.531	0.000	24.00
2050	46.300	0.00%	46.30	1.531	0.000	24.00
2051	46.300	0.00%	46.30	1.531	0.000	24.00
2052	46.300	0.00%	46.30	1.531	0.000	24.00
2053	46.300	0.00%	46.30	1.531	0.000	24.00
2054	46.300	0.00%	46.30	1.531	0.000	24.00
2055	46.300	0.00%	46.30	1.531	0.000	24.00
2056	46.300	0.00%	46.30	1.531	0.000	24.00
2057	46.300	0.00%	46.30	1.531	0.000	24.00
2058	46.300	0.00%	46.30	1.531	0.000	24.00
2059	46.300	0.00%	46.30	1.531	0.000	24.00
2060	46.300	0.00%	46.30	1.531	0.000	24.00
2061	46.300	0.00%	46.30	1.531	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Mvoti Transfer Study

Isithundu Dam and Mvoti View Abstraction Works - Incl Fawsley Park Treatment Works

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	WEIR		TREATMENT WORKS			PIPELINE: Tunnel to Off-Channel Dam		PIPELINE: Off-Channel Dam to Fawsley Park WWTW		ISITHUNDU DAM		OFF-CHANNEL STORAGE DAM		RIVER PUMP STATION					RAW WATER PUMP STATION FROM DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL - CIVIL	CAPITAL - MECH & ELECT	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000																										
2001																										
2002																										
2003																										
2004																										
2005																										
2006																										
2007																										
2008																										
2009																										
2010																										
2011	38,572,558		3,214,380																							
2012	38,572,558	8,085,000	3,214,380																							
2013	38,572,558	8,085,000	3,214,380										177,054,570													
2014													177,054,570													
2015						41,081,040	45,405,360						177,054,570		12,852,840											
2016				7,218,750		41,081,040	45,405,360		1,439,130		14,490,457		177,054,570		12,852,840		5,341,875	13,253,625				2,102,100	13,571,250			
2017					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2018					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2019					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2020					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2021					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2022					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2023					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2024					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2025					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2026					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2027					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2028					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2029					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2030					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2031					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0	836,798	0	543,500	1,391,261	0	705,301	0	548,105	8,111,027
2032					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2033					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2034					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2035					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2036					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2037					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2038					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2039					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2040					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2041					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2042					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2043					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2044					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2045					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2046					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0	836,798	0	543,500	1,391,261	0	705,301	0	548,105	8,111,027
2047					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2048					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2049					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2050					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2051					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2052					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2053					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2054					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2055					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2056					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2057					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2058					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2059					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2060					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
2061					18,047			3,837,834		7,196		72,452	0	1,770,546		64,264	0		0	543,500	1,391,261	0		0	548,105	8,111,027
TOTAL	115,717,674	16,170,000	9,643,139	7,218,750	812,109	82,162,080	90,810,720	172,702,530	1,439,130	323,804	14,490,457	3,260,353	708,218,280	79,674,567	25,705,680	2,891,888	5,341,875	14,927,220	0	24,457,486	62,606,762	2,102,100	14,981,852	0	24,664,736	364,996,196

Mvoti Transfer Study

Isithundu Dam and Mvoti View Abstraction Works - Incl Fawsley Park Treatment Works

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	41,786,938	0	33,099,169	0	30,714,647	0	28,541,041	0
2012	49,871,938	0	37,267,213	0	33,942,003	0	30,966,550	0
2013	226,926,508	0	159,974,234	0	143,002,193	0	128,094,098	0
2014	177,054,570	0	117,751,401	0	103,309,641	0	90,856,990	0
2015	276,393,810	0	173,412,896	0	149,326,975	0	128,939,752	0
2016	333,810,997	0	197,582,216	0	166,988,606	0	141,568,449	0
2017	0	16,364,232	0	9,137,701	0	7,579,806	0	6,309,120
2018	0	16,364,232	0	8,620,473	0	7,018,338	0	5,735,563
2019	0	16,364,232	0	8,132,522	0	6,498,462	0	5,214,148
2020	0	16,364,232	0	7,672,190	0	6,017,094	0	4,740,135
2021	0	16,364,232	0	7,237,915	0	5,571,383	0	4,309,214
2022	0	16,364,232	0	6,828,222	0	5,158,688	0	3,917,467
2023	0	16,364,232	0	6,441,719	0	4,776,563	0	3,561,334
2024	0	16,364,232	0	6,077,093	0	4,422,744	0	3,237,576
2025	0	16,364,232	0	5,733,107	0	4,095,133	0	2,943,251
2026	0	16,364,232	0	5,408,591	0	3,791,790	0	2,675,683
2027	0	16,364,232	0	5,102,445	0	3,510,917	0	2,432,439
2028	0	16,364,232	0	4,813,627	0	3,250,849	0	2,211,308
2029	0	16,364,232	0	4,541,158	0	3,010,045	0	2,010,280
2030	0	16,364,232	0	4,284,111	0	2,787,079	0	1,827,527
2031	1,542,098	16,364,232	380,865	4,041,614	243,188	2,580,628	156,562	1,661,388
2032	0	16,364,232	0	3,812,844	0	2,389,471	0	1,510,353
2033	0	16,364,232	0	3,597,022	0	2,212,473	0	1,373,048
2034	0	16,364,232	0	3,393,417	0	2,048,586	0	1,248,226
2035	0	16,364,232	0	3,201,337	0	1,896,839	0	1,134,751
2036	0	16,364,232	0	3,020,129	0	1,756,332	0	1,031,591
2037	0	16,364,232	0	2,849,179	0	1,626,234	0	937,810
2038	0	16,364,232	0	2,687,904	0	1,505,772	0	852,555
2039	0	16,364,232	0	2,535,759	0	1,394,233	0	775,050
2040	0	16,364,232	0	2,392,225	0	1,290,957	0	704,591
2041	0	16,364,232	0	2,256,816	0	1,195,330	0	640,537
2042	0	16,364,232	0	2,129,072	0	1,106,787	0	582,306
2043	0	16,364,232	0	2,008,558	0	1,024,803	0	529,370
2044	0	16,364,232	0	1,894,866	0	948,892	0	481,245
2045	0	16,364,232	0	1,787,610	0	878,603	0	437,495
2046	1,542,098	16,364,232	158,922	1,686,424	76,663	813,522	37,480	397,723
2047	0	16,364,232	0	1,590,966	0	753,261	0	361,567
2048	0	16,364,232	0	1,500,912	0	697,464	0	328,697
2049	0	16,364,232	0	1,415,954	0	645,800	0	298,815
2050	0	16,364,232	0	1,335,806	0	597,963	0	271,650
2051	0	16,364,232	0	1,260,194	0	553,669	0	246,955
2052	0	16,364,232	0	1,188,863	0	512,657	0	224,504
2053	0	16,364,232	0	1,121,569	0	474,682	0	204,095
2054	0	16,364,232	0	1,058,084	0	439,520	0	185,541
2055	0	16,364,232	0	998,192	0	406,963	0	168,673
2056	0	16,364,232	0	941,691	0	376,818	0	153,340
2057	0	16,364,232	0	888,387	0	348,906	0	139,400
2058	0	16,364,232	0	838,101	0	323,061	0	126,727
2059	0	16,364,232	0	790,662	0	299,130	0	115,206
2060	0	16,364,232	0	745,907	0	276,972	0	104,733
2061	0	16,364,232	0	703,686	0	256,456	0	95,213
TOTAL	**1,108,928,956**	**736,390,422**	**719,626,915**	**149,704,626**	**627,603,916**	**99,121,675**	**549,160,921**	**68,448,199**

NET PRESENT COST

Discounted at 6%	869,331,541
Discounted at 8%	726,725,590
Discounted at 10%	617,609,120

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Mvoti Transfer Study
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R 41,786,938	0	R 33,099,169	0	R 30,714,647	0	R 28,541,041
2012	0	R 49,871,938	0	R 37,267,213	0	R 33,942,003	0	R 30,966,550
2013	0	R 226,926,508	0	R 159,974,234	0	R 143,002,193	0	R 128,094,098
2014	0	R 177,054,570	0	R 117,751,401	0	R 103,309,641	0	R 90,856,990
2015	0	R 276,393,810	0	R 173,412,896	0	R 149,326,975	0	R 128,939,752
2016	0	R 333,810,997	0	R 197,582,216	0	R 166,988,606	0	R 141,568,449
2017	46.3	R 16,364,232	26	R 9,137,701	21	R 7,579,806	18	R 6,309,120
2018	46.3	R 16,364,232	24	R 8,620,473	20	R 7,018,338	16	R 5,735,563
2019	46.3	R 16,364,232	23	R 8,132,522	18	R 6,498,462	15	R 5,214,148
2020	46.3	R 16,364,232	22	R 7,672,190	17	R 6,017,094	13	R 4,740,135
2021	46.3	R 16,364,232	20	R 7,237,915	16	R 5,571,383	12	R 4,309,214
2022	46.3	R 16,364,232	19	R 6,828,222	15	R 5,158,688	11	R 3,917,467
2023	46.3	R 16,364,232	18	R 6,441,719	14	R 4,776,563	10	R 3,561,334
2024	46.3	R 16,364,232	17	R 6,077,093	13	R 4,422,744	9	R 3,237,576
2025	46.3	R 16,364,232	16	R 5,733,107	12	R 4,095,133	8	R 2,943,251
2026	46.3	R 16,364,232	15	R 5,408,591	11	R 3,791,790	8	R 2,675,683
2027	46.3	R 16,364,232	14	R 5,102,445	10	R 3,510,917	7	R 2,432,439
2028	46.3	R 16,364,232	14	R 4,813,627	9	R 3,250,849	6	R 2,211,308
2029	46.3	R 16,364,232	13	R 4,541,158	9	R 3,010,045	6	R 2,010,280
2030	46.3	R 16,364,232	12	R 4,284,111	8	R 2,787,079	5	R 1,827,527
2031	46.3	R 17,906,330	11	R 4,422,479	7	R 2,823,816	5	R 1,817,951
2032	46.3	R 16,364,232	11	R 3,812,844	7	R 2,389,471	4	R 1,510,353
2033	46.3	R 16,364,232	10	R 3,597,022	6	R 2,212,473	4	R 1,373,048
2034	46.3	R 16,364,232	10	R 3,393,417	6	R 2,048,586	4	R 1,248,226
2035	46.3	R 16,364,232	9	R 3,201,337	5	R 1,896,839	3	R 1,134,751
2036	46.3	R 16,364,232	9	R 3,020,129	5	R 1,756,332	3	R 1,031,591
2037	46.3	R 16,364,232	8	R 2,849,179	5	R 1,626,234	3	R 937,810
2038	46.3	R 16,364,232	8	R 2,687,904	4	R 1,505,772	2	R 852,555
2039	46.3	R 16,364,232	7	R 2,535,759	4	R 1,394,233	2	R 775,050
2040	46.3	R 16,364,232	7	R 2,392,225	4	R 1,290,957	2	R 704,591
2041	46.3	R 16,364,232	6	R 2,256,816	3	R 1,195,330	2	R 640,537
2042	46.3	R 16,364,232	6	R 2,129,072	3	R 1,106,787	2	R 582,306
2043	46.3	R 16,364,232	6	R 2,008,558	3	R 1,024,803	1	R 529,370
2044	46.3	R 16,364,232	5	R 1,894,866	3	R 948,892	1	R 481,245
2045	46.3	R 16,364,232	5	R 1,787,610	2	R 878,603	1	R 437,495
2046	46.3	R 17,906,330	5	R 1,845,346	2	R 890,185	1	R 435,203
2047	46.3	R 16,364,232	5	R 1,590,966	2	R 753,261	1	R 361,567
2048	46.3	R 16,364,232	4	R 1,500,912	2	R 697,464	1	R 328,697
2049	46.3	R 16,364,232	4	R 1,415,954	2	R 645,800	1	R 298,815
2050	46.3	R 16,364,232	4	R 1,335,806	2	R 597,963	1	R 271,650
2051	46.3	R 16,364,232	4	R 1,260,194	2	R 553,669	1	R 246,955
2052	46.3	R 16,364,232	3	R 1,188,863	1	R 512,657	1	R 224,504
2053	46.3	R 16,364,232	3	R 1,121,569	1	R 474,682	1	R 204,095
2054	46.3	R 16,364,232	3	R 1,058,084	1	R 439,520	1	R 185,541
2055	46.3	R 16,364,232	3	R 998,192	1	R 406,963	0	R 168,673
2056	46.3	R 16,364,232	3	R 941,691	1	R 376,818	0	R 153,340
2057	46.3	R 16,364,232	3	R 888,387	1	R 348,906	0	R 139,400
2058	46.3	R 16,364,232	2	R 838,101	1	R 323,061	0	R 126,727
2059	46.3	R 16,364,232	2	R 790,662	1	R 299,130	0	R 115,206
2060	46.3	R 16,364,232	2	R 745,907	1	R 276,972	0	R 104,733
2061	46.3	R 16,364,232	2	R 703,686	1	R 256,456	0	R 95,212
TOTAL	**2083.5**	**R 1,845,319,378**	**424**	**R 869,331,541**	**280**	**R 726,725,590**	**194**	**R 617,609,120**
URV				**R 2.05**		**R 2.59**		**R 3.19**

Appendix D.4

Economic Analyses:

Desalination Option

Project Name: Desalination Option
Option: 50 Million m³/a
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1	**Commision year:**	2017	**Output:**	50.00 m³/a

Component	**Type**	**Name**	**Characteristics**		**Total Cost Sept 07**	**Total Cost Ecalated**	**Total Capital**	**Timing**		**Duration**	**Construction Cash Flow per year**
								Start	**End**		
Deslination Plant		Deslination Plant	**Cap**	50Mm³/a	R 926,000,000	R 926,000,000	R 926,000,000	2013	2016	4	R 231,500,000
Brine Outfall and Intake		Brine Outfall and Intake			R 926,000,000	R 926,000,000	R 926,000,000	2013	2016	4	R 231,500,000
Sub-Total					**R 1,852,000,000**	**R 1,852,000,000**	**R 1,852,000,000**			4	R 463,000,000
Engineering Fees	12%						**R 222,240,000.00**			4	R 55,560,000
Land Acquisitions and relocations							**R 5,000,000.00**			1	R 5,000,000
Social and Environmental	1%						**R 9,260,000.00**			2	R 4,630,000
Sub-Total							**R 2,088,500,000.00**				
VAT	14%						**R 292,390,000.00**				
Total							**R 2,380,890,000.00**				

DESALINATION OPTION

50 Million m³/a

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	DESALINATION PLANT, INTAKE AND BRINE OUTFALL	
				CAPITAL	MAINTENANCE & OPERATION
2007					
2008					
2009					
2010					
2011	55,560,000				
2012	55,560,000				
2013	55,560,000			463,000,000	
2014	55,560,000			463,000,000	
2015			4,630,000	463,000,000	
2016		5,000,000	4,630,000	463,000,000	
2017					343,000,000
2018					343,000,000
2019					343,000,000
2020					343,000,000
2021					343,000,000
2022					343,000,000
2023					343,000,000
2024					343,000,000
2025					343,000,000
2026					343,000,000
2027					343,000,000
2028					343,000,000
2029					343,000,000
2030					343,000,000
2031					343,000,000
2032					343,000,000
2033					343,000,000
2034					343,000,000
2035					343,000,000
2036					343,000,000
2037					343,000,000
2038					343,000,000
2039					343,000,000
2040					343,000,000
2041					343,000,000
2042					343,000,000
2043					343,000,000
2044					343,000,000
2045					343,000,000
2046					343,000,000
2047					343,000,000
2048					343,000,000
2049					343,000,000
2050					343,000,000
2051					343,000,000
2052					343,000,000
2053					343,000,000
2054					343,000,000
2055					343,000,000
2056					343,000,000
2057					343,000,000
2058					343,000,000
2059					343,000,000
2060					343,000,000
2061					343,000,000
TOTAL	**222,240,000**	**5,000,000**	**9,260,000**	**1,852,000,000**	**15,435,000,000**

DESALINATION OPTION

50 Million m³/a

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	55,560,000	0	44,008,724	0	40,838,259	0	37,948,228	0
2012	55,560,000	0	41,517,664	0	37,813,202	0	34,498,389	0
2013	518,560,000	0	365,564,338	0	326,780,762	0	292,713,601	0
2014	518,560,000	0	344,872,017	0	302,574,779	0	266,103,274	0
2015	467,630,000	0	293,396,847	0	252,645,938	0	218,152,846	0
2016	472,630,000	0	279,748,971	0	236,432,669	0	200,441,257	0
2017	0	343,000,000	0	191,529,408	0	158,875,366	0	132,241,348
2018	0	343,000,000	0	180,688,121	0	147,106,821	0	120,219,408
2019	0	343,000,000	0	170,460,492	0	136,210,019	0	109,290,370
2020	0	343,000,000	0	160,811,785	0	126,120,388	0	99,354,882
2021	0	343,000,000	0	151,709,231	0	116,778,137	0	90,322,620
2022	0	343,000,000	0	143,121,916	0	108,127,905	0	82,111,473
2023	0	343,000,000	0	135,020,675	0	100,118,430	0	74,646,794
2024	0	343,000,000	0	127,377,996	0	92,702,250	0	67,860,721
2025	0	343,000,000	0	120,167,920	0	85,835,417	0	61,691,565
2026	0	343,000,000	0	113,365,963	0	79,477,238	0	56,083,241
2027	0	343,000,000	0	106,949,021	0	73,590,035	0	50,984,764
2028	0	343,000,000	0	100,895,303	0	68,138,921	0	46,349,786
2029	0	343,000,000	0	95,184,248	0	63,091,594	0	42,136,169
2030	0	343,000,000	0	89,796,461	0	58,418,143	0	38,305,608
2031	0	343,000,000	0	84,713,642	0	54,090,873	0	34,823,280
2032	0	343,000,000	0	79,918,530	0	50,084,141	0	31,657,527
2033	0	343,000,000	0	75,394,840	0	46,374,205	0	28,779,570
2034	0	343,000,000	0	71,127,207	0	42,939,079	0	26,163,246
2035	0	343,000,000	0	67,101,139	0	39,758,406	0	23,784,769
2036	0	343,000,000	0	63,302,961	0	36,813,339	0	21,622,517
2037	0	343,000,000	0	59,719,775	0	34,086,425	0	19,656,834
2038	0	343,000,000	0	56,339,410	0	31,561,505	0	17,869,849
2039	0	343,000,000	0	53,150,387	0	29,223,615	0	16,245,317
2040	0	343,000,000	0	50,141,875	0	27,058,903	0	14,768,470
2041	0	343,000,000	0	47,303,655	0	25,054,540	0	13,425,882
2042	0	343,000,000	0	44,626,090	0	23,198,648	0	12,205,347
2043	0	343,000,000	0	42,100,085	0	21,480,230	0	11,095,770
2044	0	343,000,000	0	39,717,061	0	19,889,102	0	10,087,064
2045	0	343,000,000	0	37,468,926	0	18,415,835	0	9,170,058
2046	0	343,000,000	0	35,348,043	0	17,051,699	0	8,336,416
2047	0	343,000,000	0	33,347,210	0	15,788,610	0	7,578,560
2048	0	343,000,000	0	31,459,632	0	14,619,083	0	6,889,600
2049	0	343,000,000	0	29,678,899	0	13,536,188	0	6,263,273
2050	0	343,000,000	0	27,998,961	0	12,533,508	0	5,693,885
			0					
2051	0	343,000,000	0	26,414,114	0	11,605,100	0	5,176,259
2052	0	343,000,000	0	24,918,976	0	10,745,463	0	4,705,690
2053	0	343,000,000	0	23,508,467	0	9,949,503	0	4,277,900
2054	0	343,000,000	0	22,177,799	0	9,212,502	0	3,889,000
2055	0	343,000,000	0	20,922,452	0	8,530,095	0	3,535,454
2056	0	343,000,000	0	19,738,163	0	7,898,236	0	3,214,049
2057	0	343,000,000	0	18,620,908	0	7,313,181	0	2,921,863
2058	0	343,000,000	0	17,566,894	0	6,771,464	0	2,656,239
2059	0	343,000,000	0	16,572,542	0	6,269,874	0	2,414,763
2060	0	343,000,000	0	15,634,474	0	5,805,439	0	2,195,239
2061	0	343,000,000	0	14,749,503	0	5,375,407	0	1,995,672
TOTAL	**2,088,500,000**	**15,435,000,000**	**1,369,108,561**	**3,137,861,161**	**1,197,085,610**	**2,077,624,864**	**1,049,857,595**	**1,434,698,113**

NET PRESENT COST

Discounted at 6%	4,506,969,722
Discounted at 8%	3,274,710,473
Discounted at 10%	2,484,555,708

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: DESALINATION OPTION - 50 Million m³/a
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand Mm³/a	Total annual costs (excl VAT)	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
				Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007	0	R -	0	R -	0	R -	0	R -
	2008	0	R -	0	R -	0	R -	0	R -
	2009	0	R -	0	R -	0	R -	0	R -
	2010	0	R -	0	R -	0	R -	0	R -
	2011	0	R 55,560,000	0	R 44,008,724	0	R 40,838,259	0	R 37,948,228
	2012	0	R 55,560,000	0	R 41,517,664	0	R 37,813,202	0	R 34,498,389
	2013	0	R 518,560,000	0	R 365,564,338	0	R 326,780,762	0	R 292,713,601
	2014	0	R 518,560,000	0	R 344,872,017	0	R 302,574,779	0	R 266,103,274
	2015	0	R 467,630,000	0	R 293,396,847	0	R 252,645,938	0	R 218,152,846
	2016	0	R 472,630,000	0	R 279,748,971	0	R 236,432,669	0	R 200,441,257
1	2017	7.9	R 343,000,000	4	R 191,529,408	4	R 158,875,366	3	R 132,241,348
2	2018	14.8	R 343,000,000	8	R 180,688,121	6	R 147,106,821	5	R 120,219,408
3	2019	23.9	R 343,000,000	12	R 170,460,492	9	R 136,210,019	8	R 109,290,370
4	2020	34.6	R 343,000,000	16	R 160,811,785	13	R 126,120,388	10	R 99,354,882
5	2021	41.3	R 343,000,000	18	R 151,709,231	14	R 116,778,137	11	R 90,322,620
6	2022	48.1	R 343,000,000	20	R 143,121,916	15	R 108,127,905	12	R 82,111,473
7	2023	50	R 343,000,000	20	R 135,020,675	15	R 100,118,430	11	R 74,646,794
8	2024	50	R 343,000,000	19	R 127,377,996	14	R 92,702,250	10	R 67,860,721
9	2025	50	R 343,000,000	18	R 120,167,920	13	R 85,835,417	9	R 61,691,565
10	2026	50	R 343,000,000	17	R 113,365,963	12	R 79,477,238	8	R 56,083,241
11	2027	50	R 343,000,000	16	R 106,949,021	11	R 73,590,035	7	R 50,984,764
12	2028	50	R 343,000,000	15	R 100,895,303	10	R 68,138,921	7	R 46,349,786
13	2029	50	R 343,000,000	14	R 95,184,248	9	R 63,091,594	6	R 42,136,169
14	2030	50	R 343,000,000	13	R 89,796,461	9	R 58,418,143	6	R 38,305,608
15	2031	50	R 343,000,000	12	R 84,713,642	8	R 54,090,873	5	R 34,823,280
16	2032	50	R 343,000,000	12	R 79,918,530	7	R 50,084,141	5	R 31,657,527
17	2033	50	R 343,000,000	11	R 75,394,840	7	R 46,374,205	4	R 28,779,570
18	2034	50	R 343,000,000	10	R 71,127,207	6	R 42,939,079	4	R 26,163,246
19	2035	50	R 343,000,000	10	R 67,101,139	6	R 39,758,406	3	R 23,784,769
20	2036	50	R 343,000,000	9	R 63,302,961	5	R 36,813,339	3	R 21,622,517
21	2037	50	R 343,000,000	9	R 59,719,775	5	R 34,086,425	3	R 19,656,834
22	2038	50	R 343,000,000	8	R 56,339,410	5	R 31,561,505	3	R 17,869,849
23	2039	50	R 343,000,000	8	R 53,150,387	4	R 29,223,615	2	R 16,245,317
24	2040	50	R 343,000,000	7	R 50,141,875	4	R 27,058,903	2	R 14,768,470
25	2041	50	R 343,000,000	7	R 47,303,655	4	R 25,054,540	2	R 13,425,882
26	2042	50	R 343,000,000	7	R 44,626,090	3	R 23,198,648	2	R 12,205,347
27	2043	50	R 343,000,000	6	R 42,100,085	3	R 21,480,230	2	R 11,095,770
28	2044	50	R 343,000,000	6	R 39,717,061	3	R 19,889,102	1	R 10,087,064
29	2045	50	R 343,000,000	5	R 37,468,926	3	R 18,415,835	1	R 9,170,058
30	2046	50	R 343,000,000	5	R 35,348,043	2	R 17,051,699	1	R 8,336,416
31	2047	50	R 343,000,000	5	R 33,347,210	2	R 15,788,610	1	R 7,578,560
32	2048	50	R 343,000,000	5	R 31,459,632	2	R 14,619,083	1	R 6,889,600
33	2049	50	R 343,000,000	4	R 29,678,899	2	R 13,536,188	1	R 6,263,273
34	2050	50	R 343,000,000	4	R 27,998,961	2	R 12,533,508	1	R 5,693,885
35	2051	50	R 343,000,000	4	R 26,414,114	2	R 11,605,100	1	R 5,176,259
36	2052	50	R 343,000,000	4	R 24,918,976	2	R 10,745,463	1	R 4,705,690
37	2053	50	R 343,000,000	3	R 23,508,467	1	R 9,949,503	1	R 4,277,900
38	2054	50	R 343,000,000	3	R 22,177,799	1	R 9,212,502	1	R 3,889,000
39	2055	50	R 343,000,000	3	R 20,922,452	1	R 8,530,095	1	R 3,535,454
40	2056	50	R 343,000,000	3	R 19,738,163	1	R 7,898,236	0	R 3,214,049
41	2057	50	R 343,000,000	3	R 18,620,908	1	R 7,313,181	0	R 2,921,863
42	2058	50	R 343,000,000	3	R 17,566,894	1	R 6,771,464	0	R 2,656,239
43	2059	50	R 343,000,000	2	R 16,572,542	1	R 6,269,874	0	R 2,414,763
44	2060	50	R 343,000,000	2	R 15,634,474	1	R 5,805,439	0	R 2,195,239
45	2061	50	R 343,000,000	2	R 14,749,503	1	R 5,375,407	0	R 1,995,672
	TOTAL	**2120.6**	**R 17,523,500,000**	**391**	**R 4,506,969,722**	**249**	**R 3,274,710,473**	**165**	**R 2,484,555,708**
	URV				**R 11.54**		**R 13.17**		**R 15.05**

Appendix D.5

Economic Analyses:

Lower Tugela Scheme

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Capital Cost - Sept 2007
Weir and Abstraction Works		Weir in Tugela River			R 33,858,825	R 33,858,825
Treatment Works		Fawsley Park	**Cap**		R 172,972,800	R 172,973,520
Pipelines			**Dia**	**Length**		
		Absraction Works to Fawsley Park WW	1200	27km	R 237,391,560	R 237,391,560
Pumpstation		Tugela River			R 29,000,000	R 29,000,000
Advance infrastructure		Access and Elect to Site			R 10,000,000	R 10,000,000
Sub-Total					**R 483,223,185**	**R 483,223,905**
Engineering Fees	12%					**R 57,986,868.60**
Land Acquisitions and relocations						**R 5,000,000.00**
Social and Environmental	1%					**R 4,832,239.05**
Sub-Total						**R 551,043,012.65**
VAT	14%					**R 77,146,021.77**
Total						**R 628,189,034.42**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: TUGELA SCHEME
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	1.217	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	1.62	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	1.217	
Peak factor	1.04			
Average head pumped		m	240.00	**240.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	3.3	**3.3**
power absorbed at Qd: (Pd / Pf)		MVA	3.5	**3.5**
		MVAh	83.3	**83.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	4.6	**4.6**
head pumped (Hd)		m	240.00	**240.0**
Energy consumed over 24 hours (continuous use)	24	MWh	80.0	**80**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	5,516,475.80	**R**	**5,516,475.80**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	555,509.11	**R**	**555,509.11**
Transmission surcharge (< 300 km)	%		1.00%	R	55,164.76	**R**	**55,164.76**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	417,024.30	**R**	**417,024.30**
Network Charge	R/MVA	R	6,340.00	R	29,339.49	**R**	**29,339.49**
Total annual cost				**R**	**6,586,361.46**	**R**	**6,586,361.46**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: TUGELA SCHEME
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.406	m3/s	Pump Station Capacity
Total flow	1.217	m3/s	36.8 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
2	2018	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
3	2019	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
4	2020	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
5	2021	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
6	2022	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
7	2023	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
8	2024	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
9	2025	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
10	2026	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
11	2027	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
12	2028	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
13	2029	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
14	2030	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
15	2031	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
16	2032	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
17	2033	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
18	2034	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
19	2035	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
20	2036	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
21	2037	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
22	2038	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
23	2039	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
24	2040	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
25	2041	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
26	2042	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
27	2043	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
28	2044	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
29	2045	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
30	2046	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
31	2047	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
32	2048	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
33	2049	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
34	2050	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
35	2051	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
36	2052	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
37	2053	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
38	2054	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
39	2055	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
40	2056	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
41	2057	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
42	2058	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
43	2059	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
44	2060	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
45	2061	24.00	4	3	80	5,516,476	42,187	417,024	610,674	6,586,361
	TOTAL					**248,241,411**	**1,898,437**		**27,480,324**	**296,386,266**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	36.800	0.00%	36.80	1.217	0.000	24.00
2018	36.800	0.00%	36.80	1.217	0.000	24.00
2019	36.800	0.00%	36.80	1.217	0.000	24.00
2020	36.800	0.00%	36.80	1.217	0.000	24.00
2021	36.800	0.00%	36.80	1.217	0.000	24.00
2022	36.800	0.00%	36.80	1.217	0.000	24.00
2023	36.800	0.00%	36.80	1.217	0.000	24.00
2024	36.800	0.00%	36.80	1.217	0.000	24.00
2025	36.800	0.00%	36.80	1.217	0.000	24.00
2026	36.800	0.00%	36.80	1.217	0.000	24.00
2027	36.800	0.00%	36.80	1.217	0.000	24.00
2028	36.800	0.00%	36.80	1.217	0.000	24.00
2029	36.800	0.00%	36.80	1.217	0.000	24.00
2030	36.800	0.00%	36.80	1.217	0.000	24.00
2031	36.800	0.00%	36.80	1.217	0.000	24.00
2032	36.800	0.00%	36.80	1.217	0.000	24.00
2033	36.800	0.00%	36.80	1.217	0.000	24.00
2034	36.800	0.00%	36.80	1.217	0.000	24.00
2035	36.800	0.00%	36.80	1.217	0.000	24.00
2036	36.800	0.00%	36.80	1.217	0.000	24.00
2037	36.800	0.00%	36.80	1.217	0.000	24.00
2038	36.800	0.00%	36.80	1.217	0.000	24.00
2039	36.800	0.00%	36.80	1.217	0.000	24.00
2040	36.800	0.00%	36.80	1.217	0.000	24.00
2041	36.800	0.00%	36.80	1.217	0.000	24.00
2042	36.800	0.00%	36.80	1.217	0.000	24.00
2043	36.800	0.00%	36.80	1.217	0.000	24.00
2044	36.800	0.00%	36.80	1.217	0.000	24.00
2045	36.800	0.00%	36.80	1.217	0.000	24.00
2046	36.800	0.00%	36.80	1.217	0.000	24.00
2047	36.800	0.00%	36.80	1.217	0.000	24.00
2048	36.800	0.00%	36.80	1.217	0.000	24.00
2049	36.800	0.00%	36.80	1.217	0.000	24.00
2050	36.800	0.00%	36.80	1.217	0.000	24.00
2051	36.800	0.00%	36.80	1.217	0.000	24.00
2052	36.800	0.00%	36.80	1.217	0.000	24.00
2053	36.800	0.00%	36.80	1.217	0.000	24.00
2054	36.800	0.00%	36.80	1.217	0.000	24.00
2055	36.800	0.00%	36.80	1.217	0.000	24.00
2056	36.800	0.00%	36.80	1.217	0.000	24.00
2057	36.800	0.00%	36.80	1.217	0.000	24.00
2058	36.800	0.00%	36.80	1.217	0.000	24.00
2059	36.800	0.00%	36.80	1.217	0.000	24.00
2060	36.800	0.00%	36.80	1.217	0.000	24.00
2061	36.800	0.00%	36.80	1.217	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Tugela Transfer Study

Tugela Scheme

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	WEIR AND ABSTRACTION WORKS		TREATMENT WORKS			PIPELINE: WEIR TO FAWSLEY PARK WW		ADVANCED INFRASTRUCTURE		PUMP STATION AND INTAKE TOWER COSTS				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL - CIVIL	CAPITAL - MECH & ELECT	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000																	
2001																	
2002																	
2003																	
2004																	
2005																	
2006																	
2007																	
2008																	
2009																	
2010																	
2011																	
2012																	
2013	28,993,434																
2014	28,993,434																
2015		5,000,000	4,832,239	16,929,413		41,081,400	45,405,360		118,695,780				4,640,000	9,860,000			
2016				16,929,413		41,081,400	45,405,360		118,695,780		10,000,000		4,640,000	9,860,000			
2017					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2018					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2019					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2020					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2021					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2022					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2023					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2024					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2025					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2026					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2027					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2028					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2029					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2030					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2031					84,647			3,837,836		1,186,958		25,000	0	1,305,000	0	812,000	6,586,361
2032					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2033					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2034					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2035					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2036					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2037					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2038					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2039					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2040					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2041					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2042					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2043					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2044					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2045					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2046					84,647			3,837,836		1,186,958		25,000	0	1,305,000	0	812,000	6,586,361
2047					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2048					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2049					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2050					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2051					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2052					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2053					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2054					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2055					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2056					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2057					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2058					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2059					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2060					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
2061					84,647			3,837,836		1,186,958		25,000	0		0	812,000	6,586,361
TOTAL	**57,986,869**	**5,000,000**	**4,832,239**	**33,858,825**	**3,809,118**	**82,162,800**	**90,810,720**	**172,702,611**	**237,391,560**	**53,413,101**	**10,000,000**	**1,125,000**	**9,280,000**	**22,330,000**	**0**	**36,540,000**	**296,386,266**

Tugela Transfer Study

Tugela Scheme

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	28,993,434	0	20,439,227	0	18,270,782	0	16,366,038	0
2014	28,993,434	0	19,282,290	0	16,917,390	0	14,878,216	0
2015	246,444,192	0	154,622,135	0	133,146,128	0	114,968,034	0
2016	246,611,953	0	145,969,236	0	123,367,375	0	104,587,542	0
2017	0	12,532,802	0	6,998,251	0	5,805,112	0	4,831,938
2018	0	12,532,802	0	6,602,124	0	5,375,104	0	4,392,671
2019	0	12,532,802	0	6,228,419	0	4,976,948	0	3,993,337
2020	0	12,532,802	0	5,875,867	0	4,608,285	0	3,630,306
2021	0	12,532,802	0	5,543,270	0	4,266,931	0	3,300,279
2022	0	12,532,802	0	5,229,500	0	3,950,862	0	3,000,253
2023	0	12,532,802	0	4,933,491	0	3,658,205	0	2,727,503
2024	0	12,532,802	0	4,654,237	0	3,387,227	0	2,479,548
2025	0	12,532,802	0	4,390,789	0	3,136,322	0	2,254,135
2026	0	12,532,802	0	4,142,254	0	2,904,001	0	2,049,213
2027	0	12,532,802	0	3,907,787	0	2,688,890	0	1,862,921
2028	0	12,532,802	0	3,686,591	0	2,489,713	0	1,693,565
2029	0	12,532,802	0	3,477,916	0	2,305,290	0	1,539,604
2030	0	12,532,802	0	3,281,053	0	2,134,528	0	1,399,640
2031	1,305,000	12,532,802	322,307	3,095,333	205,798	1,976,415	132,491	1,272,400
2032	0	12,532,802	0	2,920,126	0	1,830,014	0	1,156,727
2033	0	12,532,802	0	2,754,836	0	1,694,457	0	1,051,570
2034	0	12,532,802	0	2,598,902	0	1,568,942	0	955,973
2035	0	12,532,802	0	2,451,794	0	1,452,724	0	869,066
2036	0	12,532,802	0	2,313,013	0	1,345,115	0	790,060
2037	0	12,532,802	0	2,182,088	0	1,245,476	0	718,237
2038	0	12,532,802	0	2,058,573	0	1,153,219	0	652,943
2039	0	12,532,802	0	1,942,050	0	1,067,795	0	593,584
2040	0	12,532,802	0	1,832,123	0	988,699	0	539,622
2041	0	12,532,802	0	1,728,418	0	915,462	0	490,565
2042	0	12,532,802	0	1,630,583	0	847,650	0	445,969
2043	0	12,532,802	0	1,538,286	0	784,861	0	405,426
2044	0	12,532,802	0	1,451,213	0	726,724	0	368,569
2045	0	12,532,802	0	1,369,069	0	672,892	0	335,063
2046	1,305,000	12,532,802	134,487	1,291,574	64,876	623,048	31,717	304,602
2047	0	12,532,802	0	1,218,466	0	576,897	0	276,911
2048	0	12,532,802	0	1,149,497	0	534,163	0	251,738
2049	0	12,532,802	0	1,084,431	0	494,596	0	228,852
2050	0	12,532,802	0	1,023,048	0	457,959	0	208,048
			0					
2051	0	12,532,802	0	965,140	0	424,036	0	189,134
2052	0	12,532,802	0	910,509	0	392,626	0	171,940
2053	0	12,532,802	0	858,971	0	363,543	0	156,309
2054	0	12,532,802	0	810,350	0	336,614	0	142,099
2055	0	12,532,802	0	764,481	0	311,679	0	129,181
2056	0	12,532,802	0	721,208	0	288,592	0	117,437
2057	0	12,532,802	0	680,385	0	267,215	0	106,761
2058	0	12,532,802	0	641,873	0	247,421	0	97,056
2059	0	12,532,802	0	605,540	0	229,094	0	88,232
2060	0	12,532,802	0	571,265	0	212,124	0	80,211
2061	0	12,532,802	0	538,929	0	196,411	0	72,919
TOTAL	553,653,013	563,976,095	340,769,682	114,653,624	291,972,349	75,913,881	250,964,038	52,422,121

NET PRESENT COST

Discounted at 6%	455,423,306
Discounted at 8%	367,886,230
Discounted at 10%	303,386,159

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: TUGELA SCHEME
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R 28,993,434	0	R 20,439,227	0	R 18,270,782	0	R 16,366,038
2014	0	R 28,993,434	0	R 19,282,290	0	R 16,917,390	0	R 14,878,216
2015	0	R 246,444,192	0	R 154,622,135	0	R 133,146,128	0	R 114,968,034
2016	0	R 246,611,953	0	R 145,969,236	0	R 123,367,375	0	R 104,587,542
2017	36.8	R 12,532,802	21	R 6,998,251	17	R 5,805,112	14	R 4,831,938
2018	36.8	R 12,532,802	19	R 6,602,124	16	R 5,375,104	13	R 4,392,671
2019	36.8	R 12,532,802	18	R 6,228,419	15	R 4,976,948	12	R 3,993,337
2020	36.8	R 12,532,802	17	R 5,875,867	14	R 4,608,285	11	R 3,630,306
2021	36.8	R 12,532,802	16	R 5,543,270	13	R 4,266,931	10	R 3,300,279
2022	36.8	R 12,532,802	15	R 5,229,500	12	R 3,950,862	9	R 3,000,253
2023	36.8	R 12,532,802	14	R 4,933,491	11	R 3,658,205	8	R 2,727,503
2024	36.8	R 12,532,802	14	R 4,654,237	10	R 3,387,227	7	R 2,479,548
2025	36.8	R 12,532,802	13	R 4,390,789	9	R 3,136,322	7	R 2,254,135
2026	36.8	R 12,532,802	12	R 4,142,254	9	R 2,904,001	6	R 2,049,213
2027	36.8	R 12,532,802	11	R 3,907,787	8	R 2,688,890	5	R 1,862,921
2028	36.8	R 12,532,802	11	R 3,686,591	7	R 2,489,713	5	R 1,693,565
2029	36.8	R 12,532,802	10	R 3,477,916	7	R 2,305,290	5	R 1,539,604
2030	36.8	R 12,532,802	10	R 3,281,053	6	R 2,134,528	4	R 1,399,640
2031	36.8	R 13,837,802	9	R 3,417,640	6	R 2,182,212	4	R 1,404,891
2032	36.8	R 12,532,802	9	R 2,920,126	5	R 1,830,014	3	R 1,156,727
2033	36.8	R 12,532,802	8	R 2,754,836	5	R 1,694,457	3	R 1,051,570
2034	36.8	R 12,532,802	8	R 2,598,902	5	R 1,568,942	3	R 955,973
2035	36.8	R 12,532,802	7	R 2,451,794	4	R 1,452,724	3	R 869,066
2036	36.8	R 12,532,802	7	R 2,313,013	4	R 1,345,115	2	R 790,060
2037	36.8	R 12,532,802	6	R 2,182,088	4	R 1,245,476	2	R 718,237
2038	36.8	R 12,532,802	6	R 2,058,573	3	R 1,153,219	2	R 652,943
2039	36.8	R 12,532,802	6	R 1,942,050	3	R 1,067,795	2	R 593,584
2040	36.8	R 12,532,802	5	R 1,832,123	3	R 988,699	2	R 539,622
2041	36.8	R 12,532,802	5	R 1,728,418	3	R 915,462	1	R 490,565
2042	36.8	R 12,532,802	5	R 1,630,583	2	R 847,650	1	R 445,969
2043	36.8	R 12,532,802	5	R 1,538,286	2	R 784,861	1	R 405,426
2044	36.8	R 12,532,802	4	R 1,451,213	2	R 726,724	1	R 368,569
2045	36.8	R 12,532,802	4	R 1,369,069	2	R 672,892	1	R 335,063
2046	36.8	R 13,837,802	4	R 1,426,062	2	R 687,924	1	R 336,320
2047	36.8	R 12,532,802	4	R 1,218,466	2	R 576,897	1	R 276,911
2048	36.8	R 12,532,802	3	R 1,149,497	2	R 534,163	1	R 251,738
2049	36.8	R 12,532,802	3	R 1,084,431	1	R 494,596	1	R 228,852
2050	36.8	R 12,532,802	3	R 1,023,048	1	R 457,959	1	R 208,048
2051	36.8	R 12,532,802	3	R 965,140	1	R 424,036	1	R 189,134
2052	36.8	R 12,532,802	3	R 910,509	1	R 392,626	1	R 171,940
2053	36.8	R 12,532,802	3	R 858,971	1	R 363,543	0	R 156,309
2054	36.8	R 12,532,802	2	R 810,350	1	R 336,614	0	R 142,099
2055	36.8	R 12,532,802	2	R 764,481	1	R 311,679	0	R 129,181
2056	36.8	R 12,532,802	2	R 721,208	1	R 288,592	0	R 117,437
2057	36.8	R 12,532,802	2	R 680,385	1	R 267,215	0	R 106,761
2058	36.8	R 12,532,802	2	R 641,873	1	R 247,421	0	R 97,056
2059	36.8	R 12,532,802	2	R 605,540	1	R 229,094	0	R 88,232
2060	36.8	R 12,532,802	2	R 571,265	1	R 212,124	0	R 80,211
2061	36.8	R 12,532,802	2	R 538,929	1	R 196,411	0	R 72,919
TOTAL	**1656**	**R 1,117,629,108**	**337**	**R 455,423,306**	**223**	**R 367,886,230**	**154**	**R 303,386,159**

URV				**R 1.35**		**R 1.65**		**R 1.97**

Appendix D.6

Economic Analyses:

Waste Water Reuse Options

BLOCK DEMAND

- Kwamashu WWTW to Hazelmere Dam – 23 million m^3/a – Block demand

Project Name: Re-Use Options
Option: KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 0.76 m³/s

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Kwamashu WWTW		Kwamashu WWTW			R 29,000,000	R 29,000,000	R 29,000,000		R 29,000,000	2015	2016	2	R 14,500,000	R -
Pipelines			**Dia**	**Length**										
		Kwamashu WWTW to Hazlemere	900	20km	R 78,649,200	R 78,649,200	R 78,649,200		R 78,649,200	2015	2016	2	R 39,324,600	R -
Pumpstation		At Kwamashu WWTW			R 53,000,000	R 53,000,000	R 16,430,000	R 36,570,000	R 53,000,000	2015	2016	2	R 8,215,000	R 18,285,000
Sub-Total					**R 160,649,200**	**R 160,649,200**	**R 124,079,200**	**R 36,570,000**	**R 160,649,200**					
Engineering Fees	12%								**R 19,277,904.00**			2	R 9,638,952	
Land Acquisitions and relocations									**R 5,000,000.00**			1	R 5,000,000	
Social and Environmenta	1%								**R 1,606,492.00**			1	R 1,606,492	
Sub-Total									**R 186,533,596.00**					
VAT	14%								**R 26,114,703.44**					
Total									**R 212,648,299.44**					

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand
DATE: September 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.761	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	1.01	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.761	
Peak factor	1.04			
Average head pumped		m	123.00	**123.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	1.1	**1.1**
power absorbed at Qd: (Pd / Pf)		MVA	1.1	**1.1**
		MVAh	26.7	**26.7**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	1.5	**1.5**
head pumped (Hd)		m	123.00	**123.0**
Energy consumed over 24 hours (continuous use)	24	MWh	25.6	**26**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	1,766,996.15	**R**	**1,766,996.15**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	177,936.51	**R**	**177,936.51**
Transmission surcharge (< 300 km)	%		1.00%	R	17,669.96	**R**	**17,669.96**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	133,578.10	**R**	**133,578.10**
Network Charge	R/MVA	R	6,340.00	R	9,397.81	**R**	**9,397.81**
Total annual cost				**R**	**2,118,426.53**	**R**	**2,118,426.53**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand
DATE: September 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.254	m3/s		Pump Station Capacity
Total flow	0.761	m3/s		23 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
2	2018	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
3	2019	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
4	2020	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
5	2021	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
6	2022	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
7	2023	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
8	2024	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
9	2025	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
10	2026	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
11	2027	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
12	2028	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
13	2029	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
14	2030	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
15	2031	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
16	2032	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
17	2033	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
18	2034	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
19	2035	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
20	2036	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
21	2037	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
22	2038	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
23	2039	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
24	2040	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
25	2041	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
26	2042	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
27	2043	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
28	2044	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
29	2045	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
30	2046	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
31	2047	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
32	2048	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
33	2049	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
34	2050	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
35	2051	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
36	2052	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
37	2053	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
38	2054	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
39	2055	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
40	2056	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
41	2057	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
42	2058	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
43	2059	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
44	2060	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
45	2061	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
	TOTAL					**79,514,827**	**1,001,061**		**8,802,291**	**95,329,194**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	23.000	0.00%	23.00	0.761	0.000	24.00
2018	23.000	0.00%	23.00	0.761	0.000	24.00
2019	23.000	0.00%	23.00	0.761	0.000	24.00
2020	23.000	0.00%	23.00	0.761	0.000	24.00
2021	23.000	0.00%	23.00	0.761	0.000	24.00
2022	23.000	0.00%	23.00	0.761	0.000	24.00
2023	23.000	0.00%	23.00	0.761	0.000	24.00
2024	23.000	0.00%	23.00	0.761	0.000	24.00
2025	23.000	0.00%	23.00	0.761	0.000	24.00
2026	23.000	0.00%	23.00	0.761	0.000	24.00
2027	23.000	0.00%	23.00	0.761	0.000	24.00
2028	23.000	0.00%	23.00	0.761	0.000	24.00
2029	23.000	0.00%	23.00	0.761	0.000	24.00
2030	23.000	0.00%	23.00	0.761	0.000	24.00
2031	23.000	0.00%	23.00	0.761	0.000	24.00
2032	23.000	0.00%	23.00	0.761	0.000	24.00
2033	23.000	0.00%	23.00	0.761	0.000	24.00
2034	23.000	0.00%	23.00	0.761	0.000	24.00
2035	23.000	0.00%	23.00	0.761	0.000	24.00
2036	23.000	0.00%	23.00	0.761	0.000	24.00
2037	23.000	0.00%	23.00	0.761	0.000	24.00
2038	23.000	0.00%	23.00	0.761	0.000	24.00
2039	23.000	0.00%	23.00	0.761	0.000	24.00
2040	23.000	0.00%	23.00	0.761	0.000	24.00
2041	23.000	0.00%	23.00	0.761	0.000	24.00
2042	23.000	0.00%	23.00	0.761	0.000	24.00
2043	23.000	0.00%	23.00	0.761	0.000	24.00
2044	23.000	0.00%	23.00	0.761	0.000	24.00
2045	23.000	0.00%	23.00	0.761	0.000	24.00
2046	23.000	0.00%	23.00	0.761	0.000	24.00
2047	23.000	0.00%	23.00	0.761	0.000	24.00
2048	23.000	0.00%	23.00	0.761	0.000	24.00
2049	23.000	0.00%	23.00	0.761	0.000	24.00
2050	23.000	0.00%	23.00	0.761	0.000	24.00
2051	23.000	0.00%	23.00	0.761	0.000	24.00
2052	23.000	0.00%	23.00	0.761	0.000	24.00
2053	23.000	0.00%	23.00	0.761	0.000	24.00
2054	23.000	0.00%	23.00	0.761	0.000	24.00
2055	23.000	0.00%	23.00	0.761	0.000	24.00
2056	23.000	0.00%	23.00	0.761	0.000	24.00
2057	23.000	0.00%	23.00	0.761	0.000	24.00
2058	23.000	0.00%	23.00	0.761	0.000	24.00
2059	23.000	0.00%	23.00	0.761	0.000	24.00
2060	23.000	0.00%	23.00	0.761	0.000	24.00
2061	23.000	0.00%	23.00	0.761	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PUMP STATION AT KWAMASHU WWTW				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014	9,638,952											
2015	9,638,952	5,000,000	1,606,492	14,500,000		39,324,600		8,215,000	18,285,000			
2016				14,500,000		39,324,600		8,215,000	18,285,000			
2017					2,960,000		393,246	0		0	1,503,875	2,118,427
2018					2,960,000		393,246	0		0	1,503,875	2,118,427
2019					2,960,000		393,246	0		0	1,503,875	2,118,427
2020					2,960,000		393,246	0		0	1,503,875	2,118,427
2021					2,960,000		393,246	0		0	1,503,875	2,118,427
2022					2,960,000		393,246	0		0	1,503,875	2,118,427
2023					2,960,000		393,246	0		0	1,503,875	2,118,427
2024					2,960,000		393,246	0		0	1,503,875	2,118,427
2025					2,960,000		393,246	0		0	1,503,875	2,118,427
2026					2,960,000		393,246	0		0	1,503,875	2,118,427
2027					2,960,000		393,246	0		0	1,503,875	2,118,427
2028					2,960,000		393,246	0		0	1,503,875	2,118,427
2029					2,960,000		393,246	0		0	1,503,875	2,118,427
2030					2,960,000		393,246	0		0	1,503,875	2,118,427
2031					2,960,000		393,246	0	2,385,000	0	1,503,875	2,118,427
2032					2,960,000		393,246	0		0	1,503,875	2,118,427
2033					2,960,000		393,246	0		0	1,503,875	2,118,427
2034					2,960,000		393,246	0		0	1,503,875	2,118,427
2035					2,960,000		393,246	0		0	1,503,875	2,118,427
2036					2,960,000		393,246	0		0	1,503,875	2,118,427
2037					2,960,000		393,246	0		0	1,503,875	2,118,427
2038					2,960,000		393,246	0		0	1,503,875	2,118,427
2039					2,960,000		393,246	0		0	1,503,875	2,118,427
2040					2,960,000		393,246	0		0	1,503,875	2,118,427
2041					2,960,000		393,246	0		0	1,503,875	2,118,427
2042					2,960,000		393,246	0		0	1,503,875	2,118,427
2043					2,960,000		393,246	0		0	1,503,875	2,118,427
2044					2,960,000		393,246	0		0	1,503,875	2,118,427
2045					2,960,000		393,246	0		0	1,503,875	2,118,427
2046					2,960,000		393,246	0	2,385,000	0	1,503,875	2,118,427
2047					2,960,000		393,246	0		0	1,503,875	2,118,427
2048					2,960,000		393,246	0		0	1,503,875	2,118,427
2049					2,960,000		393,246	0		0	1,503,875	2,118,427
2050					2,960,000		393,246	0		0	1,503,875	2,118,427
2051					2,960,000		393,246	0		0	1,503,875	2,118,427
2052					2,960,000		393,246	0		0	1,503,875	2,118,427
2053					2,960,000		393,246	0		0	1,503,875	2,118,427
2054					2,960,000		393,246	0		0	1,503,875	2,118,427
2055					2,960,000		393,246	0		0	1,503,875	2,118,427
2056					2,960,000		393,246	0		0	1,503,875	2,118,427
2057					2,960,000		393,246	0		0	1,503,875	2,118,427
2058					2,960,000		393,246	0		0	1,503,875	2,118,427
2059					2,960,000		393,246	0		0	1,503,875	2,118,427
2060					2,960,000		393,246	0		0	1,503,875	2,118,427
2061					2,960,000		393,246	0		0	1,503,875	2,118,427
TOTAL	**19,277,904**	**5,000,000**	**1,606,492**	**29,000,000**	**133,200,000**	**78,649,200**	**17,696,070**	**16,430,000**	**41,340,000**	**0**	**67,674,375**	**95,329,194**

Re-Use Options

KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	9,638,952	0	6,410,454	0	5,624,236	0	4,946,306	0
2015	96,570,044	0	60,589,240	0	52,173,790	0	45,050,638	0
2016	80,324,600	0	47,544,007	0	40,182,298	0	34,065,472	0
2017	0	6,975,548	0	3,895,109	0	3,231,028	0	2,689,376
2018	0	6,975,548	0	3,674,631	0	2,991,693	0	2,444,887
2019	0	6,975,548	0	3,466,633	0	2,770,086	0	2,222,624
2020	0	6,975,548	0	3,270,409	0	2,564,894	0	2,020,568
2021	0	6,975,548	0	3,085,291	0	2,374,902	0	1,836,880
2022	0	6,975,548	0	2,910,652	0	2,198,983	0	1,669,891
2023	0	6,975,548	0	2,745,898	0	2,036,096	0	1,518,082
2024	0	6,975,548	0	2,590,470	0	1,885,274	0	1,380,075
2025	0	6,975,548	0	2,443,840	0	1,745,624	0	1,254,614
2026	0	6,975,548	0	2,305,509	0	1,616,319	0	1,140,558
2027	0	6,975,548	0	2,175,009	0	1,496,591	0	1,036,871
2028	0	6,975,548	0	2,051,895	0	1,385,733	0	942,610
2029	0	6,975,548	0	1,935,750	0	1,283,086	0	856,918
2030	0	6,975,548	0	1,826,179	0	1,188,042	0	779,016
2031	2,385,000	6,975,548	589,044	1,722,811	376,113	1,100,039	242,139	708,197
2032	0	6,975,548	0	1,625,293	0	1,018,555	0	643,815
2033	0	6,975,548	0	1,533,295	0	943,106	0	585,286
2034	0	6,975,548	0	1,446,505	0	873,247	0	532,079
2035	0	6,975,548	0	1,364,627	0	808,562	0	483,708
2036	0	6,975,548	0	1,287,384	0	748,668	0	439,734
2037	0	6,975,548	0	1,214,513	0	693,211	0	399,759
2038	0	6,975,548	0	1,145,767	0	641,862	0	363,417
2039	0	6,975,548	0	1,080,913	0	594,317	0	330,379
2040	0	6,975,548	0	1,019,729	0	550,293	0	300,345
2041	0	6,975,548	0	962,008	0	509,531	0	273,040
2042	0	6,975,548	0	907,555	0	471,788	0	248,219
2043	0	6,975,548	0	856,184	0	436,841	0	225,653
2044	0	6,975,548	0	807,721	0	404,482	0	205,139
2045	0	6,975,548	0	762,001	0	374,520	0	186,490
2046	2,385,000	6,975,548	245,787	718,869	118,566	346,778	57,966	169,537
2047	0	6,975,548	0	678,178	0	321,091	0	154,124
2048	0	6,975,548	0	639,791	0	297,306	0	140,113
2049	0	6,975,548	0	603,576	0	275,284	0	127,375
2050	0	6,975,548	0	569,411	0	254,892	0	115,796
			0					
2051	0	6,975,548	0	537,180	0	236,011	0	105,269
2052	0	6,975,548	0	506,774	0	218,529	0	95,699
2053	0	6,975,548	0	478,089	0	202,342	0	86,999
2054	0	6,975,548	0	451,027	0	187,353	0	79,090
2055	0	6,975,548	0	425,497	0	173,475	0	71,900
2056	0	6,975,548	0	401,413	0	160,625	0	65,364
2057	0	6,975,548	0	378,691	0	148,727	0	59,422
2058	0	6,975,548	0	357,256	0	137,710	0	54,020
2059	0	6,975,548	0	337,034	0	127,510	0	49,109
2060	0	6,975,548	0	317,956	0	118,064	0	44,644
2061	0	6,975,548	0	299,959	0	109,319	0	40,586
TOTAL	**191,303,596**	**313,899,639**	**115,378,532**	**63,814,285**	**98,475,003**	**42,252,394**	**84,362,521**	**29,177,274**

NET PRESENT COST

Discounted at 6%	179,192,817
Discounted at 8%	140,727,397
Discounted at 10%	113,539,795

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: KwaMashu to Hazelmere Dam - 23Mm³/a - Block Demand
DATE: September 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 9,638,952	0	R 6,410,454	0	R 5,624,236	0	R 4,946,306
2015	0	R 96,570,044	0	R 60,589,240	0	R 52,173,790	0	R 45,050,638
2016	0	R 80,324,600	0	R 47,544,007	0	R 40,182,298	0	R 34,065,472
2017	23	R 6,975,548	13	R 3,895,109	11	R 3,231,028	9	R 2,689,376
2018	23	R 6,975,548	12	R 3,674,631	10	R 2,991,693	8	R 2,444,887
2019	23	R 6,975,548	11	R 3,466,633	9	R 2,770,086	7	R 2,222,624
2020	23	R 6,975,548	11	R 3,270,409	8	R 2,564,894	7	R 2,020,568
2021	23	R 6,975,548	10	R 3,085,291	8	R 2,374,902	6	R 1,836,880
2022	23	R 6,975,548	10	R 2,910,652	7	R 2,198,983	6	R 1,669,891
2023	23	R 6,975,548	9	R 2,745,898	7	R 2,036,096	5	R 1,518,082
2024	23	R 6,975,548	9	R 2,590,470	6	R 1,885,274	5	R 1,380,075
2025	23	R 6,975,548	8	R 2,443,840	6	R 1,745,624	4	R 1,254,614
2026	23	R 6,975,548	8	R 2,305,509	5	R 1,616,319	4	R 1,140,558
2027	23	R 6,975,548	7	R 2,175,009	5	R 1,496,591	3	R 1,036,871
2028	23	R 6,975,548	7	R 2,051,895	5	R 1,385,733	3	R 942,610
2029	23	R 6,975,548	6	R 1,935,750	4	R 1,283,086	3	R 856,918
2030	23	R 6,975,548	6	R 1,826,179	4	R 1,188,042	3	R 779,016
2031	23	R 9,360,548	6	R 2,311,854	4	R 1,476,152	2	R 950,335
2032	23	R 6,975,548	5	R 1,625,293	3	R 1,018,555	2	R 643,815
2033	23	R 6,975,548	5	R 1,533,295	3	R 943,106	2	R 585,286
2034	23	R 6,975,548	5	R 1,446,505	3	R 873,247	2	R 532,079
2035	23	R 6,975,548	4	R 1,364,627	3	R 808,562	2	R 483,708
2036	23	R 6,975,548	4	R 1,287,384	2	R 748,668	1	R 439,734
2037	23	R 6,975,548	4	R 1,214,513	2	R 693,211	1	R 399,759
2038	23	R 6,975,548	4	R 1,145,767	2	R 641,862	1	R 363,417
2039	23	R 6,975,548	4	R 1,080,913	2	R 594,317	1	R 330,379
2040	23	R 6,975,548	3	R 1,019,729	2	R 550,293	1	R 300,345
2041	23	R 6,975,548	3	R 962,008	2	R 509,531	1	R 273,040
2042	23	R 6,975,548	3	R 907,555	2	R 471,788	1	R 248,219
2043	23	R 6,975,548	3	R 856,184	1	R 436,841	1	R 225,653
2044	23	R 6,975,548	3	R 807,721	1	R 404,482	1	R 205,139
2045	23	R 6,975,548	3	R 762,001	1	R 374,520	1	R 186,490
2046	23	R 9,360,548	2	R 964,656	1	R 465,345	1	R 227,503
2047	23	R 6,975,548	2	R 678,178	1	R 321,091	1	R 154,124
2048	23	R 6,975,548	2	R 639,791	1	R 297,306	0	R 140,113
2049	23	R 6,975,548	2	R 603,576	1	R 275,284	0	R 127,375
2050	23	R 6,975,548	2	R 569,411	1	R 254,892	0	R 115,796
2051	23	R 6,975,548	2	R 537,180	1	R 236,011	0	R 105,269
2052	23	R 6,975,548	2	R 506,774	1	R 218,529	0	R 95,699
2053	23	R 6,975,548	2	R 478,089	1	R 202,342	0	R 86,999
2054	23	R 6,975,548	1	R 451,027	1	R 187,353	0	R 79,090
2055	23	R 6,975,548	1	R 425,497	1	R 173,475	0	R 71,900
2056	23	R 6,975,548	1	R 401,413	1	R 160,625	0	R 65,364
2057	23	R 6,975,548	1	R 378,691	0	R 148,727	0	R 59,422
2058	23	R 6,975,548	1	R 357,256	0	R 137,710	0	R 54,020
2059	23	R 6,975,548	1	R 337,034	0	R 127,510	0	R 49,109
2060	23	R 6,975,548	1	R 317,956	0	R 118,064	0	R 44,644
2061	23	R 6,975,548	1	R 299,959	0	R 109,319	0	R 40,586
TOTAL	**1035**	**R 505,203,235**	**210**	**R 179,192,817**	**139**	**R 140,727,397**	**96**	**R 113,539,795**
URV				**R 0.85**		**R 1.01**		**R 1.18**

SCENARIO 1A

- Kwamashu WWTW to Hazelmere Dam – 23 million m^3/a
- Northern WWTW to Inanda Dam – 19,7 million m^3/a
- North Coast (to Hazelmere Dam)
  - Tongaat WWTW – 2,9 million m^3/a
  - Verulem WWTW – 2,4 million m^3/a
  - Phoenix WWTW – 5,1 million m^3/a (Incl. and Excl.)

Kwamashu WWTW to Hazelmere Dam – 23 million m³/a

Project Name: Re-Use Options
Option: Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 0.76 m³/s

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Kwamashu WWTW		Kwamashu WWTW			R 29,000,000	R 29,000,000	R 29,000,000		R 29,000,000	2015	2016	2	R 14,500,000	R -
Pipelines			**Dia**	**Length**										
		Kwamashu WWTW to Hazlemere	900	20km	R 78,649,200	R 78,649,200	R 78,649,200		R 78,649,200	2015	2016	2	R 39,324,600	R -
Pumpstation		At Kwamashu WWTW			R 53,000,000	R 53,000,000	R 16,430,000	R 36,570,000	R 53,000,000	2015	2016	2	R 8,215,000	R 18,285,000
Sub-Total					**R 160,649,200**	**R 160,649,200**	**R 124,079,200**	**R 36,570,000**	**R 160,649,200**					
Engineering Fees	12%								**R 19,277,904.00**			2	R 9,638,952	
Land Acquisitions and relocations									**R 5,000,000.00**			1	R 5,000,000	
Social and Environmental	1%								**R 1,606,492.00**			1	R 1,606,492	
Sub-Total									**R 186,533,596.00**					
VAT	14%								**R 26,114,703.44**					
Total									**R 212,648,299.44**					

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a
DATE: September 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.761	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	1.01	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.761	
Peak factor	1.04			
Average head pumped		m	123.00	**123.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	1.1	**1.1**
power absorbed at Qd: (Pd / Pf)		MVA	1.1	**1.1**
		MVAh	26.7	**26.7**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	1.5	**1.5**
head pumped (Hd)		m	123.00	**123.0**
Energy consumed over 24 hours (continuous use)	24	MWh	25.6	**26**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	1,766,996.15	**R**	**1,766,996.15**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	177,936.51	**R**	**177,936.51**
Transmission surcharge (< 300 km)	%		1.00%	R	17,669.96	**R**	**17,669.96**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	133,578.10	**R**	**133,578.10**
Network Charge	R/MVA	R	6,340.00	R	9,397.81	**R**	**9,397.81**
Total annual cost				**R**	**2,118,426.53**	**R**	**2,118,426.53**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a
DATE: September 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.254	m3/s	Pump Station Capacity
Total flow	0.761	m3/s	23 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	1.36	4	3	1	99,874	22,246	7,550	178,935	308,605
2	2018	2.19	4	3	2	161,334	22,246	12,196	179,550	375,326
3	2019	2.92	4	3	3	215,113	22,246	16,262	180,088	433,708
4	2020	4.28	4	3	5	314,986	22,246	23,812	181,086	542,130
5	2021	5.53	4	3	6	407,177	22,246	30,781	182,008	642,213
6	2022	6.57	4	3	7	484,003	22,246	36,589	182,777	725,614
7	2023	7.20	4	3	8	530,099	22,246	40,073	183,238	775,656
8	2024	7.83	4	3	8	576,194	22,246	43,558	183,698	825,697
9	2025	8.45	4	3	9	622,290	22,246	47,043	184,159	875,738
10	2026	9.18	4	3	10	676,068	22,246	51,108	184,697	934,119
11	2027	9.81	4	3	10	722,164	22,246	54,593	185,158	984,160
12	2028	10.54	4	3	11	775,942	22,246	58,658	185,696	1,042,542
13	2029	11.17	4	3	12	822,037	22,246	62,143	186,157	1,092,583
14	2030	11.90	4	3	13	875,815	22,246	66,208	186,695	1,150,964
15	2031	13.15	4	3	14	968,007	22,246	73,178	187,617	1,251,047
16	2032	13.98	4	3	15	1,029,467	22,246	77,824	188,231	1,317,768
17	2033	14.71	4	3	16	1,083,245	22,246	81,889	188,769	1,376,149
18	2034	15.55	4	3	17	1,144,706	22,246	86,535	189,384	1,442,871
19	2035	16.38	4	3	17	1,206,167	22,246	91,182	189,998	1,509,592
20	2036	17.22	4	3	18	1,267,628	22,246	95,828	190,613	1,576,314
21	2037	17.95	4	3	19	1,321,406	22,246	99,893	191,151	1,634,695
22	2038	18.78	4	3	20	1,382,867	22,246	104,539	191,765	1,701,417
23	2039	19.62	4	3	21	1,444,327	22,246	109,186	192,380	1,768,138
24	2040	20.45	4	3	22	1,505,788	22,246	113,832	192,994	1,834,860
25	2041	21.18	4	3	23	1,559,566	22,246	117,897	193,532	1,893,241
26	2042	22.02	4	3	23	1,621,027	22,246	122,543	194,147	1,959,963
27	2043	22.85	4	3	24	1,682,488	22,246	127,190	194,761	2,026,684
28	2044	23.69	4	3	25	1,743,948	22,246	131,836	195,376	2,093,406
29	2045	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
30	2046	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
31	2047	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
32	2048	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
33	2049	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
34	2050	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
35	2051	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
36	2052	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
37	2053	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
38	2054	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
39	2055	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
40	2056	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
41	2057	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
42	2058	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
43	2059	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
44	2060	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
45	2061	24.00	4	3	26	1,766,996	22,246	133,578	195,606	2,118,427
	TOTAL					**56,282,669**	**1,001,061**		**8,569,970**	**70,108,453**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	1.300	0.00%	1.30	0.043	0.000	1.36
2018	2.100	0.00%	2.10	0.069	0.000	2.19
2019	2.800	0.00%	2.80	0.093	0.000	2.92
2020	4.100	0.00%	4.10	0.136	0.000	4.28
2021	5.300	0.00%	5.30	0.175	0.000	5.53
2022	6.300	0.00%	6.30	0.208	0.000	6.57
2023	6.900	0.00%	6.90	0.228	0.000	7.20
2024	7.500	0.00%	7.50	0.248	0.000	7.83
2025	8.100	0.00%	8.10	0.268	0.000	8.45
2026	8.800	0.00%	8.80	0.291	0.000	9.18
2027	9.400	0.00%	9.40	0.311	0.000	9.81
2028	10.100	0.00%	10.10	0.334	0.000	10.54
2029	10.700	0.00%	10.70	0.354	0.000	11.17
2030	11.400	0.00%	11.40	0.377	0.000	11.90
2031	12.600	0.00%	12.60	0.417	0.000	13.15
2032	13.400	0.00%	13.40	0.443	0.000	13.98
2033	14.100	0.00%	14.10	0.466	0.000	14.71
2034	14.900	0.00%	14.90	0.493	0.000	15.55
2035	15.700	0.00%	15.70	0.519	0.000	16.38
2036	16.500	0.00%	16.50	0.546	0.000	17.22
2037	17.200	0.00%	17.20	0.569	0.000	17.95
2038	18.000	0.00%	18.00	0.595	0.000	18.78
2039	18.800	0.00%	18.80	0.622	0.000	19.62
2040	19.600	0.00%	19.60	0.648	0.000	20.45
2041	20.300	0.00%	20.30	0.671	0.000	21.18
2042	21.100	0.00%	21.10	0.698	0.000	22.02
2043	21.900	0.00%	21.90	0.724	0.000	22.85
2044	22.700	0.00%	22.70	0.751	0.000	23.69
2045	23.000	0.00%	23.00	0.761	0.000	24.00
2046	23.000	0.00%	23.00	0.761	0.000	24.00
2047	23.000	0.00%	23.00	0.761	0.000	24.00
2048	23.000	0.00%	23.00	0.761	0.000	24.00
2049	23.000	0.00%	23.00	0.761	0.000	24.00
2050	23.000	0.00%	23.00	0.761	0.000	24.00
2051	23.000	0.00%	23.00	0.761	0.000	24.00
2052	23.000	0.00%	23.00	0.761	0.000	24.00
2053	23.000	0.00%	23.00	0.761	0.000	24.00
2054	23.000	0.00%	23.00	0.761	0.000	24.00
2055	23.000	0.00%	23.00	0.761	0.000	24.00
2056	23.000	0.00%	23.00	0.761	0.000	24.00
2057	23.000	0.00%	23.00	0.761	0.000	24.00
2058	23.000	0.00%	23.00	0.761	0.000	24.00
2059	23.000	0.00%	23.00	0.761	0.000	24.00
2060	23.000	0.00%	23.00	0.761	0.000	24.00
2061	23.000	0.00%	23.00	0.761	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PUMP STATION AT KWAMASHU WWTW				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014	9,638,952											
2015	9,638,952	5,000,000	1,606,492	14,500,000		39,324,600		8,215,000	18,285,000			
2016				14,500,000		39,324,600		8,215,000	18,285,000			
2017					2,960,000		393,246	0		0	1,503,875	308,605
2018					2,960,000		393,246	0		0	1,503,875	375,326
2019					2,960,000		393,246	0		0	1,503,875	433,708
2020					2,960,000		393,246	0		0	1,503,875	542,130
2021					2,960,000		393,246	0		0	1,503,875	642,213
2022					2,960,000		393,246	0		0	1,503,875	725,614
2023					2,960,000		393,246	0		0	1,503,875	775,656
2024					2,960,000		393,246	0		0	1,503,875	825,697
2025					2,960,000		393,246	0		0	1,503,875	875,738
2026					2,960,000		393,246	0		0	1,503,875	934,119
2027					2,960,000		393,246	0		0	1,503,875	984,160
2028					2,960,000		393,246	0		0	1,503,875	1,042,542
2029					2,960,000		393,246	0		0	1,503,875	1,092,583
2030					2,960,000		393,246	0		0	1,503,875	1,150,964
2031					2,960,000		393,246	0	2,385,000	0	1,503,875	1,251,047
2032					2,960,000		393,246	0		0	1,503,875	1,317,768
2033					2,960,000		393,246	0		0	1,503,875	1,376,149
2034					2,960,000		393,246	0		0	1,503,875	1,442,871
2035					2,960,000		393,246	0		0	1,503,875	1,509,592
2036					2,960,000		393,246	0		0	1,503,875	1,576,314
2037					2,960,000		393,246	0		0	1,503,875	1,634,695
2038					2,960,000		393,246	0		0	1,503,875	1,701,417
2039					2,960,000		393,246	0		0	1,503,875	1,768,138
2040					2,960,000		393,246	0		0	1,503,875	1,834,860
2041					2,960,000		393,246	0		0	1,503,875	1,893,241
2042					2,960,000		393,246	0		0	1,503,875	1,959,963
2043					2,960,000		393,246	0		0	1,503,875	2,026,684
2044					2,960,000		393,246	0		0	1,503,875	2,093,406
2045					2,960,000		393,246	0		0	1,503,875	2,118,427
2046					2,960,000		393,246	0	2,385,000	0	1,503,875	2,118,427
2047					2,960,000		393,246	0		0	1,503,875	2,118,427
2048					2,960,000		393,246	0		0	1,503,875	2,118,427
2049					2,960,000		393,246	0		0	1,503,875	2,118,427
2050					2,960,000		393,246	0		0	1,503,875	2,118,427
2051					2,960,000		393,246	0		0	1,503,875	2,118,427
2052					2,960,000		393,246	0		0	1,503,875	2,118,427
2053					2,960,000		393,246	0		0	1,503,875	2,118,427
2054					2,960,000		393,246	0		0	1,503,875	2,118,427
2055					2,960,000		393,246	0		0	1,503,875	2,118,427
2056					2,960,000		393,246	0		0	1,503,875	2,118,427
2057					2,960,000		393,246	0		0	1,503,875	2,118,427
2058					2,960,000		393,246	0		0	1,503,875	2,118,427
2059					2,960,000		393,246	0		0	1,503,875	2,118,427
2060					2,960,000		393,246	0		0	1,503,875	2,118,427
2061					2,960,000		393,246	0		0	1,503,875	2,118,427
TOTAL	**19,277,904**	**5,000,000**	**1,606,492**	**29,000,000**	**133,200,000**	**78,649,200**	**17,696,070**	**16,430,000**	**41,340,000**	**0**	**67,674,375**	**70,108,453**

Re-Use Options

Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	9,638,952	0	6,410,454	0	5,624,236	0	4,946,306	0
2015	96,570,044	0	60,589,240	0	52,173,790	0	45,050,638	0
2016	80,324,600	0	47,544,007	0	40,182,298	0	34,065,472	0
2017	0	5,165,726	0	2,884,514	0	2,392,731	0	1,991,611
2018	0	5,232,447	0	2,756,388	0	2,244,107	0	1,833,941
2019	0	5,290,829	0	2,629,380	0	2,101,061	0	1,685,821
2020	0	5,399,251	0	2,531,380	0	1,985,293	0	1,563,971
2021	0	5,499,334	0	2,432,361	0	1,872,309	0	1,448,146
2022	0	5,582,735	0	2,329,480	0	1,759,911	0	1,336,462
2023	0	5,632,777	0	2,217,322	0	1,644,154	0	1,225,856
2024	0	5,682,818	0	2,110,396	0	1,535,889	0	1,124,315
2025	0	5,732,859	0	2,008,472	0	1,434,642	0	1,031,105
2026	0	5,791,240	0	1,914,080	0	1,341,900	0	946,914
2027	0	5,841,281	0	1,821,339	0	1,253,236	0	868,269
2028	0	5,899,663	0	1,735,418	0	1,172,002	0	797,225
2029	0	5,949,704	0	1,651,073	0	1,094,392	0	730,897
2030	0	6,008,085	0	1,572,900	0	1,023,269	0	670,972
2031	2,385,000	6,108,168	589,044	1,508,586	376,113	963,254	242,139	620,135
2032	0	6,174,889	0	1,438,741	0	901,644	0	569,918
2033	0	6,233,270	0	1,370,135	0	842,749	0	523,005
2034	0	6,299,992	0	1,306,416	0	788,676	0	480,549
2035	0	6,366,713	0	1,245,521	0	737,989	0	441,489
2036	0	6,433,435	0	1,187,334	0	690,485	0	405,560
2037	0	6,491,816	0	1,130,291	0	645,139	0	372,037
2038	0	6,558,538	0	1,077,272	0	603,491	0	341,691
2039	0	6,625,259	0	1,026,633	0	564,472	0	313,788
2040	0	6,691,981	0	978,275	0	527,923	0	288,135
2041	0	6,750,362	0	930,953	0	493,082	0	264,226
2042	0	6,817,084	0	886,938	0	461,070	0	242,580
2043	0	6,883,805	0	844,924	0	431,095	0	222,685
2044	0	6,950,527	0	804,824	0	403,031	0	204,404
2045	0	6,975,548	0	762,001	0	374,520	0	186,490
2046	2,385,000	6,975,548	245,787	718,869	118,566	346,778	57,966	169,537
2047	0	6,975,548	0	678,178	0	321,091	0	154,124
2048	0	6,975,548	0	639,791	0	297,306	0	140,113
2049	0	6,975,548	0	603,576	0	275,284	0	127,375
2050	0	6,975,548	0	569,411	0	254,892	0	115,796
			0					
2051	0	6,975,548	0	537,180	0	236,011	0	105,269
2052	0	6,975,548	0	506,774	0	218,529	0	95,699
2053	0	6,975,548	0	478,089	0	202,342	0	86,999
2054	0	6,975,548	0	451,027	0	187,353	0	79,090
2055	0	6,975,548	0	425,497	0	173,475	0	71,900
2056	0	6,975,548	0	401,413	0	160,625	0	65,364
2057	0	6,975,548	0	378,691	0	148,727	0	59,422
2058	0	6,975,548	0	357,256	0	137,710	0	54,020
2059	0	6,975,548	0	337,034	0	127,510	0	49,109
2060	0	6,975,548	0	317,956	0	118,064	0	44,644
2061	0	6,975,548	0	299,959	0	109,319	0	40,586
TOTAL	**191,303,596**	**288,678,898**	**115,378,532**	**54,794,046**	**98,475,003**	**35,598,538**	**84,362,521**	**24,191,245**

NET PRESENT COST

Discounted at 6%	170,172,579
Discounted at 8%	134,073,542
Discounted at 10%	108,553,766

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1A - KwaMashu to Hazelmere Dam - 23Mm³/a
DATE: September 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 9,638,952	0	R 6,410,454	0	R 5,624,236	0	R 4,946,306
2015	0	R 96,570,044	0	R 60,589,240	0	R 52,173,790	0	R 45,050,638
2016	0	R 80,324,600	0	R 47,544,007	0	R 40,182,298	0	R 34,065,472
2017	1.3	R 5,165,726	1	R 2,884,514	1	R 2,392,731	1	R 1,991,611
2018	2.1	R 5,232,447	1	R 2,756,388	1	R 2,244,107	1	R 1,833,941
2019	2.8	R 5,290,829	1	R 2,629,380	1	R 2,101,061	1	R 1,685,821
2020	4.1	R 5,399,251	2	R 2,531,380	2	R 1,985,293	1	R 1,563,971
2021	5.3	R 5,499,334	2	R 2,432,361	2	R 1,872,309	1	R 1,448,146
2022	6.3	R 5,582,735	3	R 2,329,480	2	R 1,759,911	2	R 1,336,462
2023	6.9	R 5,632,777	3	R 2,217,322	2	R 1,644,154	2	R 1,225,856
2024	7.5	R 5,682,818	3	R 2,110,396	2	R 1,535,889	1	R 1,124,315
2025	8.1	R 5,732,859	3	R 2,008,472	2	R 1,434,642	1	R 1,031,105
2026	8.8	R 5,791,240	3	R 1,914,080	2	R 1,341,900	1	R 946,914
2027	9.4	R 5,841,281	3	R 1,821,339	2	R 1,253,236	1	R 868,269
2028	10.1	R 5,899,663	3	R 1,735,418	2	R 1,172,002	1	R 797,225
2029	10.7	R 5,949,704	3	R 1,651,073	2	R 1,094,392	1	R 730,897
2030	11.4	R 6,008,085	3	R 1,572,900	2	R 1,023,269	1	R 670,972
2031	12.6	R 8,493,168	3	R 2,097,630	2	R 1,339,367	1	R 862,274
2032	13.4	R 6,174,889	3	R 1,438,741	2	R 901,644	1	R 569,918
2033	14.1	R 6,233,270	3	R 1,370,135	2	R 842,749	1	R 523,005
2034	14.9	R 6,299,992	3	R 1,306,416	2	R 788,676	1	R 480,549
2035	15.7	R 6,366,713	3	R 1,245,521	2	R 737,989	1	R 441,489
2036	16.5	R 6,433,435	3	R 1,187,334	2	R 690,485	1	R 405,560
2037	17.2	R 6,491,816	3	R 1,130,291	2	R 645,139	1	R 372,037
2038	18	R 6,558,538	3	R 1,077,272	2	R 603,491	1	R 341,691
2039	18.8	R 6,625,259	3	R 1,026,633	2	R 564,472	1	R 313,788
2040	19.6	R 6,691,981	3	R 978,275	2	R 527,923	1	R 288,135
2041	20.3	R 6,750,362	3	R 930,953	1	R 493,082	1	R 264,226
2042	21.1	R 6,817,084	3	R 886,938	1	R 461,070	1	R 242,580
2043	21.9	R 6,883,805	3	R 844,924	1	R 431,095	1	R 222,685
2044	22.7	R 6,950,527	3	R 804,824	1	R 403,031	1	R 204,404
2045	23	R 6,975,548	3	R 762,001	1	R 374,520	1	R 186,490
2046	23	R 9,360,548	2	R 964,656	1	R 465,345	1	R 227,503
2047	23	R 6,975,548	2	R 678,178	1	R 321,091	1	R 154,124
2048	23	R 6,975,548	2	R 639,791	1	R 297,306	0	R 140,113
2049	23	R 6,975,548	2	R 603,576	1	R 275,284	0	R 127,375
2050	23	R 6,975,548	2	R 569,411	1	R 254,892	0	R 115,796
2051	23	R 6,975,548	2	R 537,180	1	R 236,011	0	R 105,269
2052	23	R 6,975,548	2	R 506,774	1	R 218,529	0	R 95,699
2053	23	R 6,975,548	2	R 478,089	1	R 202,342	0	R 86,999
2054	23	R 6,975,548	1	R 451,027	1	R 187,353	0	R 79,090
2055	23	R 6,975,548	1	R 425,497	1	R 173,475	0	R 71,900
2056	23	R 6,975,548	1	R 401,413	1	R 160,625	0	R 65,364
2057	23	R 6,975,548	1	R 378,691	0	R 148,727	0	R 59,422
2058	23	R 6,975,548	1	R 357,256	0	R 137,710	0	R 54,020
2059	23	R 6,975,548	1	R 337,034	0	R 127,510	0	R 49,109
2060	23	R 6,975,548	1	R 317,956	0	R 118,064	0	R 44,644
2061	23	R 6,975,548	1	R 299,959	0	R 109,319	0	R 40,586
TOTAL	**732.6**	**R 479,982,494**	**102**	**R 170,172,579**	**60**	**R 134,073,542**	**36**	**R 108,553,766**
URV				**R 1.66**		**R 2.25**		**R 2.98**

Northern WWTW to Inanda Dam – 19,7 million m^3/a

Project Name: Re-Use Options
Option: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 19.70 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Northern WWTW		Northern WWTW			R 26,100,000	R 26,100,000	R 26,100,000		R 26,100,000	2015	2016	2	R 13,050,000	R -
Pipelines			**Dia**	**Length**										
		Northern WWTW to Inanda Dam	800	22km	R 123,464,000	R 123,464,000	R 123,464,000		R 123,464,000	2015	2016	2	R 61,732,000	R -
Pumpstation		At Northern WWTW			R 22,500,000	R 22,500,000	R 7,200,000	R 15,300,000	R 22,500,000	2015	2016	2	R 3,600,000	R 7,650,000
Sub-Total					**R 172,064,000**	**R 172,064,000**	**R 156,764,000**	**R 15,300,000**	**R 172,064,000**					

Engineering Fees	12%	**R**	**20,647,680.00**	2	R 10,323,840
Land Acquisitions and relocations		**R**	**5,000,000.00**	1	R 5,000,000
Social and Environmental	1%	**R**	**1,720,640.00**	1	R 1,720,640
Sub-Total		**R**	**199,432,320.00**		
VAT	14%	**R**	**27,920,524.80**		
Total		**R**	**227,352,844.80**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.651	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.87	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.651	
Peak factor	1.04			
Average head pumped		m	369.00	**369.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	2.7	**2.7**
power absorbed at Qd: (Pd / Pf)		MVA	2.9	**2.9**
		MVAh	68.6	**68.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	3.8	**3.8**
head pumped (Hd)		m	369.00	**369.0**
Energy consumed over 24 hours (continuous use)	24	MWh	65.8	**66**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	4,540,411.86	**R**	**4,540,411.86**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	457,219.47	**R**	**457,219.47**
Transmission surcharge (< 300 km)	%		1.00%	R	45,404.12	**R**	**45,404.12**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	343,237.63	**R**	**343,237.63**
Network Charge	R/MVA	R	6,340.00	R	24,148.27	**R**	**24,148.27**
Total annual cost				**R**	**5,423,269.35**	**R**	**5,423,269.35**

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PUMP STATION AT NORTHERN WWTW				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014	10,323,840											
2015	10,323,840	5,000,000	1,720,640	13,050,000		61,732,000		3,600,000	7,650,000			
2016				13,050,000		61,732,000		3,600,000	7,650,000			
2017					2,530,000		617,320	0		0	630,000	2,470,841
2018					2,530,000		617,320	0		0	630,000	4,197,261
2019					2,530,000		617,320	0		0	630,000	5,423,269
2020					2,530,000		617,320	0		0	630,000	5,423,269
2021					2,530,000		617,320	0		0	630,000	5,423,269
2022					2,530,000		617,320	0		0	630,000	5,423,269
2023					2,530,000		617,320	0		0	630,000	5,423,269
2024					2,530,000		617,320	0		0	630,000	5,423,269
2025					2,530,000		617,320	0		0	630,000	5,423,269
2026					2,530,000		617,320	0		0	630,000	5,423,269
2027					2,530,000		617,320	0		0	630,000	5,423,269
2028					2,530,000		617,320	0		0	630,000	5,423,269
2029					2,530,000		617,320	0		0	630,000	5,423,269
2030					2,530,000		617,320	0		0	630,000	5,423,269
2031					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2032					2,530,000		617,320	0		0	630,000	5,423,269
2033					2,530,000		617,320	0		0	630,000	5,423,269
2034					2,530,000		617,320	0		0	630,000	5,423,269
2035					2,530,000		617,320	0		0	630,000	5,423,269
2036					2,530,000		617,320	0		0	630,000	5,423,269
2037					2,530,000		617,320	0		0	630,000	5,423,269
2038					2,530,000		617,320	0		0	630,000	5,423,269
2039					2,530,000		617,320	0		0	630,000	5,423,269
2040					2,530,000		617,320	0		0	630,000	5,423,269
2041					2,530,000		617,320	0		0	630,000	5,423,269
2042					2,530,000		617,320	0		0	630,000	5,423,269
2043					2,530,000		617,320	0		0	630,000	5,423,269
2044					2,530,000		617,320	0		0	630,000	5,423,269
2045					2,530,000		617,320	0		0	630,000	5,423,269
2046					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2047					2,530,000		617,320	0		0	630,000	5,423,269
2048					2,530,000		617,320	0		0	630,000	5,423,269
2049					2,530,000		617,320	0		0	630,000	5,423,269
2050					2,530,000		617,320	0		0	630,000	5,423,269
2051					2,530,000		617,320	0		0	630,000	5,423,269
2052					2,530,000		617,320	0		0	630,000	5,423,269
2053					2,530,000		617,320	0		0	630,000	5,423,269
2054					2,530,000		617,320	0		0	630,000	5,423,269
2055					2,530,000		617,320	0		0	630,000	5,423,269
2056					2,530,000		617,320	0		0	630,000	5,423,269
2057					2,530,000		617,320	0		0	630,000	5,423,269
2058					2,530,000		617,320	0		0	630,000	5,423,269
2059					2,530,000		617,320	0		0	630,000	5,423,269
2060					2,530,000		617,320	0		0	630,000	5,423,269
2061					2,530,000		617,320	0		0	630,000	5,423,269
TOTAL	**20,647,680**	**5,000,000**	**1,720,640**	**26,100,000**	**113,850,000**	**123,464,000**	**27,779,400**	**7,200,000**	**17,325,000**	**0**	**28,350,000**	**239,868,685**

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	10,323,840	0	6,865,943	0	6,023,861	0	5,297,762	0
2015	103,076,480	0	64,671,459	0	55,689,015	0	48,085,939	0
2016	86,032,000	0	50,922,209	0	43,037,419	0	36,485,966	0
2017	0	6,248,161	0	3,488,941	0	2,894,108	0	2,408,937
2018	0	7,974,581	0	4,200,910	0	3,420,161	0	2,795,042
2019	0	9,200,589	0	4,572,411	0	3,653,681	0	2,931,591
2020	0	9,200,589	0	4,313,595	0	3,383,038	0	2,665,083
2021	0	9,200,589	0	4,069,430	0	3,132,442	0	2,422,803
2022	0	9,200,589	0	3,839,084	0	2,900,409	0	2,202,548
2023	0	9,200,589	0	3,621,778	0	2,685,564	0	2,002,316
2024	0	9,200,589	0	3,416,772	0	2,486,634	0	1,820,288
2025	0	9,200,589	0	3,223,369	0	2,302,439	0	1,654,807
2026	0	9,200,589	0	3,040,914	0	2,131,888	0	1,504,370
2027	0	9,200,589	0	2,868,787	0	1,973,970	0	1,367,609
2028	0	9,200,589	0	2,706,403	0	1,827,750	0	1,243,281
2029	0	9,200,589	0	2,553,210	0	1,692,361	0	1,130,255
2030	0	9,200,589	0	2,408,689	0	1,567,001	0	1,027,505
2031	1,012,500	9,200,589	250,066	2,272,348	159,671	1,450,927	102,795	934,095
2032	0	9,200,589	0	2,143,725	0	1,343,451	0	849,178
2033	0	9,200,589	0	2,022,382	0	1,243,936	0	771,980
2034	0	9,200,589	0	1,907,907	0	1,151,793	0	701,800
2035	0	9,200,589	0	1,799,913	0	1,066,475	0	638,000
2036	0	9,200,589	0	1,698,031	0	987,476	0	580,000
2037	0	9,200,589	0	1,601,916	0	914,330	0	527,272
2038	0	9,200,589	0	1,511,241	0	846,602	0	479,339
2039	0	9,200,589	0	1,425,699	0	783,891	0	435,762
2040	0	9,200,589	0	1,344,999	0	725,825	0	396,148
2041	0	9,200,589	0	1,268,867	0	672,060	0	360,134
2042	0	9,200,589	0	1,197,045	0	622,278	0	327,395
2043	0	9,200,589	0	1,129,287	0	576,183	0	297,632
2044	0	9,200,589	0	1,065,366	0	533,503	0	270,574
2045	0	9,200,589	0	1,005,062	0	493,984	0	245,976
2046	1,012,500	9,200,589	104,344	948,172	50,335	457,393	24,608	223,615
2047	0	9,200,589	0	894,501	0	423,512	0	203,286
2048	0	9,200,589	0	843,869	0	392,140	0	184,806
2049	0	9,200,589	0	796,103	0	363,093	0	168,005
2050	0	9,200,589	0	751,041	0	336,197	0	152,732
			0					
2051	0	9,200,589	0	708,529	0	311,294	0	138,847
2052	0	9,200,589	0	668,424	0	288,235	0	126,225
2053	0	9,200,589	0	630,588	0	266,884	0	114,750
2054	0	9,200,589	0	594,895	0	247,115	0	104,318
2055	0	9,200,589	0	561,221	0	228,810	0	94,835
2056	0	9,200,589	0	529,454	0	211,861	0	86,213
2057	0	9,200,589	0	499,485	0	196,168	0	78,376
2058	0	9,200,589	0	471,212	0	181,637	0	71,251
2059	0	9,200,589	0	444,540	0	168,182	0	64,773
2060	0	9,200,589	0	419,377	0	155,724	0	58,885
2061	0	9,200,589	0	395,639	0	144,189	0	53,532
TOTAL	**201,457,320**	**409,848,085**	**122,814,020**	**81,875,131**	**104,960,301**	**53,836,592**	**89,997,070**	**36,916,167**

NET PRESENT COST

Discounted at 6%	204,689,151
Discounted at 8%	158,796,893
Discounted at 10%	126,913,237

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 10,323,840	0	R 6,865,943	0	R 6,023,861	0	R 5,297,762
2015	0	R 103,076,480	0	R 64,671,459	0	R 55,689,015	0	R 48,085,939
2016	0	R 86,032,000	0	R 50,922,209	0	R 43,037,419	0	R 36,485,966
2017	7.9	R 6,248,161	4	R 3,488,941	4	R 2,894,108	3	R 2,408,937
2018	14.8	R 7,974,581	8	R 4,200,910	6	R 3,420,161	5	R 2,795,042
2019	19.7	R 9,200,589	10	R 4,572,411	8	R 3,653,681	6	R 2,931,591
2020	19.7	R 9,200,589	9	R 4,313,595	7	R 3,383,038	6	R 2,665,083
2021	19.7	R 9,200,589	9	R 4,069,430	7	R 3,132,442	5	R 2,422,803
2022	19.7	R 9,200,589	8	R 3,839,084	6	R 2,900,409	5	R 2,202,548
2023	19.7	R 9,200,589	8	R 3,621,778	6	R 2,685,564	4	R 2,002,316
2024	19.7	R 9,200,589	7	R 3,416,772	5	R 2,486,634	4	R 1,820,288
2025	19.7	R 9,200,589	7	R 3,223,369	5	R 2,302,439	4	R 1,654,807
2026	19.7	R 9,200,589	7	R 3,040,914	5	R 2,131,888	3	R 1,504,370
2027	19.7	R 9,200,589	6	R 2,868,787	4	R 1,973,970	3	R 1,367,609
2028	19.7	R 9,200,589	6	R 2,706,403	4	R 1,827,750	3	R 1,243,281
2029	19.7	R 9,200,589	5	R 2,553,210	4	R 1,692,361	2	R 1,130,255
2030	19.7	R 9,200,589	5	R 2,408,689	3	R 1,567,001	2	R 1,027,505
2031	19.7	R 10,213,089	5	R 2,522,414	3	R 1,610,597	2	R 1,036,890
2032	19.7	R 9,200,589	5	R 2,143,725	3	R 1,343,451	2	R 849,178
2033	19.7	R 9,200,589	4	R 2,022,382	3	R 1,243,936	2	R 771,980
2034	19.7	R 9,200,589	4	R 1,907,907	2	R 1,151,793	2	R 701,800
2035	19.7	R 9,200,589	4	R 1,799,913	2	R 1,066,475	1	R 638,000
2036	19.7	R 9,200,589	4	R 1,698,031	2	R 987,476	1	R 580,000
2037	19.7	R 9,200,589	3	R 1,601,916	2	R 914,330	1	R 527,272
2038	19.7	R 9,200,589	3	R 1,511,241	2	R 846,602	1	R 479,339
2039	19.7	R 9,200,589	3	R 1,425,699	2	R 783,891	1	R 435,762
2040	19.7	R 9,200,589	3	R 1,344,999	2	R 725,825	1	R 396,148
2041	19.7	R 9,200,589	3	R 1,268,867	1	R 672,060	1	R 360,134
2042	19.7	R 9,200,589	3	R 1,197,045	1	R 622,278	1	R 327,395
2043	19.7	R 9,200,589	2	R 1,129,287	1	R 576,183	1	R 297,632
2044	19.7	R 9,200,589	2	R 1,065,366	1	R 533,503	1	R 270,574
2045	19.7	R 9,200,589	2	R 1,005,062	1	R 493,984	1	R 245,976
2046	19.7	R 10,213,089	2	R 1,052,515	1	R 507,727	0	R 248,223
2047	19.7	R 9,200,589	2	R 894,501	1	R 423,512	0	R 203,286
2048	19.7	R 9,200,589	2	R 843,869	1	R 392,140	0	R 184,806
2049	19.7	R 9,200,589	2	R 796,103	1	R 363,093	0	R 168,005
2050	19.7	R 9,200,589	2	R 751,041	1	R 336,197	0	R 152,732
2051	19.7	R 9,200,589	2	R 708,529	1	R 311,294	0	R 138,847
2052	19.7	R 9,200,589	1	R 668,424	1	R 288,235	0	R 126,225
2053	19.7	R 9,200,589	1	R 630,588	1	R 266,884	0	R 114,750
2054	19.7	R 9,200,589	1	R 594,895	1	R 247,115	0	R 104,318
2055	19.7	R 9,200,589	1	R 561,221	0	R 228,810	0	R 94,835
2056	19.7	R 9,200,589	1	R 529,454	0	R 211,861	0	R 86,213
2057	19.7	R 9,200,589	1	R 499,485	0	R 196,168	0	R 78,376
2058	19.7	R 9,200,589	1	R 471,212	0	R 181,637	0	R 71,251
2059	19.7	R 9,200,589	1	R 444,540	0	R 168,182	0	R 64,773
2060	19.7	R 9,200,589	1	R 419,377	0	R 155,724	0	R 58,885
2061	19.7	R 9,200,589	1	R 395,639	0	R 144,189	0	R 53,532
TOTAL	**869.8**	**R 611,305,405**	**171**	**R 204,689,151**	**112**	**R 158,796,893**	**76**	**R 126,913,237**
URV				**R 1.20**		**R 1.42**		**R 1.67**

North Coast (to Hazelmere Dam) – Including Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a
- Phoenix WWTW – 5,1 million m^3/a

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R	6,800,000
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R	5,900,000
Upgrade Existing Phoenix WWTW		Phoenix WWTW	**No**	1	R	10,100,000
Pipelines			**Dia**	**Length**		
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R	7,650,720
		Verulam to Hazelmere Dam	500mm	8km	R	14,001,120
		Phoenix to Verulam	400mm	6km	R	8,406,720
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R	3,913,938
Pumpstation to Hazelmere Dam		Verulam Pump Station			R	6,491,898
Pumpstation to Hazelmere Dam		Phoenix Pump Station			R	3,913,938
Sub-Total					**R**	**67,178,334**
Engineering Fees	12%				**R**	**8,061,400.08**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**671,783.34**
Sub-Total					**R**	**80,911,517.42**
VAT	14%				**R**	**11,327,612.44**
Total					**R**	**92,239,129.86**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Bl
DATE: SEP 2007

Number of pumps	3	(excluding standby)			
Standby pumps	1				
Flow per pump	0.032	m3/s		Pump Station Capacity	
Total flow	0.096	m3/s		2.9	million m³
Pumps active	350	days per annum	350	49.82888433	weeks
Pumping Peak factor to supply within limited period	1.0429				

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.248	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.33	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.248	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.4	**0.4**
power absorbed at Qd: (Pd / Pf)		MVA	0.4	**0.4**
		MVAh	9.6	**9.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.5	**0.5**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	9.2	**9**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	637,092.99	**R**	**637,093**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	64,155.26	**R**	**64,155**
Transmission surcharge (< 300 km)	%		1.00%	R	6,370.93	**R**	**6,371**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	48,161.77	**R**	**48,162**
Network Charge	R/MVA	R	6,340.00	R	3,388.39	**R**	**3,388**
Total annual cost				**R**	**772,017.35**	**R**	**772,017**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.169	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.22	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.169	
Peak factor	1.04			
Average head pumped		m	83.00	**83.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.0	**4.0**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	83.00	**83.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.8	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	264,393.59	**R**	**264,394**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	26,624.43	**R**	**26,624**
Transmission surcharge (< 300 km)	%		1.00%	R	2,643.94	**R**	**2,644**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	19,987.14	**R**	**19,987**
Network Charge	R/MVA	R	6,340.00	R	1,406.18	**R**	**1,406**
Total annual cost				**R**	**327,903.28**	**R**	**327,903**

PHOENIX PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - E
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.056	m3/s	Pump Station Capacity
Total flow	0.169	m3/s	5.1 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS	NUMBER OF PUMPS		MWh	ANNUAL ELECTRICITY COST FOR PUMP STATIONS				
		PUMPED	INSTALLED	ACTIVE	per day	ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
2	2018	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
3	2019	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
4	2020	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
5	2021	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
6	2022	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
7	2023	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
8	2024	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
9	2025	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
10	2026	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
11	2027	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
12	2028	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
13	2029	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
14	2030	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
15	2031	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
16	2032	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
17	2033	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
18	2034	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
19	2035	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
20	2036	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
21	2037	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
22	2038	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
23	2039	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
24	2040	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
25	2041	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
26	2042	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
27	2043	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
28	2044	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
29	2045	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
30	2046	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
31	2047	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
32	2048	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
33	2049	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
34	2050	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
35	2051	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
36	2052	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
37	2053	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
38	2054	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
39	2055	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
40	2056	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
41	2057	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
42	2058	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
43	2059	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
44	2060	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
45	2061	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
	TOTAL					**11,897,712**	**641,438**		**1,317,077**	**14,755,648**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	5.100	0.00%	5.10	0.169	0.000	24.00
2018	5.100	0.00%	5.10	0.169	0.000	24.00
2019	5.100	0.00%	5.10	0.169	0.000	24.00
2020	5.100	0.00%	5.10	0.169	0.000	24.00
2021	5.100	0.00%	5.10	0.169	0.000	24.00
2022	5.100	0.00%	5.10	0.169	0.000	24.00
2023	5.100	0.00%	5.10	0.169	0.000	24.00
2024	5.100	0.00%	5.10	0.169	0.000	24.00
2025	5.100	0.00%	5.10	0.169	0.000	24.00
2026	5.100	0.00%	5.10	0.169	0.000	24.00
2027	5.100	0.00%	5.10	0.169	0.000	24.00
2028	5.100	0.00%	5.10	0.169	0.000	24.00
2029	5.100	0.00%	5.10	0.169	0.000	24.00
2030	5.100	0.00%	5.10	0.169	0.000	24.00
2031	5.100	0.00%	5.10	0.169	0.000	24.00
2032	5.100	0.00%	5.10	0.169	0.000	24.00
2033	5.100	0.00%	5.10	0.169	0.000	24.00
2034	5.100	0.00%	5.10	0.169	0.000	24.00
2035	5.100	0.00%	5.10	0.169	0.000	24.00
2036	5.100	0.00%	5.10	0.169	0.000	24.00
2037	5.100	0.00%	5.10	0.169	0.000	24.00
2038	5.100	0.00%	5.10	0.169	0.000	24.00
2039	5.100	0.00%	5.10	0.169	0.000	24.00
2040	5.100	0.00%	5.10	0.169	0.000	24.00
2041	5.100	0.00%	5.10	0.169	0.000	24.00
2042	5.100	0.00%	5.10	0.169	0.000	24.00
2043	5.100	0.00%	5.10	0.169	0.000	24.00
2044	5.100	0.00%	5.10	0.169	0.000	24.00
2045	5.100	0.00%	5.10	0.169	0.000	24.00
2046	5.100	0.00%	5.10	0.169	0.000	24.00
2047	5.100	0.00%	5.10	0.169	0.000	24.00
2048	5.100	0.00%	5.10	0.169	0.000	24.00
2049	5.100	0.00%	5.10	0.169	0.000	24.00
2050	5.100	0.00%	5.10	0.169	0.000	24.00
2051	5.100	0.00%	5.10	0.169	0.000	24.00
2052	5.100	0.00%	5.10	0.169	0.000	24.00
2053	5.100	0.00%	5.10	0.169	0.000	24.00
2054	5.100	0.00%	5.10	0.169	0.000	24.00
2055	5.100	0.00%	5.10	0.169	0.000	24.00
2056	5.100	0.00%	5.10	0.169	0.000	24.00
2057	5.100	0.00%	5.10	0.169	0.000	24.00
2058	5.100	0.00%	5.10	0.169	0.000	24.00
2059	5.100	0.00%	5.10	0.169	0.000	24.00
2060	5.100	0.00%	5.10	0.169	0.000	24.00
2061	5.100	0.00%	5.10	0.169	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		UPGRADE EXISTING PHOENIX WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		PIPELINE: Phoenix WWTW to Verulam WWTW	
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014	4,030,700	2,500,000	335,892												
2015	4,030,700	2,500,000	335,892	3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2016				3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2017					380,000		310,000		660,000		38,254		70,006		42,034
2018					380,000		310,000		660,000		38,254		70,006		42,034
2019					380,000		310,000		660,000		38,254		70,006		42,034
2020					380,000		310,000		660,000		38,254		70,006		42,034
2021					380,000		310,000		660,000		38,254		70,006		42,034
2022					380,000		310,000		660,000		38,254		70,006		42,034
2023					380,000		310,000		660,000		38,254		70,006		42,034
2024					380,000		310,000		660,000		38,254		70,006		42,034
2025					380,000		310,000		660,000		38,254		70,006		42,034
2026					380,000		310,000		660,000		38,254		70,006		42,034
2027					380,000		310,000		660,000		38,254		70,006		42,034
2028					380,000		310,000		660,000		38,254		70,006		42,034
2029					380,000		310,000		660,000		38,254		70,006		42,034
2030					380,000		310,000		660,000		38,254		70,006		42,034
2031					380,000		310,000		660,000		38,254		70,006		42,034
2032					380,000		310,000		660,000		38,254		70,006		42,034
2033					380,000		310,000		660,000		38,254		70,006		42,034
2034					380,000		310,000		660,000		38,254		70,006		42,034
2035					380,000		310,000		660,000		38,254		70,006		42,034
2036					380,000		310,000		660,000		38,254		70,006		42,034
2037					380,000		310,000		660,000		38,254		70,006		42,034
2038					380,000		310,000		660,000		38,254		70,006		42,034
2039					380,000		310,000		660,000		38,254		70,006		42,034
2040					380,000		310,000		660,000		38,254		70,006		42,034
2041					380,000		310,000		660,000		38,254		70,006		42,034
2042					380,000		310,000		660,000		38,254		70,006		42,034
2043					380,000		310,000		660,000		38,254		70,006		42,034
2044					380,000		310,000		660,000		38,254		70,006		42,034
2045					380,000		310,000		660,000		38,254		70,006		42,034
2046					380,000		310,000		660,000		38,254		70,006		42,034
2047					380,000		310,000		660,000		38,254		70,006		42,034
2048					380,000		310,000		660,000		38,254		70,006		42,034
2049					380,000		310,000		660,000		38,254		70,006		42,034
2050					380,000		310,000		660,000		38,254		70,006		42,034
2051					380,000		310,000		660,000		38,254		70,006		42,034
2052					380,000		310,000		660,000		38,254		70,006		42,034
2053					380,000		310,000		660,000		38,254		70,006		42,034
2054					380,000		310,000		660,000		38,254		70,006		42,034
2055					380,000		310,000		660,000		38,254		70,006		42,034
2056					380,000		310,000		660,000		38,254		70,006		42,034
2057					380,000		310,000		660,000		38,254		70,006		42,034
2058					380,000		310,000		660,000		38,254		70,006		42,034
2059					380,000		310,000		660,000		38,254		70,006		42,034
2060					380,000		310,000		660,000		38,254		70,006		42,034
2061					380,000		310,000		660,000		38,254		70,006		42,034
TOTAL	**8,061,400**	**5,000,000**	**671,783**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**10,100,000**	**29,700,000**	**7,650,720**	**1,721,412**	**14,001,120**	**3,150,252**	**8,406,720**	**1,891,512**

YEAR	TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM					PHOENIX PUMP STATION TO VERULAM WWTW				
	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014															
2015	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2016	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2017	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2018	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2019	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2020	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2021	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2022	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2023	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2024	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2025	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2026	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2027	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2028	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2029	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2030	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2031	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2032	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2033	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2034	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2035	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2036	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2037	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2038	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2039	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2040	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2041	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2042	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2043	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2044	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2045	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2046	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2047	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2048	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2049	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2050	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2051	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2052	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2053	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2054	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2055	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2056	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2057	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2058	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2059	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2060	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2061	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
TOTAL	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**2,272,164**	**4,804,005**	**0**	**7,851,139**	**17,756,540**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**14,755,648**

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	6,866,592	0	4,566,676	0	4,006,590	0	3,523,647	0
2015	40,455,759	0	25,382,444	0	21,856,988	0	18,872,910	0
2016	33,589,167	0	19,881,376	0	16,802,946	0	14,245,086	0
2017	0	2,958,573	0	1,652,052	0	1,370,392	0	1,140,658
2018	0	2,958,573	0	1,558,539	0	1,268,881	0	1,036,962
2019	0	2,958,573	0	1,470,320	0	1,174,890	0	942,693
2020	0	2,958,573	0	1,387,095	0	1,087,861	0	856,993
2021	0	2,958,573	0	1,308,580	0	1,007,279	0	779,085
2022	0	2,958,573	0	1,234,509	0	932,666	0	708,259
2023	0	2,958,573	0	1,164,631	0	863,579	0	643,872
2024	0	2,958,573	0	1,098,709	0	799,610	0	585,338
2025	0	2,958,573	0	1,036,518	0	740,380	0	532,125
2026	0	2,958,573	0	977,847	0	685,537	0	483,750
2027	0	2,958,573	0	922,497	0	634,757	0	439,773
2028	0	2,958,573	0	870,280	0	587,738	0	399,794
2029	0	2,958,573	0	821,019	0	544,201	0	363,449
2030	0	2,958,573	0	774,546	0	503,890	0	330,408
2031	644,390	2,958,573	159,150	730,704	101,620	466,565	65,422	300,371
2032	0	2,958,573	0	689,343	0	432,005	0	273,064
2033	0	2,958,573	0	650,324	0	400,004	0	248,240
2034	0	2,958,573	0	613,513	0	370,374	0	225,673
2035	0	2,958,573	0	578,786	0	342,939	0	205,157
2036	0	2,958,573	0	546,025	0	317,536	0	186,507
2037	0	2,958,573	0	515,118	0	294,015	0	169,552
2038	0	2,958,573	0	485,960	0	272,236	0	154,138
2039	0	2,958,573	0	458,453	0	252,071	0	140,125
2040	0	2,958,573	0	432,503	0	233,399	0	127,387
2041	0	2,958,573	0	408,021	0	216,110	0	115,806
2042	0	2,958,573	0	384,926	0	200,102	0	105,278
2043	0	2,958,573	0	363,138	0	185,279	0	95,707
2044	0	2,958,573	0	342,583	0	171,555	0	87,007
2045	0	2,958,573	0	323,191	0	158,847	0	79,097
2046	644,390	2,958,573	66,408	304,897	32,035	147,081	15,662	71,906
2047	0	2,958,573	0	287,639	0	136,186	0	65,369
2048	0	2,958,573	0	271,358	0	126,098	0	59,427
2049	0	2,958,573	0	255,998	0	116,757	0	54,024
2050	0	2,958,573	0	241,507	0	108,109	0	49,113
			0					
2051	0	2,958,573	0	227,837	0	100,101	0	44,648
2052	0	2,958,573	0	214,941	0	92,686	0	40,589
2053	0	2,958,573	0	202,774	0	85,820	0	36,899
2054	0	2,958,573	0	191,296	0	79,463	0	33,545
2055	0	2,958,573	0	180,468	0	73,577	0	30,495
2056	0	2,958,573	0	170,253	0	68,127	0	27,723
2057	0	2,958,573	0	160,616	0	63,080	0	25,203
2058	0	2,958,573	0	151,525	0	58,408	0	22,912
2059	0	2,958,573	0	142,948	0	54,081	0	20,829
2060	0	2,958,573	0	134,856	0	50,075	0	18,935
2061	0	2,958,573	0	127,223	0	46,366	0	17,214
TOTAL	**82,200,297**	**133,135,790**	**50,056,054**	**27,065,865**	**42,800,179**	**17,920,714**	**36,722,727**	**12,375,100**

NET PRESENT COST

Discounted at 6%	77,121,919
Discounted at 8%	60,720,893
Discounted at 10%	49,097,826

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 6,866,592	0	R 4,566,676	0	R 4,006,590	0	R 3,523,647
2015	0	R 40,455,759	0	R 25,382,444	0	R 21,856,988	0	R 18,872,910
2016	0	R 33,589,167	0	R 19,881,376	0	R 16,802,946	0	R 14,245,086
2017	10.4	R 2,958,573	6	R 1,652,052	5	R 1,370,392	4	R 1,140,658
2018	10.4	R 2,958,573	5	R 1,558,539	4	R 1,268,881	4	R 1,036,962
2019	10.4	R 2,958,573	5	R 1,470,320	4	R 1,174,890	3	R 942,693
2020	10.4	R 2,958,573	5	R 1,387,095	4	R 1,087,861	3	R 856,993
2021	10.4	R 2,958,573	5	R 1,308,580	4	R 1,007,279	3	R 779,085
2022	10.4	R 2,958,573	4	R 1,234,509	3	R 932,666	2	R 708,259
2023	10.4	R 2,958,573	4	R 1,164,631	3	R 863,579	2	R 643,872
2024	10.4	R 2,958,573	4	R 1,098,709	3	R 799,610	2	R 585,338
2025	10.4	R 2,958,573	4	R 1,036,518	3	R 740,380	2	R 532,125
2026	10.4	R 2,958,573	3	R 977,847	2	R 685,537	2	R 483,750
2027	10.4	R 2,958,573	3	R 922,497	2	R 634,757	2	R 439,773
2028	10.4	R 2,958,573	3	R 870,280	2	R 587,738	1	R 399,794
2029	10.4	R 2,958,573	3	R 821,019	2	R 544,201	1	R 363,449
2030	10.4	R 2,958,573	3	R 774,546	2	R 503,890	1	R 330,408
2031	10.4	R 3,602,963	3	R 889,855	2	R 568,185	1	R 365,793
2032	10.4	R 2,958,573	2	R 689,343	2	R 432,005	1	R 273,064
2033	10.4	R 2,958,573	2	R 650,324	1	R 400,004	1	R 248,240
2034	10.4	R 2,958,573	2	R 613,513	1	R 370,374	1	R 225,673
2035	10.4	R 2,958,573	2	R 578,786	1	R 342,939	1	R 205,157
2036	10.4	R 2,958,573	2	R 546,025	1	R 317,536	1	R 186,507
2037	10.4	R 2,958,573	2	R 515,118	1	R 294,015	1	R 169,552
2038	10.4	R 2,958,573	2	R 485,960	1	R 272,236	1	R 154,138
2039	10.4	R 2,958,573	2	R 458,453	1	R 252,071	0	R 140,125
2040	10.4	R 2,958,573	2	R 432,503	1	R 233,399	0	R 127,387
2041	10.4	R 2,958,573	1	R 408,021	1	R 216,110	0	R 115,806
2042	10.4	R 2,958,573	1	R 384,926	1	R 200,102	0	R 105,278
2043	10.4	R 2,958,573	1	R 363,138	1	R 185,279	0	R 95,707
2044	10.4	R 2,958,573	1	R 342,583	1	R 171,555	0	R 87,007
2045	10.4	R 2,958,573	1	R 323,191	1	R 158,847	0	R 79,097
2046	10.4	R 3,602,963	1	R 371,305	1	R 179,116	0	R 87,568
2047	10.4	R 2,958,573	1	R 287,639	0	R 136,186	0	R 65,369
2048	10.4	R 2,958,573	1	R 271,358	0	R 126,098	0	R 59,427
2049	10.4	R 2,958,573	1	R 255,998	0	R 116,757	0	R 54,024
2050	10.4	R 2,958,573	1	R 241,507	0	R 108,109	0	R 49,113
2051	10.4	R 2,958,573	1	R 227,837	0	R 100,101	0	R 44,648
2052	10.4	R 2,958,573	1	R 214,941	0	R 92,686	0	R 40,589
2053	10.4	R 2,958,573	1	R 202,774	0	R 85,820	0	R 36,899
2054	10.4	R 2,958,573	1	R 191,296	0	R 79,463	0	R 33,545
2055	10.4	R 2,958,573	1	R 180,468	0	R 73,577	0	R 30,495
2056	10.4	R 2,958,573	1	R 170,253	0	R 68,127	0	R 27,723
2057	10.4	R 2,958,573	1	R 160,616	0	R 63,080	0	R 25,203
2058	10.4	R 2,958,573	1	R 151,525	0	R 58,408	0	R 22,912
2059	10.4	R 2,958,573	1	R 142,948	0	R 54,081	0	R 20,829
2060	10.4	R 2,958,573	0	R 134,856	0	R 50,075	0	R 18,935
2061	10.4	R 2,958,573	0	R 127,223	0	R 46,366	0	R 17,214
TOTAL	**468**	**R 215,336,087**	**95**	**R 77,121,919**	**63**	**R 60,720,893**	**44**	**R 49,097,826**

URV				**R 0.81**		**R 0.96**		**R 1.13**

North Coast (to Hazelmere Dam) – Excluding Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a

Project Name: Re-Use Options
Option: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
Base year of study cost: Sep 2007
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 5.30 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R 6,800,000	R 6,800,000	R 6,800,000		R 6,800,000	2015	2016	2	R 3,400,000	R -
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R 5,900,000	R 5,900,000	R 5,900,000		R 5,900,000	2015	2016	2	R 2,950,000	R -
Pipelines			**Dia**	**Length**										
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R 7,650,720	R 7,650,720	R 7,650,720		R 7,650,720	2015	2016	2	R 3,825,360	R -
		Verulam to Hazelmere Dam	300mm	8km	R 9,283,680	R 9,283,680	R 9,283,680		R 9,283,680	2015	2016	2	R 4,641,840	R -
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R 3,913,938	R 3,913,938	R 1,409,018	R 2,504,920	R 3,913,938	2015	2016	2	R 704,509	R 1,252,460
Pumpstation to Hazelmere Dam		Verulam Pump Station			R 2,359,728	R 2,359,728	R 873,099	R 1,486,629	R 2,359,728	2015	2016	2	R 436,550	R 743,314
Sub-Total					**R 35,908,066**	**R 35,908,066**	**R 31,916,517**	**R 3,991,549**	**R 35,908,066**					

Engineering Fees	12%	**R 4,308,967.92**	2	R 2,154,484
Land Acquisitions and relocations		**R 3,000,000.00**	2	R 1,500,000
Social and Environmental	1%	**R 359,080.66**	2	R 179,540
Sub-Total		**R 43,576,114.58**		
VAT	14%	**R 6,100,656.04**		
Total		**R 49,676,770.62**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.032	m3/s		Pump Station Capacity
Total flow	0.096	m3/s		2.9 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.079	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.11	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.079	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.1	**0.1**
power absorbed at Qd: (Pd / Pf)		MVA	0.1	**0.1**
		MVAh	3.1	**3.1**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.0	**3**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	203,869.76	**R**	**203,870**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	20,529.68	**R**	**20,530**
Transmission surcharge (< 300 km)	%		1.00%	R	2,038.70	**R**	**2,039**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	15,411.77	**R**	**15,412**
Network Charge	R/MVA	R	6,340.00	R	1,084.29	**R**	**1,084**
Total annual cost				**R**	**255,782.19**	**R**	**255,782**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007																					
2008																					
2009																					
2010																					
2011																					
2012																					
2013																					
2014	2,154,484	1,500,000	179,540																		
2015	2,154,484	1,500,000	179,540	3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2016				3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2017					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2018					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2019					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2020					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2021					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2022					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2023					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2024					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2025					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2026					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2027					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2028					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2029					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2030					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2031					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2032					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2033					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2034					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2035					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2036					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2037					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2038					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2039					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2040					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2041					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2042					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2043					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2044					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2045					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2046					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2047					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2048					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2049					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2050					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2051					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2052					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2053					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2054					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2055					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2056					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2057					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2058					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2059					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2060					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2061					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
TOTAL	**4,308,968**	**3,000,000**	**359,081**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**7,650,720**	**1,721,412**	**9,283,680**	**2,088,828**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**873,099**	**1,699,004**	**0**	**2,774,155**	**15,494,754**

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	3,834,024	0	2,549,845	0	2,237,116	0	1,967,461	0
2015	21,788,057	0	13,670,097	0	11,771,409	0	10,164,290	0
2016	17,954,033	0	10,626,965	0	8,981,486	0	7,614,263	0
2017	0	1,638,246	0	914,788	0	758,825	0	631,615
2018	0	1,638,246	0	863,007	0	702,616	0	574,195
2019	0	1,638,246	0	814,158	0	650,570	0	521,996
2020	0	1,638,246	0	768,074	0	602,380	0	474,541
2021	0	1,638,246	0	724,598	0	557,759	0	431,401
2022	0	1,638,246	0	683,583	0	516,443	0	392,183
2023	0	1,638,246	0	644,889	0	478,188	0	356,530
2024	0	1,638,246	0	608,386	0	442,767	0	324,118
2025	0	1,638,246	0	573,949	0	409,969	0	294,653
2026	0	1,638,246	0	541,462	0	379,601	0	267,866
2027	0	1,638,246	0	510,813	0	351,483	0	243,515
2028	0	1,638,246	0	481,899	0	325,447	0	221,377
2029	0	1,638,246	0	454,622	0	301,340	0	201,252
2030	0	1,638,246	0	428,888	0	279,018	0	182,956
2031	282,315	1,638,246	69,726	404,612	44,521	258,350	28,662	166,324
2032	0	1,638,246	0	381,709	0	239,213	0	151,204
2033	0	1,638,246	0	360,103	0	221,494	0	137,458
2034	0	1,638,246	0	339,720	0	205,087	0	124,962
2035	0	1,638,246	0	320,490	0	189,895	0	113,601
2036	0	1,638,246	0	302,349	0	175,829	0	103,274
2037	0	1,638,246	0	285,235	0	162,805	0	93,886
2038	0	1,638,246	0	269,090	0	150,745	0	85,350
2039	0	1,638,246	0	253,858	0	139,579	0	77,591
2040	0	1,638,246	0	239,489	0	129,239	0	70,538
2041	0	1,638,246	0	225,933	0	119,666	0	64,125
2042	0	1,638,246	0	213,144	0	110,802	0	58,296
2043	0	1,638,246	0	201,080	0	102,594	0	52,996
2044	0	1,638,246	0	189,698	0	94,995	0	48,178
2045	0	1,638,246	0	178,960	0	87,958	0	43,798
2046	282,315	1,638,246	29,094	168,830	14,035	81,443	6,862	39,817
2047	0	1,638,246	0	159,274	0	75,410	0	36,197
2048	0	1,638,246	0	150,258	0	69,824	0	32,906
2049	0	1,638,246	0	141,753	0	64,652	0	29,915
2050	0	1,638,246	0	133,729	0	59,863	0	27,195
			0					
2051	0	1,638,246	0	126,160	0	55,429	0	24,723
2052	0	1,638,246	0	119,019	0	51,323	0	22,475
2053	0	1,638,246	0	112,282	0	47,521	0	20,432
2054	0	1,638,246	0	105,926	0	44,001	0	18,575
2055	0	1,638,246	0	99,930	0	40,742	0	16,886
2056	0	1,638,246	0	94,274	0	37,724	0	15,351
2057	0	1,638,246	0	88,938	0	34,929	0	13,955
2058	0	1,638,246	0	83,903	0	32,342	0	12,687
2059	0	1,638,246	0	79,154	0	29,946	0	11,533
2060	0	1,638,246	0	74,674	0	27,728	0	10,485
2061	0	1,638,246	0	70,447	0	25,674	0	9,532
TOTAL	**44,140,745**	**73,721,065**	**26,945,726**	**14,987,137**	**23,048,568**	**9,923,208**	**19,781,537**	**6,852,444**

NET PRESENT COST

Discounted at 6%	41,932,864
Discounted at 8%	32,971,776
Discounted at 10%	26,633,981

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 3,834,024	0	R 2,549,845	0	R 2,237,116	0	R 1,967,461
2015	0	R 21,788,057	0	R 13,670,097	0	R 11,771,409	0	R 10,164,290
2016	0	R 17,954,033	0	R 10,626,965	0	R 8,981,486	0	R 7,614,263
2017	5.3	R 1,638,246	3	R 914,788	2	R 758,825	2	R 631,615
2018	5.3	R 1,638,246	3	R 863,007	2	R 702,616	2	R 574,195
2019	5.3	R 1,638,246	3	R 814,158	2	R 650,570	2	R 521,996
2020	5.3	R 1,638,246	2	R 768,074	2	R 602,380	2	R 474,541
2021	5.3	R 1,638,246	2	R 724,598	2	R 557,759	1	R 431,401
2022	5.3	R 1,638,246	2	R 683,583	2	R 516,443	1	R 392,183
2023	5.3	R 1,638,246	2	R 644,889	2	R 478,188	1	R 356,530
2024	5.3	R 1,638,246	2	R 608,386	1	R 442,767	1	R 324,118
2025	5.3	R 1,638,246	2	R 573,949	1	R 409,969	1	R 294,653
2026	5.3	R 1,638,246	2	R 541,462	1	R 379,601	1	R 267,866
2027	5.3	R 1,638,246	2	R 510,813	1	R 351,483	1	R 243,515
2028	5.3	R 1,638,246	2	R 481,899	1	R 325,447	1	R 221,377
2029	5.3	R 1,638,246	1	R 454,622	1	R 301,340	1	R 201,252
2030	5.3	R 1,638,246	1	R 428,888	1	R 279,018	1	R 182,956
2031	5.3	R 1,920,561	1	R 474,337	1	R 302,871	1	R 194,986
2032	5.3	R 1,638,246	1	R 381,709	1	R 239,213	0	R 151,204
2033	5.3	R 1,638,246	1	R 360,103	1	R 221,494	0	R 137,458
2034	5.3	R 1,638,246	1	R 339,720	1	R 205,087	0	R 124,962
2035	5.3	R 1,638,246	1	R 320,490	1	R 189,895	0	R 113,601
2036	5.3	R 1,638,246	1	R 302,349	1	R 175,829	0	R 103,274
2037	5.3	R 1,638,246	1	R 285,235	1	R 162,805	0	R 93,886
2038	5.3	R 1,638,246	1	R 269,090	0	R 150,745	0	R 85,350
2039	5.3	R 1,638,246	1	R 253,858	0	R 139,579	0	R 77,591
2040	5.3	R 1,638,246	1	R 239,489	0	R 129,239	0	R 70,538
2041	5.3	R 1,638,246	1	R 225,933	0	R 119,666	0	R 64,125
2042	5.3	R 1,638,246	1	R 213,144	0	R 110,802	0	R 58,296
2043	5.3	R 1,638,246	1	R 201,080	0	R 102,594	0	R 52,996
2044	5.3	R 1,638,246	1	R 189,698	0	R 94,995	0	R 48,178
2045	5.3	R 1,638,246	1	R 178,960	0	R 87,958	0	R 43,798
2046	5.3	R 1,920,561	1	R 197,924	0	R 95,478	0	R 46,678
2047	5.3	R 1,638,246	1	R 159,274	0	R 75,410	0	R 36,197
2048	5.3	R 1,638,246	0	R 150,258	0	R 69,824	0	R 32,906
2049	5.3	R 1,638,246	0	R 141,753	0	R 64,652	0	R 29,915
2050	5.3	R 1,638,246	0	R 133,729	0	R 59,863	0	R 27,195
2051	5.3	R 1,638,246	0	R 126,160	0	R 55,429	0	R 24,723
2052	5.3	R 1,638,246	0	R 119,019	0	R 51,323	0	R 22,475
2053	5.3	R 1,638,246	0	R 112,282	0	R 47,521	0	R 20,432
2054	5.3	R 1,638,246	0	R 105,926	0	R 44,001	0	R 18,575
2055	5.3	R 1,638,246	0	R 99,930	0	R 40,742	0	R 16,886
2056	5.3	R 1,638,246	0	R 94,274	0	R 37,724	0	R 15,351
2057	5.3	R 1,638,246	0	R 88,938	0	R 34,929	0	R 13,955
2058	5.3	R 1,638,246	0	R 83,903	0	R 32,342	0	R 12,687
2059	5.3	R 1,638,246	0	R 79,154	0	R 29,946	0	R 11,533
2060	5.3	R 1,638,246	0	R 74,674	0	R 27,728	0	R 10,485
2061	5.3	R 1,638,246	0	R 70,447	0	R 25,674	0	R 9,532
TOTAL	**238.5**	**R 117,861,810**	**48**	**R 41,932,864**	**32**	**R 32,971,776**	**22**	**R 26,633,981**
URV				**R 0.86**		**R 1.03**		**R 1.20**

SCENARIO 1B

- Kwamashu WWTW to Hazelmere Dam – (14 million m^3/a) and Inanda Dam (9 million m^3/a)
- Northern WWTW to Inanda Dam – 19,7 million m^3/a
- North Coast (to Hazelmere Dam)
  - Tongaat WWTW – 2,9 million m^3/a
  - Verulem WWTW – 2,4 million m^3/a
  - Phoenix WWTW – 5,1 million m^3/a (Incl. and Excl.)

Kwamashu WWTW to Hazelmere Dam – (14 million m^3/a) and Inanda Dam (9 million m^3/a)

Project Name: Re-Use Options
Option: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
Base year of study cost: Sep 2007
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 23.00 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing KwaMashu WWTW		KwaMashu WWTW	**No**	1	R 29,000,000	R 29,000,000	R 29,000,000		R 29,000,000	2015	2016	2	R 14,500,000	R -
Pipelines			**Dia**	**Length**										
		Kwamashu to Hazelmere Dam	700mm	20km	R 61,790,400	R 61,790,400	R 61,790,400		R 61,790,400	2015	2016	2	R 30,895,200	R -
		Kwamashu to Inanda Dam	600mm	30km	R 75,600,000	R 75,600,000	R 75,600,000		R 75,600,000	2015	2016	2	R 37,800,000	R -
Pumpstation to Hazelmere Dam		Hazelmere Pump Station			R 9,767,646	R 9,767,646	R 3,321,000	R 6,446,646	R 9,767,646	2015	2016	2	R 1,660,500	R 3,223,323
Pumpstation to Inanda Dam		Inanda Pump Station			R 12,672,576	R 12,672,576	R 4,308,676	R 8,363,900	R 12,672,576	2015	2016	2	R 2,154,338	R 4,181,950
Sub-Total					**R 188,830,622**	**R 188,830,622**	**R 174,020,075**	**R 14,810,547**	**R 188,830,622**					
Engineering Fees	12%								**R 22,659,674.64**			2	R 11,329,837	
Land Acquisitions and relocations									**R 5,000,000.00**			2	R 2,500,000	
Social and Environmental	1%								**R 1,888,306.22**			2	R 944,153	
Sub-Total									**R 218,378,602.86**					
VAT	14%								**R 30,573,004.40**					
Total									**R 248,951,607.26**					

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.463	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.62	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.463	
Peak factor	1.04			
Average head pumped		m	131.00	**131.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.7	**0.7**
power absorbed at Qd: (Pd / Pf)		MVA	0.7	**0.7**
		MVAh	17.3	**17.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	1.0	**1.0**
head pumped (Hd)		m	131.00	**131.0**
Energy consumed over 24 hours (continuous use)	24	MWh	16.6	**17**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	1,145,518.19	**R**	**1,145,518**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	115,353.68	**R**	**115,354**
Transmission surcharge (< 300 km)	%		1.00%	R	11,455.18	**R**	**11,455**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	86,596.76	**R**	**86,597**
Network Charge	R/MVA	R	6,340.00	R	6,092.46	**R**	**6,092**
Total annual cost				**R**	**1,377,864.27**	**R**	**1,377,864**

PUMP STATION TO HAZELMERE DAM

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.154	m3/s	Pump Station Capacity
Total flow	0.463	m3/s	14 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	2.23	4	3	2	106,370	18,940	8,041	116,417	249,769
2	2018	3.60	4	3	2	171,828	18,940	12,990	117,072	320,830
3	2019	4.80	4	3	3	229,104	18,940	17,319	117,645	383,008
4	2020	7.03	4	3	5	335,473	18,940	25,360	118,708	498,483
5	2021	9.09	4	3	6	433,660	18,940	32,783	119,690	605,074
6	2022	10.80	4	3	7	515,483	18,940	38,969	120,509	693,901
7	2023	11.83	4	3	8	564,577	18,940	42,680	120,999	747,197
8	2024	12.86	4	3	9	613,670	18,940	46,391	121,490	800,492
9	2025	13.89	4	3	10	662,764	18,940	50,102	121,981	853,788
10	2026	15.09	4	3	10	720,040	18,940	54,432	122,554	915,967
11	2027	16.11	4	3	11	769,134	18,940	58,144	123,045	969,263
12	2028	17.31	4	3	12	826,410	18,940	62,473	123,618	1,031,441
13	2029	18.34	4	3	13	875,503	18,940	66,185	124,109	1,084,737
14	2030	19.54	4	3	14	932,779	18,940	70,515	124,681	1,146,916
15	2031	22.11	4	3	15	1,055,513	18,940	79,793	125,909	1,280,155
16	2032	23.49	4	3	16	1,120,971	18,940	84,741	126,563	1,351,216
17	2033	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
18	2034	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
19	2035	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
20	2036	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
21	2037	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
22	2038	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
23	2039	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
24	2040	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
25	2041	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
26	2042	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
27	2043	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
28	2044	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
29	2045	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
30	2046	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
31	2047	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
32	2048	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
33	2049	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
34	2050	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
35	2051	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
36	2052	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
37	2053	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
38	2054	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
39	2055	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
40	2056	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
41	2057	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
42	2058	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
43	2059	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
44	2060	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
45	2061	24.00	4	3	17	1,145,518	18,940	86,597	126,809	1,377,864
	TOTAL					**43,153,306**	**852,321**		**5,622,449**	**52,890,300**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	1.300	0.00%	1.30	0.043	0.000	2.23
2018	2.100	0.00%	2.10	0.069	0.000	3.60
2019	2.800	0.00%	2.80	0.093	0.000	4.80
2020	4.100	0.00%	4.10	0.136	0.000	7.03
2021	5.300	0.00%	5.30	0.175	0.000	9.09
2022	6.300	0.00%	6.30	0.208	0.000	10.80
2023	6.900	0.00%	6.90	0.228	0.000	11.83
2024	7.500	0.00%	7.50	0.248	0.000	12.86
2025	8.100	0.00%	8.10	0.268	0.000	13.89
2026	8.800	0.00%	8.80	0.291	0.000	15.09
2027	9.400	0.00%	9.40	0.311	0.000	16.11
2028	10.100	0.00%	10.10	0.334	0.000	17.31
2029	10.700	0.00%	10.70	0.354	0.000	18.34
2030	11.400	0.00%	11.40	0.377	0.000	19.54
2031	12.900	0.00%	12.90	0.427	0.000	22.11
2032	13.700	0.00%	13.70	0.453	0.000	23.49
2033	14.000	0.00%	14.00	0.463	0.000	24.00
2034	14.000	0.00%	14.00	0.463	0.000	24.00
2035	14.000	0.00%	14.00	0.463	0.000	24.00
2036	14.000	0.00%	14.00	0.463	0.000	24.00
2037	14.000	0.00%	14.00	0.463	0.000	24.00
2038	14.000	0.00%	14.00	0.463	0.000	24.00
2039	14.000	0.00%	14.00	0.463	0.000	24.00
2040	14.000	0.00%	14.00	0.463	0.000	24.00
2041	14.000	0.00%	14.00	0.463	0.000	24.00
2042	14.000	0.00%	14.00	0.463	0.000	24.00
2043	14.000	0.00%	14.00	0.463	0.000	24.00
2044	14.000	0.00%	14.00	0.463	0.000	24.00
2045	14.000	0.00%	14.00	0.463	0.000	24.00
2046	14.000	0.00%	14.00	0.463	0.000	24.00
2047	14.000	0.00%	14.00	0.463	0.000	24.00
2048	14.000	0.00%	14.00	0.463	0.000	24.00
2049	14.000	0.00%	14.00	0.463	0.000	24.00
2050	14.000	0.00%	14.00	0.463	0.000	24.00
2051	14.000	0.00%	14.00	0.463	0.000	24.00
2052	14.000	0.00%	14.00	0.463	0.000	24.00
2053	14.000	0.00%	14.00	0.463	0.000	24.00
2054	14.000	0.00%	14.00	0.463	0.000	24.00
2055	14.000	0.00%	14.00	0.463	0.000	24.00
2056	14.000	0.00%	14.00	0.463	0.000	24.00
2057	14.000	0.00%	14.00	0.463	0.000	24.00
2058	14.000	0.00%	14.00	0.463	0.000	24.00
2059	14.000	0.00%	14.00	0.463	0.000	24.00
2060	14.000	0.00%	14.00	0.463	0.000	24.00
2061	14.000	0.00%	14.00	0.463	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.298	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.40	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.298	
Peak factor	1.04			
Average head pumped		m	364.00	**364.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	1.2	**1.2**
power absorbed at Qd: (Pd / Pf)		MVA	1.3	**1.3**
		MVAh	30.9	**30.9**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	1.7	**1.7**
head pumped (Hd)		m	364.00	**364.0**
Energy consumed over 24 hours (continuous use)	24	MWh	29.7	**30**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	2,046,192.79	**R**	**2,046,193**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	206,051.61	**R**	**206,052**
Transmission surcharge (< 300 km)	%		1.00%	R	20,461.93	**R**	**20,462**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	154,684.28	**R**	**154,684**
Network Charge	R/MVA	R	6,340.00	R	10,882.72	**R**	**10,883**
Total annual cost				**R**	**2,451,121.33**	**R**	**2,451,121**

PUMP STATION TO INANDA DAM

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
DATE: SEP 2007

Number of pumps	3 (excluding standby)			
Standby pumps	1			
Flow per pump	0.099 m3/s		Pump Station Capacity	
Total flow	0.298 m3/s		9 million m³	
Pumps active	350 days per annum	350	49.82888433 weeks	
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	21.07	4	3	26	1,796,103	23,731	135,778	224,013	2,179,624
2	2018	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
3	2019	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
4	2020	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
5	2021	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
6	2022	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
7	2023	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
8	2024	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
9	2025	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
10	2026	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
11	2027	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
12	2028	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
13	2029	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
14	2030	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
15	2031	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
16	2032	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
17	2033	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
18	2034	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
19	2035	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
20	2036	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
21	2037	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
22	2038	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
23	2039	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
24	2040	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
25	2041	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
26	2042	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
27	2043	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
28	2044	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
29	2045	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
30	2046	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
31	2047	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
32	2048	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
33	2049	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
34	2050	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
35	2051	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
36	2052	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
37	2053	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
38	2054	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
39	2055	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
40	2056	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
41	2057	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
42	2058	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
43	2059	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
44	2060	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
45	2061	24.00	4	3	30	2,046,193	23,731	154,684	226,514	2,451,121
	TOTAL					**91,828,585**	**1,067,882**		**10,190,608**	**110,028,963**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	21.07
2018	9.000	0.00%	9.00	0.298	0.000	24.00
2019	9.000	0.00%	9.00	0.298	0.000	24.00
2020	9.000	0.00%	9.00	0.298	0.000	24.00
2021	9.000	0.00%	9.00	0.298	0.000	24.00
2022	9.000	0.00%	9.00	0.298	0.000	24.00
2023	9.000	0.00%	9.00	0.298	0.000	24.00
2024	9.000	0.00%	9.00	0.298	0.000	24.00
2025	9.000	0.00%	9.00	0.298	0.000	24.00
2026	9.000	0.00%	9.00	0.298	0.000	24.00
2027	9.000	0.00%	9.00	0.298	0.000	24.00
2028	9.000	0.00%	9.00	0.298	0.000	24.00
2029	9.000	0.00%	9.00	0.298	0.000	24.00
2030	9.000	0.00%	9.00	0.298	0.000	24.00
2031	9.000	0.00%	9.00	0.298	0.000	24.00
2032	9.000	0.00%	9.00	0.298	0.000	24.00
2033	9.000	0.00%	9.00	0.298	0.000	24.00
2034	9.000	0.00%	9.00	0.298	0.000	24.00
2035	9.000	0.00%	9.00	0.298	0.000	24.00
2036	9.000	0.00%	9.00	0.298	0.000	24.00
2037	9.000	0.00%	9.00	0.298	0.000	24.00
2038	9.000	0.00%	9.00	0.298	0.000	24.00
2039	9.000	0.00%	9.00	0.298	0.000	24.00
2040	9.000	0.00%	9.00	0.298	0.000	24.00
2041	9.000	0.00%	9.00	0.298	0.000	24.00
2042	9.000	0.00%	9.00	0.298	0.000	24.00
2043	9.000	0.00%	9.00	0.298	0.000	24.00
2044	9.000	0.00%	9.00	0.298	0.000	24.00
2045	9.000	0.00%	9.00	0.298	0.000	24.00
2046	9.000	0.00%	9.00	0.298	0.000	24.00
2047	9.000	0.00%	9.00	0.298	0.000	24.00
2048	9.000	0.00%	9.00	0.298	0.000	24.00
2049	9.000	0.00%	9.00	0.298	0.000	24.00
2050	9.000	0.00%	9.00	0.298	0.000	24.00
2051	9.000	0.00%	9.00	0.298	0.000	24.00
2052	9.000	0.00%	9.00	0.298	0.000	24.00
2053	9.000	0.00%	9.00	0.298	0.000	24.00
2054	9.000	0.00%	9.00	0.298	0.000	24.00
2055	9.000	0.00%	9.00	0.298	0.000	24.00
2056	9.000	0.00%	9.00	0.298	0.000	24.00
2057	9.000	0.00%	9.00	0.298	0.000	24.00
2058	9.000	0.00%	9.00	0.298	0.000	24.00
2059	9.000	0.00%	9.00	0.298	0.000	24.00
2060	9.000	0.00%	9.00	0.298	0.000	24.00
2061	9.000	0.00%	9.00	0.298	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PIPELINE: Kwamashu WWTW to Inanda Dam		PUMP STATION TO HAZELMERE DAM					PUMP STATION TO INANDA DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007																			
2008																			
2009																			
2010																			
2011																			
2012																			
2013																			
2014	11,329,837	2,500,000	944,153																
2015	11,329,837	2,500,000	944,153	14,500,000		30,895,200		37,800,000		1,660,500	3,223,323				2,154,338	4,181,950			
2016				14,500,000		30,895,200		37,800,000		1,660,500	3,223,323				2,154,338	4,181,950			
2017					2,960,000		308,952		378,000	0		0	266,168	249,769	0		0	345,328	2,179,624
2018					2,960,000		308,952		378,000	0		0	266,168	320,830	0		0	345,328	2,451,121
2019					2,960,000		308,952		378,000	0		0	266,168	383,008	0		0	345,328	2,451,121
2020					2,960,000		308,952		378,000	0		0	266,168	498,483	0		0	345,328	2,451,121
2021					2,960,000		308,952		378,000	0		0	266,168	605,074	0		0	345,328	2,451,121
2022					2,960,000		308,952		378,000	0		0	266,168	693,901	0		0	345,328	2,451,121
2023					2,960,000		308,952		378,000	0		0	266,168	747,197	0		0	345,328	2,451,121
2024					2,960,000		308,952		378,000	0		0	266,168	800,492	0		0	345,328	2,451,121
2025					2,960,000		308,952		378,000	0		0	266,168	853,788	0		0	345,328	2,451,121
2026					2,960,000		308,952		378,000	0		0	266,168	915,967	0		0	345,328	2,451,121
2027					2,960,000		308,952		378,000	0		0	266,168	969,263	0		0	345,328	2,451,121
2028					2,960,000		308,952		378,000	0		0	266,168	1,031,441	0		0	345,328	2,451,121
2029					2,960,000		308,952		378,000	0		0	266,168	1,084,737	0		0	345,328	2,451,121
2030					2,960,000		308,952		378,000	0		0	266,168	1,146,916	0		0	345,328	2,451,121
2031					2,960,000		308,952		378,000	0	439,544	0	266,168	1,280,155	0	570,266	0	345,328	2,451,121
2032					2,960,000		308,952		378,000	0		0	266,168	1,351,216	0		0	345,328	2,451,121
2033					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2034					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2035					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2036					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2037					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2038					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2039					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2040					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2041					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2042					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2043					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2044					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2045					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2046					2,960,000		308,952		378,000	0	439,544	0	266,168	1,377,864	0	570,266	0	345,328	2,451,121
2047					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2048					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2049					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2050					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2051					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2052					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2053					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2054					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2055					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2056					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2057					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2058					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2059					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2060					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
2061					2,960,000		308,952		378,000	0		0	266,168	1,377,864	0		0	345,328	2,451,121
TOTAL	**22,659,675**	**5,000,000**	**1,888,306**	**29,000,000**	**133,200,000**	**61,790,400**	**13,902,840**	**75,600,000**	**17,010,000**	**3,321,000**	**7,325,735**	**0**	**11,977,576**	**52,890,300**	**4,308,676**	**9,504,432**	**0**	**15,539,746**	**110,028,963**

Re-Use Options

Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	14,773,990	0	9,825,547	0	8,620,482	0	7,581,393	0
2015	109,189,301	0	68,506,719	0	58,991,582	0	50,937,615	0
2016	94,415,311	0	55,884,278	0	47,231,162	0	40,041,309	0
2017	0	6,687,841	0	3,734,455	0	3,097,764	0	2,578,452
2018	0	7,030,399	0	3,703,527	0	3,015,218	0	2,464,112
2019	0	7,092,578	0	3,524,794	0	2,816,560	0	2,259,914
2020	0	7,208,052	0	3,379,416	0	2,650,386	0	2,087,916
2021	0	7,314,644	0	3,235,274	0	2,490,351	0	1,926,174
2022	0	7,403,470	0	3,089,209	0	2,333,883	0	1,772,332
2023	0	7,456,766	0	2,935,328	0	2,176,559	0	1,622,810
2024	0	7,510,062	0	2,788,970	0	2,029,737	0	1,485,826
2025	0	7,563,358	0	2,649,775	0	1,892,723	0	1,360,336
2026	0	7,625,536	0	2,520,339	0	1,766,929	0	1,246,836
2027	0	7,678,832	0	2,394,296	0	1,647,480	0	1,141,409
2028	0	7,741,011	0	2,277,060	0	1,537,796	0	1,046,047
2029	0	7,794,306	0	2,162,960	0	1,433,689	0	957,499
2030	0	7,856,485	0	2,056,806	0	1,338,079	0	877,398
2031	1,009,810	7,989,725	249,401	1,973,291	159,246	1,259,974	102,522	811,162
2032	0	8,060,786	0	1,878,152	0	1,177,019	0	743,978
2033	0	8,087,434	0	1,777,699	0	1,093,435	0	678,580
2034	0	8,087,434	0	1,677,075	0	1,012,440	0	616,891
2035	0	8,087,434	0	1,582,146	0	937,445	0	560,810
2036	0	8,087,434	0	1,492,590	0	868,004	0	509,827
2037	0	8,087,434	0	1,408,104	0	803,708	0	463,479
2038	0	8,087,434	0	1,328,400	0	744,174	0	421,345
2039	0	8,087,434	0	1,253,208	0	689,050	0	383,041
2040	0	8,087,434	0	1,182,271	0	638,009	0	348,219
2041	0	8,087,434	0	1,115,350	0	590,749	0	316,562
2042	0	8,087,434	0	1,052,217	0	546,990	0	287,784
2043	0	8,087,434	0	992,658	0	506,472	0	261,622
2044	0	8,087,434	0	936,470	0	468,956	0	237,838
2045	0	8,087,434	0	883,462	0	434,218	0	216,216
2046	1,009,810	8,087,434	104,066	833,455	50,201	402,054	24,543	196,560
2047	0	8,087,434	0	786,278	0	372,272	0	178,691
2048	0	8,087,434	0	741,772	0	344,696	0	162,447
2049	0	8,087,434	0	699,785	0	319,163	0	147,679
2050	0	8,087,434	0	660,174	0	295,522	0	134,253
			0					
2051	0	8,087,434	0	622,806	0	273,631	0	122,049
2052	0	8,087,434	0	587,553	0	253,362	0	110,953
2053	0	8,087,434	0	554,295	0	234,595	0	100,867
2054	0	8,087,434	0	522,920	0	217,217	0	91,697
2055	0	8,087,434	0	493,321	0	201,127	0	83,361
2056	0	8,087,434	0	465,397	0	186,229	0	75,783
2057	0	8,087,434	0	439,054	0	172,434	0	68,893
2058	0	8,087,434	0	414,201	0	159,661	0	62,630
2059	0	8,087,434	0	390,756	0	147,834	0	56,937
2060	0	8,087,434	0	368,638	0	136,884	0	51,760
2061	0	8,087,434	0	347,772	0	126,744	0	47,055
TOTAL	**220,398,223**	**354,549,425**	**134,570,011**	**69,913,476**	**115,052,673**	**45,841,221**	**98,687,381**	**31,376,029**

NET PRESENT COST

Discounted at 6%	204,483,488
Discounted at 8%	160,893,893
Discounted at 10%	130,063,410

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 1B: Kwamashu WWTW to Hazelmere Dam (14Mm³) and Inanda Dam (9Mm³)
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 14,773,990	0	R 9,825,547	0	R 8,620,482	0	R 7,581,393
2015	0	R 109,189,301	0	R 68,506,719	0	R 58,991,582	0	R 50,937,615
2016	0	R 94,415,311	0	R 55,884,278	0	R 47,231,162	0	R 40,041,309
2017	9.2	R 6,687,841	5	R 3,734,455	4	R 3,097,764	4	R 2,578,452
2018	11.1	R 7,030,399	6	R 3,703,527	5	R 3,015,218	4	R 2,464,112
2019	11.8	R 7,092,578	6	R 3,524,794	5	R 2,816,560	4	R 2,259,914
2020	13.1	R 7,208,052	6	R 3,379,416	5	R 2,650,386	4	R 2,087,916
2021	14.3	R 7,314,644	6	R 3,235,274	5	R 2,490,351	4	R 1,926,174
2022	15.3	R 7,403,470	6	R 3,089,209	5	R 2,333,883	4	R 1,772,332
2023	15.9	R 7,456,766	6	R 2,935,328	5	R 2,176,559	3	R 1,622,810
2024	16.5	R 7,510,062	6	R 2,788,970	4	R 2,029,737	3	R 1,485,826
2025	17.1	R 7,563,358	6	R 2,649,775	4	R 1,892,723	3	R 1,360,336
2026	17.8	R 7,625,536	6	R 2,520,339	4	R 1,766,929	3	R 1,246,836
2027	18.4	R 7,678,832	6	R 2,394,296	4	R 1,647,480	3	R 1,141,409
2028	19.1	R 7,741,011	6	R 2,277,060	4	R 1,537,796	3	R 1,046,047
2029	19.7	R 7,794,306	5	R 2,162,960	4	R 1,433,689	2	R 957,499
2030	20.4	R 7,856,485	5	R 2,056,806	3	R 1,338,079	2	R 877,398
2031	21.9	R 8,999,535	5	R 2,222,692	3	R 1,419,221	2	R 913,683
2032	22.7	R 8,060,786	5	R 1,878,152	3	R 1,177,019	2	R 743,978
2033	23	R 8,087,434	5	R 1,777,699	3	R 1,093,435	2	R 678,580
2034	23	R 8,087,434	5	R 1,677,075	3	R 1,012,440	2	R 616,891
2035	23	R 8,087,434	4	R 1,582,146	3	R 937,445	2	R 560,810
2036	23	R 8,087,434	4	R 1,492,590	2	R 868,004	1	R 509,827
2037	23	R 8,087,434	4	R 1,408,104	2	R 803,708	1	R 463,479
2038	23	R 8,087,434	4	R 1,328,400	2	R 744,174	1	R 421,345
2039	23	R 8,087,434	4	R 1,253,208	2	R 689,050	1	R 383,041
2040	23	R 8,087,434	3	R 1,182,271	2	R 638,009	1	R 348,219
2041	23	R 8,087,434	3	R 1,115,350	2	R 590,749	1	R 316,562
2042	23	R 8,087,434	3	R 1,052,217	2	R 546,990	1	R 287,784
2043	23	R 8,087,434	3	R 992,658	1	R 506,472	1	R 261,622
2044	23	R 8,087,434	3	R 936,470	1	R 468,956	1	R 237,838
2045	23	R 8,087,434	3	R 883,462	1	R 434,218	1	R 216,216
2046	23	R 9,097,244	2	R 937,521	1	R 452,255	1	R 221,103
2047	23	R 8,087,434	2	R 786,278	1	R 372,272	1	R 178,691
2048	23	R 8,087,434	2	R 741,772	1	R 344,696	0	R 162,447
2049	23	R 8,087,434	2	R 699,785	1	R 319,163	0	R 147,679
2050	23	R 8,087,434	2	R 660,174	1	R 295,522	0	R 134,253
2051	23	R 8,087,434	2	R 622,806	1	R 273,631	0	R 122,049
2052	23	R 8,087,434	2	R 587,553	1	R 253,362	0	R 110,953
2053	23	R 8,087,434	2	R 554,295	1	R 234,595	0	R 100,867
2054	23	R 8,087,434	1	R 522,920	1	R 217,217	0	R 91,697
2055	23	R 8,087,434	1	R 493,321	1	R 201,127	0	R 83,361
2056	23	R 8,087,434	1	R 465,397	1	R 186,229	0	R 75,783
2057	23	R 8,087,434	1	R 439,054	0	R 172,434	0	R 68,893
2058	23	R 8,087,434	1	R 414,201	0	R 159,661	0	R 62,630
2059	23	R 8,087,434	1	R 390,756	0	R 147,834	0	R 56,937
2060	23	R 8,087,434	1	R 368,638	0	R 136,884	0	R 51,760
2061	23	R 8,087,434	1	R 347,772	0	R 126,744	0	R 47,055
TOTAL	**931.3**	**R 574,947,648**	**166**	**R 204,483,488**	**105**	**R 160,893,893**	**69**	**R 130,063,410**

URV	**R 1.23**		**R 1.54**		**R 1.88**

Northern WWTW to Inanda Dam – 19,7 million m^3/a

Project Name: Re-Use Options
Option: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 19.70 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Northern WWTW		Northern WWTW			R 26,100,000	R 26,100,000	R 26,100,000		R 26,100,000	2015	2016	2	R 13,050,000	R -
Pipelines			**Dia**	**Length**										
		Northern WWTW to Inanda Dam	800	22km	R 123,464,000	R 123,464,000	R 123,464,000		R 123,464,000	2015	2016	2	R 61,732,000	R -
Pumpstation		At Northern WWTW			R 22,500,000	R 22,500,000	R 7,200,000	R 15,300,000	R 22,500,000	2015	2016	2	R 3,600,000	R 7,650,000
Sub-Total					**R 172,064,000**	**R 172,064,000**	**R 156,764,000**	**R 15,300,000**	**R 172,064,000**					

Engineering Fees	12%	**R**	**20,647,680.00**	2	R 10,323,840
Land Acquisitions and relocations		**R**	**5,000,000.00**	1	R 5,000,000
Social and Environmental	1%	**R**	**1,720,640.00**	1	R 1,720,640
Sub-Total		**R**	**199,432,320.00**		
VAT	14%	**R**	**27,920,524.80**		
Total		**R**	**227,352,844.80**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.651	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.87	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.651	
Peak factor	1.04			
Average head pumped		m	369.00	**369.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	2.7	**2.7**
power absorbed at Qd: (Pd / Pf)		MVA	2.9	**2.9**
		MVAh	68.6	**68.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	3.8	**3.8**
head pumped (Hd)		m	369.00	**369.0**
Energy consumed over 24 hours (continuous use)	24	MWh	65.8	**66**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	4,540,411.86	**R**	**4,540,411.86**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	457,219.47	**R**	**457,219.47**
Transmission surcharge (< 300 km)	%		1.00%	R	45,404.12	**R**	**45,404.12**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	343,237.63	**R**	**343,237.63**
Network Charge	R/MVA	R	6,340.00	R	24,148.27	**R**	**24,148.27**
Total annual cost				**R**	**5,423,269.35**	**R**	**5,423,269.35**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.217	m3/s		Pump Station Capacity
Total flow	0.651	m3/s		19.7 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	9.62	4	3	26	1,820,774	36,996	137,644	475,427	2,470,841
2	2018	18.03	4	3	49	3,411,071	36,996	257,864	491,330	4,197,261
3	2019	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
4	2020	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
5	2021	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
6	2022	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
7	2023	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
8	2024	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
9	2025	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
10	2026	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
11	2027	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
12	2028	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
13	2029	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
14	2030	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
15	2031	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
16	2032	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
17	2033	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
18	2034	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
19	2035	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
20	2036	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
21	2037	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
22	2038	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
23	2039	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
24	2040	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
25	2041	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
26	2042	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
27	2043	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
28	2044	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
29	2045	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
30	2046	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
31	2047	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
32	2048	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
33	2049	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
34	2050	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
35	2051	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
36	2052	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
37	2053	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
38	2054	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
39	2055	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
40	2056	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
41	2057	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
42	2058	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
43	2059	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
44	2060	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
45	2061	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
	TOTAL					**200,469,555**	**1,664,832**		**22,579,572**	**239,868,685**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	9.62
2018	14.800	0.00%	14.80	0.489	0.000	18.03
2019	19.700	0.00%	19.70	0.651	0.000	24.00
2020	19.700	0.00%	19.70	0.651	0.000	24.00
2021	19.700	0.00%	19.70	0.651	0.000	24.00
2022	19.700	0.00%	19.70	0.651	0.000	24.00
2023	19.700	0.00%	19.70	0.651	0.000	24.00
2024	19.700	0.00%	19.70	0.651	0.000	24.00
2025	19.700	0.00%	19.70	0.651	0.000	24.00
2026	19.700	0.00%	19.70	0.651	0.000	24.00
2027	19.700	0.00%	19.70	0.651	0.000	24.00
2028	19.700	0.00%	19.70	0.651	0.000	24.00
2029	19.700	0.00%	19.70	0.651	0.000	24.00
2030	19.700	0.00%	19.70	0.651	0.000	24.00
2031	19.700	0.00%	19.70	0.651	0.000	24.00
2032	19.700	0.00%	19.70	0.651	0.000	24.00
2033	19.700	0.00%	19.70	0.651	0.000	24.00
2034	19.700	0.00%	19.70	0.651	0.000	24.00
2035	19.700	0.00%	19.70	0.651	0.000	24.00
2036	19.700	0.00%	19.70	0.651	0.000	24.00
2037	19.700	0.00%	19.70	0.651	0.000	24.00
2038	19.700	0.00%	19.70	0.651	0.000	24.00
2039	19.700	0.00%	19.70	0.651	0.000	24.00
2040	19.700	0.00%	19.70	0.651	0.000	24.00
2041	19.700	0.00%	19.70	0.651	0.000	24.00
2042	19.700	0.00%	19.70	0.651	0.000	24.00
2043	19.700	0.00%	19.70	0.651	0.000	24.00
2044	19.700	0.00%	19.70	0.651	0.000	24.00
2045	19.700	0.00%	19.70	0.651	0.000	24.00
2046	19.700	0.00%	19.70	0.651	0.000	24.00
2047	19.700	0.00%	19.70	0.651	0.000	24.00
2048	19.700	0.00%	19.70	0.651	0.000	24.00
2049	19.700	0.00%	19.70	0.651	0.000	24.00
2050	19.700	0.00%	19.70	0.651	0.000	24.00
2051	19.700	0.00%	19.70	0.651	0.000	24.00
2052	19.700	0.00%	19.70	0.651	0.000	24.00
2053	19.700	0.00%	19.70	0.651	0.000	24.00
2054	19.700	0.00%	19.70	0.651	0.000	24.00
2055	19.700	0.00%	19.70	0.651	0.000	24.00
2056	19.700	0.00%	19.70	0.651	0.000	24.00
2057	19.700	0.00%	19.70	0.651	0.000	24.00
2058	19.700	0.00%	19.70	0.651	0.000	24.00
2059	19.700	0.00%	19.70	0.651	0.000	24.00
2060	19.700	0.00%	19.70	0.651	0.000	24.00
2061	19.700	0.00%	19.70	0.651	0.000	24.00

Major overhaul every 15 years:	15.00%	of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00%	of electrical/mechanical cost
Maintenance cost (civil)	0.25%	of civil cost
Maintenance cost (pipelines)	0.50%	of pipeline cost

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PUMP STATION AT NORTHERN WWTW				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014	10,323,840											
2015	10,323,840	5,000,000	1,720,640	13,050,000		61,732,000		3,600,000	7,650,000			
2016				13,050,000		61,732,000		3,600,000	7,650,000			
2017					2,530,000		617,320	0		0	630,000	2,470,841
2018					2,530,000		617,320	0		0	630,000	4,197,261
2019					2,530,000		617,320	0		0	630,000	5,423,269
2020					2,530,000		617,320	0		0	630,000	5,423,269
2021					2,530,000		617,320	0		0	630,000	5,423,269
2022					2,530,000		617,320	0		0	630,000	5,423,269
2023					2,530,000		617,320	0		0	630,000	5,423,269
2024					2,530,000		617,320	0		0	630,000	5,423,269
2025					2,530,000		617,320	0		0	630,000	5,423,269
2026					2,530,000		617,320	0		0	630,000	5,423,269
2027					2,530,000		617,320	0		0	630,000	5,423,269
2028					2,530,000		617,320	0		0	630,000	5,423,269
2029					2,530,000		617,320	0		0	630,000	5,423,269
2030					2,530,000		617,320	0		0	630,000	5,423,269
2031					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2032					2,530,000		617,320	0		0	630,000	5,423,269
2033					2,530,000		617,320	0		0	630,000	5,423,269
2034					2,530,000		617,320	0		0	630,000	5,423,269
2035					2,530,000		617,320	0		0	630,000	5,423,269
2036					2,530,000		617,320	0		0	630,000	5,423,269
2037					2,530,000		617,320	0		0	630,000	5,423,269
2038					2,530,000		617,320	0		0	630,000	5,423,269
2039					2,530,000		617,320	0		0	630,000	5,423,269
2040					2,530,000		617,320	0		0	630,000	5,423,269
2041					2,530,000		617,320	0		0	630,000	5,423,269
2042					2,530,000		617,320	0		0	630,000	5,423,269
2043					2,530,000		617,320	0		0	630,000	5,423,269
2044					2,530,000		617,320	0		0	630,000	5,423,269
2045					2,530,000		617,320	0		0	630,000	5,423,269
2046					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2047					2,530,000		617,320	0		0	630,000	5,423,269
2048					2,530,000		617,320	0		0	630,000	5,423,269
2049					2,530,000		617,320	0		0	630,000	5,423,269
2050					2,530,000		617,320	0		0	630,000	5,423,269
2051					2,530,000		617,320	0		0	630,000	5,423,269
2052					2,530,000		617,320	0		0	630,000	5,423,269
2053					2,530,000		617,320	0		0	630,000	5,423,269
2054					2,530,000		617,320	0		0	630,000	5,423,269
2055					2,530,000		617,320	0		0	630,000	5,423,269
2056					2,530,000		617,320	0		0	630,000	5,423,269
2057					2,530,000		617,320	0		0	630,000	5,423,269
2058					2,530,000		617,320	0		0	630,000	5,423,269
2059					2,530,000		617,320	0		0	630,000	5,423,269
2060					2,530,000		617,320	0		0	630,000	5,423,269
2061					2,530,000		617,320	0		0	630,000	5,423,269
TOTAL	**20,647,680**	**5,000,000**	**1,720,640**	**26,100,000**	**113,850,000**	**123,464,000**	**27,779,400**	**7,200,000**	**17,325,000**	**0**	**28,350,000**	**239,868,685**

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	10,323,840	0	6,865,943	0	6,023,861	0	5,297,762	0
2015	103,076,480	0	64,671,459	0	55,689,015	0	48,085,939	0
2016	86,032,000	0	50,922,209	0	43,037,419	0	36,485,966	0
2017	0	6,248,161	0	3,488,941	0	2,894,108	0	2,408,937
2018	0	7,974,581	0	4,200,910	0	3,420,161	0	2,795,042
2019	0	9,200,589	0	4,572,411	0	3,653,681	0	2,931,591
2020	0	9,200,589	0	4,313,595	0	3,383,038	0	2,665,083
2021	0	9,200,589	0	4,069,430	0	3,132,442	0	2,422,803
2022	0	9,200,589	0	3,839,084	0	2,900,409	0	2,202,548
2023	0	9,200,589	0	3,621,778	0	2,685,564	0	2,002,316
2024	0	9,200,589	0	3,416,772	0	2,486,634	0	1,820,288
2025	0	9,200,589	0	3,223,369	0	2,302,439	0	1,654,807
2026	0	9,200,589	0	3,040,914	0	2,131,888	0	1,504,370
2027	0	9,200,589	0	2,868,787	0	1,973,970	0	1,367,609
2028	0	9,200,589	0	2,706,403	0	1,827,750	0	1,243,281
2029	0	9,200,589	0	2,553,210	0	1,692,361	0	1,130,255
2030	0	9,200,589	0	2,408,689	0	1,567,001	0	1,027,505
2031	1,012,500	9,200,589	250,066	2,272,348	159,671	1,450,927	102,795	934,095
2032	0	9,200,589	0	2,143,725	0	1,343,451	0	849,178
2033	0	9,200,589	0	2,022,382	0	1,243,936	0	771,980
2034	0	9,200,589	0	1,907,907	0	1,151,793	0	701,800
2035	0	9,200,589	0	1,799,913	0	1,066,475	0	638,000
2036	0	9,200,589	0	1,698,031	0	987,476	0	580,000
2037	0	9,200,589	0	1,601,916	0	914,330	0	527,272
2038	0	9,200,589	0	1,511,241	0	846,602	0	479,339
2039	0	9,200,589	0	1,425,699	0	783,891	0	435,762
2040	0	9,200,589	0	1,344,999	0	725,825	0	396,148
2041	0	9,200,589	0	1,268,867	0	672,060	0	360,134
2042	0	9,200,589	0	1,197,045	0	622,278	0	327,395
2043	0	9,200,589	0	1,129,287	0	576,183	0	297,632
2044	0	9,200,589	0	1,065,366	0	533,503	0	270,574
2045	0	9,200,589	0	1,005,062	0	493,984	0	245,976
2046	1,012,500	9,200,589	104,344	948,172	50,335	457,393	24,608	223,615
2047	0	9,200,589	0	894,501	0	423,512	0	203,286
2048	0	9,200,589	0	843,869	0	392,140	0	184,806
2049	0	9,200,589	0	796,103	0	363,093	0	168,005
2050	0	9,200,589	0	751,041	0	336,197	0	152,732
			0					
2051	0	9,200,589	0	708,529	0	311,294	0	138,847
2052	0	9,200,589	0	668,424	0	288,235	0	126,225
2053	0	9,200,589	0	630,588	0	266,884	0	114,750
2054	0	9,200,589	0	594,895	0	247,115	0	104,318
2055	0	9,200,589	0	561,221	0	228,810	0	94,835
2056	0	9,200,589	0	529,454	0	211,861	0	86,213
2057	0	9,200,589	0	499,485	0	196,168	0	78,376
2058	0	9,200,589	0	471,212	0	181,637	0	71,251
2059	0	9,200,589	0	444,540	0	168,182	0	64,773
2060	0	9,200,589	0	419,377	0	155,724	0	58,885
2061	0	9,200,589	0	395,639	0	144,189	0	53,532
TOTAL	**201,457,320**	**409,848,085**	**122,814,020**	**81,875,131**	**104,960,301**	**53,836,592**	**89,997,070**	**36,916,167**

NET PRESENT COST

Discounted at 6%	204,689,151
Discounted at 8%	158,796,893
Discounted at 10%	126,913,237

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 10,323,840	0	R 6,865,943	0	R 6,023,861	0	R 5,297,762
2015	0	R 103,076,480	0	R 64,671,459	0	R 55,689,015	0	R 48,085,939
2016	0	R 86,032,000	0	R 50,922,209	0	R 43,037,419	0	R 36,485,966
2017	7.9	R 6,248,161	4	R 3,488,941	4	R 2,894,108	3	R 2,408,937
2018	14.8	R 7,974,581	8	R 4,200,910	6	R 3,420,161	5	R 2,795,042
2019	19.7	R 9,200,589	10	R 4,572,411	8	R 3,653,681	6	R 2,931,591
2020	19.7	R 9,200,589	9	R 4,313,595	7	R 3,383,038	6	R 2,665,083
2021	19.7	R 9,200,589	9	R 4,069,430	7	R 3,132,442	5	R 2,422,803
2022	19.7	R 9,200,589	8	R 3,839,084	6	R 2,900,409	5	R 2,202,548
2023	19.7	R 9,200,589	8	R 3,621,778	6	R 2,685,564	4	R 2,002,316
2024	19.7	R 9,200,589	7	R 3,416,772	5	R 2,486,634	4	R 1,820,288
2025	19.7	R 9,200,589	7	R 3,223,369	5	R 2,302,439	4	R 1,654,807
2026	19.7	R 9,200,589	7	R 3,040,914	5	R 2,131,888	3	R 1,504,370
2027	19.7	R 9,200,589	6	R 2,868,787	4	R 1,973,970	3	R 1,367,609
2028	19.7	R 9,200,589	6	R 2,706,403	4	R 1,827,750	3	R 1,243,281
2029	19.7	R 9,200,589	5	R 2,553,210	4	R 1,692,361	2	R 1,130,255
2030	19.7	R 9,200,589	5	R 2,408,689	3	R 1,567,001	2	R 1,027,505
2031	19.7	R 10,213,089	5	R 2,522,414	3	R 1,610,597	2	R 1,036,890
2032	19.7	R 9,200,589	5	R 2,143,725	3	R 1,343,451	2	R 849,178
2033	19.7	R 9,200,589	4	R 2,022,382	3	R 1,243,936	2	R 771,980
2034	19.7	R 9,200,589	4	R 1,907,907	2	R 1,151,793	2	R 701,800
2035	19.7	R 9,200,589	4	R 1,799,913	2	R 1,066,475	1	R 638,000
2036	19.7	R 9,200,589	4	R 1,698,031	2	R 987,476	1	R 580,000
2037	19.7	R 9,200,589	3	R 1,601,916	2	R 914,330	1	R 527,272
2038	19.7	R 9,200,589	3	R 1,511,241	2	R 846,602	1	R 479,339
2039	19.7	R 9,200,589	3	R 1,425,699	2	R 783,891	1	R 435,762
2040	19.7	R 9,200,589	3	R 1,344,999	2	R 725,825	1	R 396,148
2041	19.7	R 9,200,589	3	R 1,268,867	1	R 672,060	1	R 360,134
2042	19.7	R 9,200,589	3	R 1,197,045	1	R 622,278	1	R 327,395
2043	19.7	R 9,200,589	2	R 1,129,287	1	R 576,183	1	R 297,632
2044	19.7	R 9,200,589	2	R 1,065,366	1	R 533,503	1	R 270,574
2045	19.7	R 9,200,589	2	R 1,005,062	1	R 493,984	1	R 245,976
2046	19.7	R 10,213,089	2	R 1,052,515	1	R 507,727	0	R 248,223
2047	19.7	R 9,200,589	2	R 894,501	1	R 423,512	0	R 203,286
2048	19.7	R 9,200,589	2	R 843,869	1	R 392,140	0	R 184,806
2049	19.7	R 9,200,589	2	R 796,103	1	R 363,093	0	R 168,005
2050	19.7	R 9,200,589	2	R 751,041	1	R 336,197	0	R 152,732
2051	19.7	R 9,200,589	2	R 708,529	1	R 311,294	0	R 138,847
2052	19.7	R 9,200,589	1	R 668,424	1	R 288,235	0	R 126,225
2053	19.7	R 9,200,589	1	R 630,588	1	R 266,884	0	R 114,750
2054	19.7	R 9,200,589	1	R 594,895	1	R 247,115	0	R 104,318
2055	19.7	R 9,200,589	1	R 561,221	0	R 228,810	0	R 94,835
2056	19.7	R 9,200,589	1	R 529,454	0	R 211,861	0	R 86,213
2057	19.7	R 9,200,589	1	R 499,485	0	R 196,168	0	R 78,376
2058	19.7	R 9,200,589	1	R 471,212	0	R 181,637	0	R 71,251
2059	19.7	R 9,200,589	1	R 444,540	0	R 168,182	0	R 64,773
2060	19.7	R 9,200,589	1	R 419,377	0	R 155,724	0	R 58,885
2061	19.7	R 9,200,589	1	R 395,639	0	R 144,189	0	R 53,532
TOTAL	**869.8**	**R 611,305,405**	**171**	**R 204,689,151**	**112**	**R 158,796,893**	**76**	**R 126,913,237**
URV				**R 1.20**		**R 1.42**		**R 1.67**

North Coast (to Hazelmere Dam) – Including Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a
- Phoenix WWTW – 5,1 million m^3/a

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R	6,800,000
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R	5,900,000
Upgrade Existing Phoenix WWTW		Phoenix WWTW	**No**	1	R	10,100,000
Pipelines			**Dia**	**Length**		
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R	7,650,720
		Verulam to Hazelmere Dam	500mm	8km	R	14,001,120
		Phoenix to Verulam	400mm	6km	R	8,406,720
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R	3,913,938
Pumpstation to Hazelmere Dam		Verulam Pump Station			R	6,491,898
Pumpstation to Hazelmere Dam		Phoenix Pump Station			R	3,913,938
Sub-Total					**R**	**67,178,334**
Engineering Fees	12%				**R**	**8,061,400.08**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**671,783.34**
Sub-Total					**R**	**80,911,517.42**
VAT	14%				**R**	**11,327,612.44**
Total					**R**	**92,239,129.86**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Bl
DATE: SEP 2007

Number of pumps	3	(excluding standby)			
Standby pumps	1				
Flow per pump	0.032	m3/s		Pump Station Capacity	
Total flow	0.096	m3/s		2.9	million m³
Pumps active	350	days per annum	350	49.82888433	weeks
Pumping Peak factor to supply within limited period	1.0429				

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.248	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.33	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.248	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.4	**0.4**
power absorbed at Qd: (Pd / Pf)		MVA	0.4	**0.4**
		MVAh	9.6	**9.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.5	**0.5**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	9.2	**9**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	637,092.99	**R**	**637,093**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	64,155.26	**R**	**64,155**
Transmission surcharge (< 300 km)	%		1.00%	R	6,370.93	**R**	**6,371**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	48,161.77	**R**	**48,162**
Network Charge	R/MVA	R	6,340.00	R	3,388.39	**R**	**3,388**
Total annual cost				**R**	**772,017.35**	**R**	**772,017**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.169	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.22	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.169	
Peak factor	1.04			
Average head pumped		m	83.00	**83.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.0	**4.0**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	83.00	**83.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.8	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	264,393.59	**R**	**264,394**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	26,624.43	**R**	**26,624**
Transmission surcharge (< 300 km)	%		1.00%	R	2,643.94	**R**	**2,644**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	19,987.14	**R**	**19,987**
Network Charge	R/MVA	R	6,340.00	R	1,406.18	**R**	**1,406**
Total annual cost				**R**	**327,903.28**	**R**	**327,903**

PHOENIX PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - E
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.056	m3/s	Pump Station Capacity
Total flow	0.169	m3/s	5.1 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS	NUMBER OF PUMPS		MWh	ANNUAL ELECTRICITY COST FOR PUMP STATIONS				
		PUMPED	INSTALLED	ACTIVE	per day	ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
2	2018	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
3	2019	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
4	2020	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
5	2021	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
6	2022	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
7	2023	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
8	2024	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
9	2025	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
10	2026	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
11	2027	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
12	2028	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
13	2029	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
14	2030	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
15	2031	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
16	2032	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
17	2033	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
18	2034	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
19	2035	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
20	2036	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
21	2037	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
22	2038	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
23	2039	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
24	2040	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
25	2041	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
26	2042	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
27	2043	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
28	2044	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
29	2045	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
30	2046	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
31	2047	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
32	2048	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
33	2049	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
34	2050	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
35	2051	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
36	2052	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
37	2053	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
38	2054	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
39	2055	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
40	2056	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
41	2057	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
42	2058	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
43	2059	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
44	2060	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
45	2061	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
	TOTAL					**11,897,712**	**641,438**		**1,317,077**	**14,755,648**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	5.100	0.00%	5.10	0.169	0.000	24.00
2018	5.100	0.00%	5.10	0.169	0.000	24.00
2019	5.100	0.00%	5.10	0.169	0.000	24.00
2020	5.100	0.00%	5.10	0.169	0.000	24.00
2021	5.100	0.00%	5.10	0.169	0.000	24.00
2022	5.100	0.00%	5.10	0.169	0.000	24.00
2023	5.100	0.00%	5.10	0.169	0.000	24.00
2024	5.100	0.00%	5.10	0.169	0.000	24.00
2025	5.100	0.00%	5.10	0.169	0.000	24.00
2026	5.100	0.00%	5.10	0.169	0.000	24.00
2027	5.100	0.00%	5.10	0.169	0.000	24.00
2028	5.100	0.00%	5.10	0.169	0.000	24.00
2029	5.100	0.00%	5.10	0.169	0.000	24.00
2030	5.100	0.00%	5.10	0.169	0.000	24.00
2031	5.100	0.00%	5.10	0.169	0.000	24.00
2032	5.100	0.00%	5.10	0.169	0.000	24.00
2033	5.100	0.00%	5.10	0.169	0.000	24.00
2034	5.100	0.00%	5.10	0.169	0.000	24.00
2035	5.100	0.00%	5.10	0.169	0.000	24.00
2036	5.100	0.00%	5.10	0.169	0.000	24.00
2037	5.100	0.00%	5.10	0.169	0.000	24.00
2038	5.100	0.00%	5.10	0.169	0.000	24.00
2039	5.100	0.00%	5.10	0.169	0.000	24.00
2040	5.100	0.00%	5.10	0.169	0.000	24.00
2041	5.100	0.00%	5.10	0.169	0.000	24.00
2042	5.100	0.00%	5.10	0.169	0.000	24.00
2043	5.100	0.00%	5.10	0.169	0.000	24.00
2044	5.100	0.00%	5.10	0.169	0.000	24.00
2045	5.100	0.00%	5.10	0.169	0.000	24.00
2046	5.100	0.00%	5.10	0.169	0.000	24.00
2047	5.100	0.00%	5.10	0.169	0.000	24.00
2048	5.100	0.00%	5.10	0.169	0.000	24.00
2049	5.100	0.00%	5.10	0.169	0.000	24.00
2050	5.100	0.00%	5.10	0.169	0.000	24.00
2051	5.100	0.00%	5.10	0.169	0.000	24.00
2052	5.100	0.00%	5.10	0.169	0.000	24.00
2053	5.100	0.00%	5.10	0.169	0.000	24.00
2054	5.100	0.00%	5.10	0.169	0.000	24.00
2055	5.100	0.00%	5.10	0.169	0.000	24.00
2056	5.100	0.00%	5.10	0.169	0.000	24.00
2057	5.100	0.00%	5.10	0.169	0.000	24.00
2058	5.100	0.00%	5.10	0.169	0.000	24.00
2059	5.100	0.00%	5.10	0.169	0.000	24.00
2060	5.100	0.00%	5.10	0.169	0.000	24.00
2061	5.100	0.00%	5.10	0.169	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		UPGRADE EXISTING PHOENIX WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		PIPELINE: Phoenix WWTW to Verulam WWTW	
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014	4,030,700	2,500,000	335,892												
2015	4,030,700	2,500,000	335,892	3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2016				3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2017					380,000		310,000		660,000		38,254		70,006		42,034
2018					380,000		310,000		660,000		38,254		70,006		42,034
2019					380,000		310,000		660,000		38,254		70,006		42,034
2020					380,000		310,000		660,000		38,254		70,006		42,034
2021					380,000		310,000		660,000		38,254		70,006		42,034
2022					380,000		310,000		660,000		38,254		70,006		42,034
2023					380,000		310,000		660,000		38,254		70,006		42,034
2024					380,000		310,000		660,000		38,254		70,006		42,034
2025					380,000		310,000		660,000		38,254		70,006		42,034
2026					380,000		310,000		660,000		38,254		70,006		42,034
2027					380,000		310,000		660,000		38,254		70,006		42,034
2028					380,000		310,000		660,000		38,254		70,006		42,034
2029					380,000		310,000		660,000		38,254		70,006		42,034
2030					380,000		310,000		660,000		38,254		70,006		42,034
2031					380,000		310,000		660,000		38,254		70,006		42,034
2032					380,000		310,000		660,000		38,254		70,006		42,034
2033					380,000		310,000		660,000		38,254		70,006		42,034
2034					380,000		310,000		660,000		38,254		70,006		42,034
2035					380,000		310,000		660,000		38,254		70,006		42,034
2036					380,000		310,000		660,000		38,254		70,006		42,034
2037					380,000		310,000		660,000		38,254		70,006		42,034
2038					380,000		310,000		660,000		38,254		70,006		42,034
2039					380,000		310,000		660,000		38,254		70,006		42,034
2040					380,000		310,000		660,000		38,254		70,006		42,034
2041					380,000		310,000		660,000		38,254		70,006		42,034
2042					380,000		310,000		660,000		38,254		70,006		42,034
2043					380,000		310,000		660,000		38,254		70,006		42,034
2044					380,000		310,000		660,000		38,254		70,006		42,034
2045					380,000		310,000		660,000		38,254		70,006		42,034
2046					380,000		310,000		660,000		38,254		70,006		42,034
2047					380,000		310,000		660,000		38,254		70,006		42,034
2048					380,000		310,000		660,000		38,254		70,006		42,034
2049					380,000		310,000		660,000		38,254		70,006		42,034
2050					380,000		310,000		660,000		38,254		70,006		42,034
2051					380,000		310,000		660,000		38,254		70,006		42,034
2052					380,000		310,000		660,000		38,254		70,006		42,034
2053					380,000		310,000		660,000		38,254		70,006		42,034
2054					380,000		310,000		660,000		38,254		70,006		42,034
2055					380,000		310,000		660,000		38,254		70,006		42,034
2056					380,000		310,000		660,000		38,254		70,006		42,034
2057					380,000		310,000		660,000		38,254		70,006		42,034
2058					380,000		310,000		660,000		38,254		70,006		42,034
2059					380,000		310,000		660,000		38,254		70,006		42,034
2060					380,000		310,000		660,000		38,254		70,006		42,034
2061					380,000		310,000		660,000		38,254		70,006		42,034
TOTAL	**8,061,400**	**5,000,000**	**671,783**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**10,100,000**	**29,700,000**	**7,650,720**	**1,721,412**	**14,001,120**	**3,150,252**	**8,406,720**	**1,891,512**

YEAR	TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM					PHOENIX PUMP STATION TO VERULAM WWTW				
	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014															
2015	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2016	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2017	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2018	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2019	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2020	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2021	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2022	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2023	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2024	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2025	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2026	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2027	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2028	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2029	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2030	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2031	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2032	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2033	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2034	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2035	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2036	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2037	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2038	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2039	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2040	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2041	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2042	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2043	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2044	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2045	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2046	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2047	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2048	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2049	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2050	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2051	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2052	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2053	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2054	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2055	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2056	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2057	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2058	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2059	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2060	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2061	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
TOTAL	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**2,272,164**	**4,804,005**	**0**	**7,851,139**	**17,756,540**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**14,755,648**

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	6,866,592	0	4,566,676	0	4,006,590	0	3,523,647	0
2015	40,455,759	0	25,382,444	0	21,856,988	0	18,872,910	0
2016	33,589,167	0	19,881,376	0	16,802,946	0	14,245,086	0
2017	0	2,958,573	0	1,652,052	0	1,370,392	0	1,140,658
2018	0	2,958,573	0	1,558,539	0	1,268,881	0	1,036,962
2019	0	2,958,573	0	1,470,320	0	1,174,890	0	942,693
2020	0	2,958,573	0	1,387,095	0	1,087,861	0	856,993
2021	0	2,958,573	0	1,308,580	0	1,007,279	0	779,085
2022	0	2,958,573	0	1,234,509	0	932,666	0	708,259
2023	0	2,958,573	0	1,164,631	0	863,579	0	643,872
2024	0	2,958,573	0	1,098,709	0	799,610	0	585,338
2025	0	2,958,573	0	1,036,518	0	740,380	0	532,125
2026	0	2,958,573	0	977,847	0	685,537	0	483,750
2027	0	2,958,573	0	922,497	0	634,757	0	439,773
2028	0	2,958,573	0	870,280	0	587,738	0	399,794
2029	0	2,958,573	0	821,019	0	544,201	0	363,449
2030	0	2,958,573	0	774,546	0	503,890	0	330,408
2031	644,390	2,958,573	159,150	730,704	101,620	466,565	65,422	300,371
2032	0	2,958,573	0	689,343	0	432,005	0	273,064
2033	0	2,958,573	0	650,324	0	400,004	0	248,240
2034	0	2,958,573	0	613,513	0	370,374	0	225,673
2035	0	2,958,573	0	578,786	0	342,939	0	205,157
2036	0	2,958,573	0	546,025	0	317,536	0	186,507
2037	0	2,958,573	0	515,118	0	294,015	0	169,552
2038	0	2,958,573	0	485,960	0	272,236	0	154,138
2039	0	2,958,573	0	458,453	0	252,071	0	140,125
2040	0	2,958,573	0	432,503	0	233,399	0	127,387
2041	0	2,958,573	0	408,021	0	216,110	0	115,806
2042	0	2,958,573	0	384,926	0	200,102	0	105,278
2043	0	2,958,573	0	363,138	0	185,279	0	95,707
2044	0	2,958,573	0	342,583	0	171,555	0	87,007
2045	0	2,958,573	0	323,191	0	158,847	0	79,097
2046	644,390	2,958,573	66,408	304,897	32,035	147,081	15,662	71,906
2047	0	2,958,573	0	287,639	0	136,186	0	65,369
2048	0	2,958,573	0	271,358	0	126,098	0	59,427
2049	0	2,958,573	0	255,998	0	116,757	0	54,024
2050	0	2,958,573	0	241,507	0	108,109	0	49,113
			0					
2051	0	2,958,573	0	227,837	0	100,101	0	44,648
2052	0	2,958,573	0	214,941	0	92,686	0	40,589
2053	0	2,958,573	0	202,774	0	85,820	0	36,899
2054	0	2,958,573	0	191,296	0	79,463	0	33,545
2055	0	2,958,573	0	180,468	0	73,577	0	30,495
2056	0	2,958,573	0	170,253	0	68,127	0	27,723
2057	0	2,958,573	0	160,616	0	63,080	0	25,203
2058	0	2,958,573	0	151,525	0	58,408	0	22,912
2059	0	2,958,573	0	142,948	0	54,081	0	20,829
2060	0	2,958,573	0	134,856	0	50,075	0	18,935
2061	0	2,958,573	0	127,223	0	46,366	0	17,214
TOTAL	**82,200,297**	**133,135,790**	**50,056,054**	**27,065,865**	**42,800,179**	**17,920,714**	**36,722,727**	**12,375,100**

NET PRESENT COST

Discounted at 6%	77,121,919
Discounted at 8%	60,720,893
Discounted at 10%	49,097,826

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 6,866,592	0	R 4,566,676	0	R 4,006,590	0	R 3,523,647
2015	0	R 40,455,759	0	R 25,382,444	0	R 21,856,988	0	R 18,872,910
2016	0	R 33,589,167	0	R 19,881,376	0	R 16,802,946	0	R 14,245,086
2017	10.4	R 2,958,573	6	R 1,652,052	5	R 1,370,392	4	R 1,140,658
2018	10.4	R 2,958,573	5	R 1,558,539	4	R 1,268,881	4	R 1,036,962
2019	10.4	R 2,958,573	5	R 1,470,320	4	R 1,174,890	3	R 942,693
2020	10.4	R 2,958,573	5	R 1,387,095	4	R 1,087,861	3	R 856,993
2021	10.4	R 2,958,573	5	R 1,308,580	4	R 1,007,279	3	R 779,085
2022	10.4	R 2,958,573	4	R 1,234,509	3	R 932,666	2	R 708,259
2023	10.4	R 2,958,573	4	R 1,164,631	3	R 863,579	2	R 643,872
2024	10.4	R 2,958,573	4	R 1,098,709	3	R 799,610	2	R 585,338
2025	10.4	R 2,958,573	4	R 1,036,518	3	R 740,380	2	R 532,125
2026	10.4	R 2,958,573	3	R 977,847	2	R 685,537	2	R 483,750
2027	10.4	R 2,958,573	3	R 922,497	2	R 634,757	2	R 439,773
2028	10.4	R 2,958,573	3	R 870,280	2	R 587,738	1	R 399,794
2029	10.4	R 2,958,573	3	R 821,019	2	R 544,201	1	R 363,449
2030	10.4	R 2,958,573	3	R 774,546	2	R 503,890	1	R 330,408
2031	10.4	R 3,602,963	3	R 889,855	2	R 568,185	1	R 365,793
2032	10.4	R 2,958,573	2	R 689,343	2	R 432,005	1	R 273,064
2033	10.4	R 2,958,573	2	R 650,324	1	R 400,004	1	R 248,240
2034	10.4	R 2,958,573	2	R 613,513	1	R 370,374	1	R 225,673
2035	10.4	R 2,958,573	2	R 578,786	1	R 342,939	1	R 205,157
2036	10.4	R 2,958,573	2	R 546,025	1	R 317,536	1	R 186,507
2037	10.4	R 2,958,573	2	R 515,118	1	R 294,015	1	R 169,552
2038	10.4	R 2,958,573	2	R 485,960	1	R 272,236	1	R 154,138
2039	10.4	R 2,958,573	2	R 458,453	1	R 252,071	0	R 140,125
2040	10.4	R 2,958,573	2	R 432,503	1	R 233,399	0	R 127,387
2041	10.4	R 2,958,573	1	R 408,021	1	R 216,110	0	R 115,806
2042	10.4	R 2,958,573	1	R 384,926	1	R 200,102	0	R 105,278
2043	10.4	R 2,958,573	1	R 363,138	1	R 185,279	0	R 95,707
2044	10.4	R 2,958,573	1	R 342,583	1	R 171,555	0	R 87,007
2045	10.4	R 2,958,573	1	R 323,191	1	R 158,847	0	R 79,097
2046	10.4	R 3,602,963	1	R 371,305	1	R 179,116	0	R 87,568
2047	10.4	R 2,958,573	1	R 287,639	0	R 136,186	0	R 65,369
2048	10.4	R 2,958,573	1	R 271,358	0	R 126,098	0	R 59,427
2049	10.4	R 2,958,573	1	R 255,998	0	R 116,757	0	R 54,024
2050	10.4	R 2,958,573	1	R 241,507	0	R 108,109	0	R 49,113
2051	10.4	R 2,958,573	1	R 227,837	0	R 100,101	0	R 44,648
2052	10.4	R 2,958,573	1	R 214,941	0	R 92,686	0	R 40,589
2053	10.4	R 2,958,573	1	R 202,774	0	R 85,820	0	R 36,899
2054	10.4	R 2,958,573	1	R 191,296	0	R 79,463	0	R 33,545
2055	10.4	R 2,958,573	1	R 180,468	0	R 73,577	0	R 30,495
2056	10.4	R 2,958,573	1	R 170,253	0	R 68,127	0	R 27,723
2057	10.4	R 2,958,573	1	R 160,616	0	R 63,080	0	R 25,203
2058	10.4	R 2,958,573	1	R 151,525	0	R 58,408	0	R 22,912
2059	10.4	R 2,958,573	1	R 142,948	0	R 54,081	0	R 20,829
2060	10.4	R 2,958,573	0	R 134,856	0	R 50,075	0	R 18,935
2061	10.4	R 2,958,573	0	R 127,223	0	R 46,366	0	R 17,214
TOTAL	**468**	**R 215,336,087**	**95**	**R 77,121,919**	**63**	**R 60,720,893**	**44**	**R 49,097,826**

URV				**R 0.81**		**R 0.96**		**R 1.13**

North Coast (to Hazelmere Dam) – Excluding Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a

Project Name: Re-Use Options
Option: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
Base year of study cost: Sep 2007
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 5.30 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R 6,800,000	R 6,800,000	R 6,800,000		R 6,800,000	2015	2016	2	R 3,400,000	R -
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R 5,900,000	R 5,900,000	R 5,900,000		R 5,900,000	2015	2016	2	R 2,950,000	R -
Pipelines			**Dia**	**Length**										
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R 7,650,720	R 7,650,720	R 7,650,720		R 7,650,720	2015	2016	2	R 3,825,360	R -
		Verulam to Hazelmere Dam	300mm	8km	R 9,283,680	R 9,283,680	R 9,283,680		R 9,283,680	2015	2016	2	R 4,641,840	R -
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R 3,913,938	R 3,913,938	R 1,409,018	R 2,504,920	R 3,913,938	2015	2016	2	R 704,509	R 1,252,460
Pumpstation to Hazelmere Dam		Verulam Pump Station			R 2,359,728	R 2,359,728	R 873,099	R 1,486,629	R 2,359,728	2015	2016	2	R 436,550	R 743,314
Sub-Total					**R 35,908,066**	**R 35,908,066**	**R 31,916,517**	**R 3,991,549**	**R 35,908,066**					

Engineering Fees	12%	**R 4,308,967.92**	2	R 2,154,484
Land Acquisitions and relocations		**R 3,000,000.00**	2	R 1,500,000
Social and Environmental	1%	**R 359,080.66**	2	R 179,540
Sub-Total		**R 43,576,114.58**		
VAT	14%	**R 6,100,656.04**		
Total		**R 49,676,770.62**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.032	m3/s		Pump Station Capacity
Total flow	0.096	m3/s		2.9 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.079	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.11	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.079	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.1	**0.1**
power absorbed at Qd: (Pd / Pf)		MVA	0.1	**0.1**
		MVAh	3.1	**3.1**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.0	**3**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	203,869.76	**R**	**203,870**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	20,529.68	**R**	**20,530**
Transmission surcharge (< 300 km)	%		1.00%	R	2,038.70	**R**	**2,039**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	15,411.77	**R**	**15,412**
Network Charge	R/MVA	R	6,340.00	R	1,084.29	**R**	**1,084**
Total annual cost				**R**	**255,782.19**	**R**	**255,782**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007																					
2008																					
2009																					
2010																					
2011																					
2012																					
2013																					
2014	2,154,484	1,500,000	179,540																		
2015	2,154,484	1,500,000	179,540	3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2016				3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2017					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2018					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2019					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2020					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2021					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2022					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2023					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2024					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2025					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2026					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2027					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2028					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2029					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2030					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2031					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2032					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2033					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2034					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2035					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2036					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2037					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2038					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2039					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2040					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2041					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2042					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2043					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2044					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2045					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2046					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2047					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2048					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2049					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2050					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2051					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2052					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2053					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2054					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2055					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2056					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2057					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2058					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2059					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2060					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2061					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
TOTAL	**4,308,968**	**3,000,000**	**359,081**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**7,650,720**	**1,721,412**	**9,283,680**	**2,088,828**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**873,099**	**1,699,004**	**0**	**2,774,155**	**15,494,754**

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	3,834,024	0	2,549,845	0	2,237,116	0	1,967,461	0
2015	21,788,057	0	13,670,097	0	11,771,409	0	10,164,290	0
2016	17,954,033	0	10,626,965	0	8,981,486	0	7,614,263	0
2017	0	1,638,246	0	914,788	0	758,825	0	631,615
2018	0	1,638,246	0	863,007	0	702,616	0	574,195
2019	0	1,638,246	0	814,158	0	650,570	0	521,996
2020	0	1,638,246	0	768,074	0	602,380	0	474,541
2021	0	1,638,246	0	724,598	0	557,759	0	431,401
2022	0	1,638,246	0	683,583	0	516,443	0	392,183
2023	0	1,638,246	0	644,889	0	478,188	0	356,530
2024	0	1,638,246	0	608,386	0	442,767	0	324,118
2025	0	1,638,246	0	573,949	0	409,969	0	294,653
2026	0	1,638,246	0	541,462	0	379,601	0	267,866
2027	0	1,638,246	0	510,813	0	351,483	0	243,515
2028	0	1,638,246	0	481,899	0	325,447	0	221,377
2029	0	1,638,246	0	454,622	0	301,340	0	201,252
2030	0	1,638,246	0	428,888	0	279,018	0	182,956
2031	282,315	1,638,246	69,726	404,612	44,521	258,350	28,662	166,324
2032	0	1,638,246	0	381,709	0	239,213	0	151,204
2033	0	1,638,246	0	360,103	0	221,494	0	137,458
2034	0	1,638,246	0	339,720	0	205,087	0	124,962
2035	0	1,638,246	0	320,490	0	189,895	0	113,601
2036	0	1,638,246	0	302,349	0	175,829	0	103,274
2037	0	1,638,246	0	285,235	0	162,805	0	93,886
2038	0	1,638,246	0	269,090	0	150,745	0	85,350
2039	0	1,638,246	0	253,858	0	139,579	0	77,591
2040	0	1,638,246	0	239,489	0	129,239	0	70,538
2041	0	1,638,246	0	225,933	0	119,666	0	64,125
2042	0	1,638,246	0	213,144	0	110,802	0	58,296
2043	0	1,638,246	0	201,080	0	102,594	0	52,996
2044	0	1,638,246	0	189,698	0	94,995	0	48,178
2045	0	1,638,246	0	178,960	0	87,958	0	43,798
2046	282,315	1,638,246	29,094	168,830	14,035	81,443	6,862	39,817
2047	0	1,638,246	0	159,274	0	75,410	0	36,197
2048	0	1,638,246	0	150,258	0	69,824	0	32,906
2049	0	1,638,246	0	141,753	0	64,652	0	29,915
2050	0	1,638,246	0	133,729	0	59,863	0	27,195
			0					
2051	0	1,638,246	0	126,160	0	55,429	0	24,723
2052	0	1,638,246	0	119,019	0	51,323	0	22,475
2053	0	1,638,246	0	112,282	0	47,521	0	20,432
2054	0	1,638,246	0	105,926	0	44,001	0	18,575
2055	0	1,638,246	0	99,930	0	40,742	0	16,886
2056	0	1,638,246	0	94,274	0	37,724	0	15,351
2057	0	1,638,246	0	88,938	0	34,929	0	13,955
2058	0	1,638,246	0	83,903	0	32,342	0	12,687
2059	0	1,638,246	0	79,154	0	29,946	0	11,533
2060	0	1,638,246	0	74,674	0	27,728	0	10,485
2061	0	1,638,246	0	70,447	0	25,674	0	9,532
TOTAL	**44,140,745**	**73,721,065**	**26,945,726**	**14,987,137**	**23,048,568**	**9,923,208**	**19,781,537**	**6,852,444**

NET PRESENT COST

Discounted at 6%	41,932,864
Discounted at 8%	32,971,776
Discounted at 10%	26,633,981

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 3,834,024	0	R 2,549,845	0	R 2,237,116	0	R 1,967,461
2015	0	R 21,788,057	0	R 13,670,097	0	R 11,771,409	0	R 10,164,290
2016	0	R 17,954,033	0	R 10,626,965	0	R 8,981,486	0	R 7,614,263
2017	5.3	R 1,638,246	3	R 914,788	2	R 758,825	2	R 631,615
2018	5.3	R 1,638,246	3	R 863,007	2	R 702,616	2	R 574,195
2019	5.3	R 1,638,246	3	R 814,158	2	R 650,570	2	R 521,996
2020	5.3	R 1,638,246	2	R 768,074	2	R 602,380	2	R 474,541
2021	5.3	R 1,638,246	2	R 724,598	2	R 557,759	1	R 431,401
2022	5.3	R 1,638,246	2	R 683,583	2	R 516,443	1	R 392,183
2023	5.3	R 1,638,246	2	R 644,889	2	R 478,188	1	R 356,530
2024	5.3	R 1,638,246	2	R 608,386	1	R 442,767	1	R 324,118
2025	5.3	R 1,638,246	2	R 573,949	1	R 409,969	1	R 294,653
2026	5.3	R 1,638,246	2	R 541,462	1	R 379,601	1	R 267,866
2027	5.3	R 1,638,246	2	R 510,813	1	R 351,483	1	R 243,515
2028	5.3	R 1,638,246	2	R 481,899	1	R 325,447	1	R 221,377
2029	5.3	R 1,638,246	1	R 454,622	1	R 301,340	1	R 201,252
2030	5.3	R 1,638,246	1	R 428,888	1	R 279,018	1	R 182,956
2031	5.3	R 1,920,561	1	R 474,337	1	R 302,871	1	R 194,986
2032	5.3	R 1,638,246	1	R 381,709	1	R 239,213	0	R 151,204
2033	5.3	R 1,638,246	1	R 360,103	1	R 221,494	0	R 137,458
2034	5.3	R 1,638,246	1	R 339,720	1	R 205,087	0	R 124,962
2035	5.3	R 1,638,246	1	R 320,490	1	R 189,895	0	R 113,601
2036	5.3	R 1,638,246	1	R 302,349	1	R 175,829	0	R 103,274
2037	5.3	R 1,638,246	1	R 285,235	1	R 162,805	0	R 93,886
2038	5.3	R 1,638,246	1	R 269,090	0	R 150,745	0	R 85,350
2039	5.3	R 1,638,246	1	R 253,858	0	R 139,579	0	R 77,591
2040	5.3	R 1,638,246	1	R 239,489	0	R 129,239	0	R 70,538
2041	5.3	R 1,638,246	1	R 225,933	0	R 119,666	0	R 64,125
2042	5.3	R 1,638,246	1	R 213,144	0	R 110,802	0	R 58,296
2043	5.3	R 1,638,246	1	R 201,080	0	R 102,594	0	R 52,996
2044	5.3	R 1,638,246	1	R 189,698	0	R 94,995	0	R 48,178
2045	5.3	R 1,638,246	1	R 178,960	0	R 87,958	0	R 43,798
2046	5.3	R 1,920,561	1	R 197,924	0	R 95,478	0	R 46,678
2047	5.3	R 1,638,246	1	R 159,274	0	R 75,410	0	R 36,197
2048	5.3	R 1,638,246	0	R 150,258	0	R 69,824	0	R 32,906
2049	5.3	R 1,638,246	0	R 141,753	0	R 64,652	0	R 29,915
2050	5.3	R 1,638,246	0	R 133,729	0	R 59,863	0	R 27,195
2051	5.3	R 1,638,246	0	R 126,160	0	R 55,429	0	R 24,723
2052	5.3	R 1,638,246	0	R 119,019	0	R 51,323	0	R 22,475
2053	5.3	R 1,638,246	0	R 112,282	0	R 47,521	0	R 20,432
2054	5.3	R 1,638,246	0	R 105,926	0	R 44,001	0	R 18,575
2055	5.3	R 1,638,246	0	R 99,930	0	R 40,742	0	R 16,886
2056	5.3	R 1,638,246	0	R 94,274	0	R 37,724	0	R 15,351
2057	5.3	R 1,638,246	0	R 88,938	0	R 34,929	0	R 13,955
2058	5.3	R 1,638,246	0	R 83,903	0	R 32,342	0	R 12,687
2059	5.3	R 1,638,246	0	R 79,154	0	R 29,946	0	R 11,533
2060	5.3	R 1,638,246	0	R 74,674	0	R 27,728	0	R 10,485
2061	5.3	R 1,638,246	0	R 70,447	0	R 25,674	0	R 9,532
TOTAL	**238.5**	**R 117,861,810**	**48**	**R 41,932,864**	**32**	**R 32,971,776**	**22**	**R 26,633,981**
URV				**R 0.86**		**R 1.03**		**R 1.20**

SCENARIO 2

- Kwamashu WWTW to Hazelmere Dam – (10 million m³/a) and Inanda Dam (13 million m³/a)
- Northern WWTW to Inanda Dam – 19,7 million m³/a
- North Coast (to Hazelmere Dam)
  - Tongaat WWTW – 2,9 million m³/a
  - Verulem WWTW – 2,4 million m³/a
  - Phoenix WWTW – 5,1 million m³/a (Incl. and Excl.)

Kwamashu WWTW to Hazelmere Dam – (10 million m^3/a) and Inanda Dam (13 million m^3/a)

Component	Type	Name	Characteristics		Total Capital	
Upgrade Existing KwaMashu WWTW		KwaMashu WWTW	**No**	1	R	29,000,000
Pipelines			**Dia**	**Length**		
		Kwamashu to Hazelmere Dam	600mm	20km	R	50,400,000
		Kwamashu to Inanda Dam	700mm	30km	R	92,685,600
Pumpstation to Hazelmere Dam		Hazelmere Pump Station			R	7,640,388
Pumpstation to Inanda Dam		Inanda Pump Station			R	20,916,000
Sub-Total					**R**	**200,641,988**
Engineering Fees	12%				**R**	**24,077,038.56**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**2,006,419.88**
Sub-Total					**R**	**231,725,446.44**
VAT	14%				**R**	**32,441,562.50**
Total					**R**	**264,167,008.94**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.331	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.44	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.331	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.5	**0.5**
power absorbed at Qd: (Pd / Pf)		MVA	0.5	**0.5**
		MVAh	12.8	**12.8**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.7	**0.7**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	12.3	**12**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	849,457.32	**R**	**849,457**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	85,540.35	**R**	**85,540**
Transmission surcharge (< 300 km)	%		1.00%	R	8,494.57	**R**	**8,495**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	64,215.70	**R**	**64,216**
Network Charge	R/MVA	R	6,340.00	R	4,517.86	**R**	**4,518**
Total annual cost				**R**	**1,025,073.80**	**R**	**1,025,074**

PUMP STATION TO HAZELMERE

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.110	m3/s	Pump Station Capacity
Total flow	0.331	m3/s	10 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	3.12	4	3	2	110,429	17,366	8,348	86,645	222,788
2	2018	5.04	4	3	3	178,386	17,366	13,485	87,324	296,561
3	2019	6.72	4	3	3	237,848	17,366	17,980	87,919	361,113
4	2020	9.84	4	3	5	348,278	17,366	26,328	89,023	480,995
5	2021	12.72	4	3	7	450,212	17,366	34,034	90,042	591,655
6	2022	15.12	4	3	8	535,158	17,366	40,456	90,892	683,872
7	2023	16.56	4	3	8	586,126	17,366	44,309	91,402	739,202
8	2024	18.00	4	3	9	637,093	17,366	48,162	91,911	794,532
9	2025	19.44	4	3	10	688,060	17,366	52,015	92,421	849,862
10	2026	21.12	4	3	11	747,522	17,366	56,510	93,016	914,414
11	2027	22.56	4	3	12	798,490	17,366	60,363	93,525	969,744
12	2028	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
13	2029	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
14	2030	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
15	2031	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
16	2032	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
17	2033	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
18	2034	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
19	2035	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
20	2036	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
21	2037	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
22	2038	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
23	2039	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
24	2040	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
25	2041	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
26	2042	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
27	2043	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
28	2044	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
29	2045	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
30	2046	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
31	2047	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
32	2048	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
33	2049	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
34	2050	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
35	2051	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
36	2052	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
37	2053	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
38	2054	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
39	2055	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
40	2056	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
41	2057	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
42	2058	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
43	2059	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
44	2060	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
45	2061	24.00	4	3	12	849,457	17,366	64,216	94,035	1,025,074
	TOTAL					**34,199,152**	**781,464**		**4,191,307**	**41,757,247**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	1.300	0.00%	1.30	0.043	0.000	3.12
2018	2.100	0.00%	2.10	0.069	0.000	5.04
2019	2.800	0.00%	2.80	0.093	0.000	6.72
2020	4.100	0.00%	4.10	0.136	0.000	9.84
2021	5.300	0.00%	5.30	0.175	0.000	12.72
2022	6.300	0.00%	6.30	0.208	0.000	15.12
2023	6.900	0.00%	6.90	0.228	0.000	16.56
2024	7.500	0.00%	7.50	0.248	0.000	18.00
2025	8.100	0.00%	8.10	0.268	0.000	19.44
2026	8.800	0.00%	8.80	0.291	0.000	21.12
2027	9.400	0.00%	9.40	0.311	0.000	22.56
2028	10.000	0.00%	10.00	0.331	0.000	24.00
2029	10.000	0.00%	10.00	0.331	0.000	24.00
2030	10.000	0.00%	10.00	0.331	0.000	24.00
2031	10.000	0.00%	10.00	0.331	0.000	24.00
2032	10.000	0.00%	10.00	0.331	0.000	24.00
2033	10.000	0.00%	10.00	0.331	0.000	24.00
2034	10.000	0.00%	10.00	0.331	0.000	24.00
2035	10.000	0.00%	10.00	0.331	0.000	24.00
2036	10.000	0.00%	10.00	0.331	0.000	24.00
2037	10.000	0.00%	10.00	0.331	0.000	24.00
2038	10.000	0.00%	10.00	0.331	0.000	24.00
2039	10.000	0.00%	10.00	0.331	0.000	24.00
2040	10.000	0.00%	10.00	0.331	0.000	24.00
2041	10.000	0.00%	10.00	0.331	0.000	24.00
2042	10.000	0.00%	10.00	0.331	0.000	24.00
2043	10.000	0.00%	10.00	0.331	0.000	24.00
2044	10.000	0.00%	10.00	0.331	0.000	24.00
2045	10.000	0.00%	10.00	0.331	0.000	24.00
2046	10.000	0.00%	10.00	0.331	0.000	24.00
2047	10.000	0.00%	10.00	0.331	0.000	24.00
2048	10.000	0.00%	10.00	0.331	0.000	24.00
2049	10.000	0.00%	10.00	0.331	0.000	24.00
2050	10.000	0.00%	10.00	0.331	0.000	24.00
2051	10.000	0.00%	10.00	0.331	0.000	24.00
2052	10.000	0.00%	10.00	0.331	0.000	24.00
2053	10.000	0.00%	10.00	0.331	0.000	24.00
2054	10.000	0.00%	10.00	0.331	0.000	24.00
2055	10.000	0.00%	10.00	0.331	0.000	24.00
2056	10.000	0.00%	10.00	0.331	0.000	24.00
2057	10.000	0.00%	10.00	0.331	0.000	24.00
2058	10.000	0.00%	10.00	0.331	0.000	24.00
2059	10.000	0.00%	10.00	0.331	0.000	24.00
2060	10.000	0.00%	10.00	0.331	0.000	24.00
2061	10.000	0.00%	10.00	0.331	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.430	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.57	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.430	
Peak factor	1.04			
Average head pumped		m	361.00	**361.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	1.8	**1.8**
power absorbed at Qd: (Pd / Pf)		MVA	1.8	**1.8**
		MVAh	44.3	**44.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	2.5	**2.5**
head pumped (Hd)		m	361.00	**361.0**
Energy consumed over 24 hours (continuous use)	24	MWh	42.5	**42**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	2,931,252.37	**R**	**2,931,252**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	295,177.11	**R**	**295,177**
Transmission surcharge (< 300 km)	%		1.00%	R	29,312.52	**R**	**29,313**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	221,591.38	**R**	**221,591**
Network Charge	R/MVA	R	6,340.00	R	15,589.93	**R**	**15,590**
Total annual cost				**R**	**3,505,771.31**	**R**	**3,505,771**

PUMP STATION TO INANDA DAM

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.143	m3/s	Pump Station Capacity
Total flow	0.430	m3/s	13 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	14.58	4	3	26	1,781,300	28,438	134,659	312,990	2,257,387
2	2018	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
3	2019	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
4	2020	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
5	2021	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
6	2022	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
7	2023	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
8	2024	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
9	2025	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
10	2026	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
11	2027	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
12	2028	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
13	2029	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
14	2030	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
15	2031	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
16	2032	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
17	2033	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
18	2034	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
19	2035	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
20	2036	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
21	2037	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
22	2038	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
23	2039	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
24	2040	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
25	2041	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
26	2042	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
27	2043	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
28	2044	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
29	2045	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
30	2046	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
31	2047	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
32	2048	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
33	2049	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
34	2050	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
35	2051	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
36	2052	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
37	2053	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
38	2054	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
39	2055	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
40	2056	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
41	2057	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
42	2058	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
43	2059	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
44	2060	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
45	2061	24.00	4	3	42	2,931,252	28,438	221,591	324,490	3,505,771
	TOTAL					**130,756,404**	**1,279,707**		**14,590,534**	**156,511,324**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	14.58
2018	13.000	0.00%	13.00	0.430	0.000	24.00
2019	13.000	0.00%	13.00	0.430	0.000	24.00
2020	13.000	0.00%	13.00	0.430	0.000	24.00
2021	13.000	0.00%	13.00	0.430	0.000	24.00
2022	13.000	0.00%	13.00	0.430	0.000	24.00
2023	13.000	0.00%	13.00	0.430	0.000	24.00
2024	13.000	0.00%	13.00	0.430	0.000	24.00
2025	13.000	0.00%	13.00	0.430	0.000	24.00
2026	13.000	0.00%	13.00	0.430	0.000	24.00
2027	13.000	0.00%	13.00	0.430	0.000	24.00
2028	13.000	0.00%	13.00	0.430	0.000	24.00
2029	13.000	0.00%	13.00	0.430	0.000	24.00
2030	13.000	0.00%	13.00	0.430	0.000	24.00
2031	13.000	0.00%	13.00	0.430	0.000	24.00
2032	13.000	0.00%	13.00	0.430	0.000	24.00
2033	13.000	0.00%	13.00	0.430	0.000	24.00
2034	13.000	0.00%	13.00	0.430	0.000	24.00
2035	13.000	0.00%	13.00	0.430	0.000	24.00
2036	13.000	0.00%	13.00	0.430	0.000	24.00
2037	13.000	0.00%	13.00	0.430	0.000	24.00
2038	13.000	0.00%	13.00	0.430	0.000	24.00
2039	13.000	0.00%	13.00	0.430	0.000	24.00
2040	13.000	0.00%	13.00	0.430	0.000	24.00
2041	13.000	0.00%	13.00	0.430	0.000	24.00
2042	13.000	0.00%	13.00	0.430	0.000	24.00
2043	13.000	0.00%	13.00	0.430	0.000	24.00
2044	13.000	0.00%	13.00	0.430	0.000	24.00
2045	13.000	0.00%	13.00	0.430	0.000	24.00
2046	13.000	0.00%	13.00	0.430	0.000	24.00
2047	13.000	0.00%	13.00	0.430	0.000	24.00
2048	13.000	0.00%	13.00	0.430	0.000	24.00
2049	13.000	0.00%	13.00	0.430	0.000	24.00
2050	13.000	0.00%	13.00	0.430	0.000	24.00
2051	13.000	0.00%	13.00	0.430	0.000	24.00
2052	13.000	0.00%	13.00	0.430	0.000	24.00
2053	13.000	0.00%	13.00	0.430	0.000	24.00
2054	13.000	0.00%	13.00	0.430	0.000	24.00
2055	13.000	0.00%	13.00	0.430	0.000	24.00
2056	13.000	0.00%	13.00	0.430	0.000	24.00
2057	13.000	0.00%	13.00	0.430	0.000	24.00
2058	13.000	0.00%	13.00	0.430	0.000	24.00
2059	13.000	0.00%	13.00	0.430	0.000	24.00
2060	13.000	0.00%	13.00	0.430	0.000	24.00
2061	13.000	0.00%	13.00	0.430	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PIPELINE: Kwamashu WWTW to Inanda Dam		PUMP STATION TO HAZELMERE DAM					PUMP STATION TO INANDA DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000																			
2001																			
2002																			
2003																			
2004																			
2005																			
2006																			
2007																			
2008																			
2009																			
2010																			
2011																			
2012																			
2013																			
2014	12,038,519	2,500,000	1,003,210																
2015	12,038,519	2,500,000	1,003,210	14,500,000		25,200,000		46,342,800		1,298,866	2,521,328				3,451,140	7,006,860			
2016				14,500,000		25,200,000		46,342,800		1,298,866	2,521,328				3,451,140	7,006,860			
2017					2,960,000		252,000		463,428	0		0	208,201	222,788	0		0	577,805	2,257,387
2018					2,960,000		252,000		463,428	0		0	208,201	296,561	0		0	577,805	3,505,771
2019					2,960,000		252,000		463,428	0		0	208,201	361,113	0		0	577,805	3,505,771
2020					2,960,000		252,000		463,428	0		0	208,201	480,995	0		0	577,805	3,505,771
2021					2,960,000		252,000		463,428	0		0	208,201	591,655	0		0	577,805	3,505,771
2022					2,960,000		252,000		463,428	0		0	208,201	683,872	0		0	577,805	3,505,771
2023					2,960,000		252,000		463,428	0		0	208,201	739,202	0		0	577,805	3,505,771
2024					2,960,000		252,000		463,428	0		0	208,201	794,532	0		0	577,805	3,505,771
2025					2,960,000		252,000		463,428	0		0	208,201	849,862	0		0	577,805	3,505,771
2026					2,960,000		252,000		463,428	0		0	208,201	914,414	0		0	577,805	3,505,771
2027					2,960,000		252,000		463,428	0		0	208,201	969,744	0		0	577,805	3,505,771
2028					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2029					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2030					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2031					2,960,000		252,000		463,428	0	343,817	0	208,201	1,025,074	0	941,220	0	577,805	3,505,771
2032					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2033					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2034					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2035					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2036					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2037					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2038					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2039					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2040					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2041					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2042					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2043					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2044					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2045					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2046					2,960,000		252,000		463,428	0	343,817	0	208,201	1,025,074	0	941,220	0	577,805	3,505,771
2047					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2048					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2049					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2050					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2051					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2052					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2053					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2054					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2055					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2056					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2057					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2058					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2059					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2060					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
2061					2,960,000		252,000		463,428	0		0	208,201	1,025,074	0		0	577,805	3,505,771
TOTAL	**24,077,039**	**5,000,000**	**2,006,420**	**29,000,000**	**133,200,000**	**50,400,000**	**11,340,000**	**92,685,600**	**20,854,260**	**2,597,732**	**5,730,291**	**0**	**9,369,026**	**41,757,247**	**6,902,280**	**15,896,160**	**0**	**26,001,203**	**156,511,324**

Re-Use Options

Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	15,541,729	0	10,336,138	0	9,068,450	0	7,975,365	0
2015	115,862,723	0	72,693,706	0	62,597,024	0	54,050,815	0
2016	100,320,994	0	59,379,842	0	50,185,474	0	42,545,895	0
2017	0	6,941,608	0	3,876,158	0	3,215,308	0	2,676,290
2018	0	8,263,766	0	4,353,249	0	3,544,187	0	2,896,399
2019	0	8,328,318	0	4,138,919	0	3,307,289	0	2,653,659
2020	0	8,448,199	0	3,960,846	0	3,106,385	0	2,447,142
2021	0	8,558,859	0	3,785,592	0	2,913,958	0	2,253,815
2022	0	8,651,076	0	3,609,792	0	2,727,180	0	2,070,999
2023	0	8,706,406	0	3,427,244	0	2,541,317	0	1,894,768
2024	0	8,761,736	0	3,253,797	0	2,368,025	0	1,733,463
2025	0	8,817,066	0	3,089,004	0	2,206,462	0	1,585,827
2026	0	8,881,618	0	2,935,490	0	2,057,978	0	1,452,216
2027	0	8,936,948	0	2,786,583	0	1,917,406	0	1,328,420
2028	0	8,992,278	0	2,645,127	0	1,786,368	0	1,215,132
2029	0	8,992,278	0	2,495,403	0	1,654,044	0	1,104,665
2030	0	8,992,278	0	2,354,154	0	1,531,522	0	1,004,241
2031	1,285,037	8,992,278	317,377	2,220,900	202,650	1,418,076	130,464	912,946
2032	0	8,992,278	0	2,095,189	0	1,313,034	0	829,951
2033	0	8,992,278	0	1,976,593	0	1,215,772	0	754,501
2034	0	8,992,278	0	1,864,710	0	1,125,715	0	685,910
2035	0	8,992,278	0	1,759,161	0	1,042,328	0	623,555
2036	0	8,992,278	0	1,659,586	0	965,119	0	566,868
2037	0	8,992,278	0	1,565,647	0	893,629	0	515,334
2038	0	8,992,278	0	1,477,025	0	827,434	0	468,486
2039	0	8,992,278	0	1,393,420	0	766,143	0	425,896
2040	0	8,992,278	0	1,314,547	0	709,391	0	387,178
2041	0	8,992,278	0	1,240,139	0	656,844	0	351,980
2042	0	8,992,278	0	1,169,942	0	608,189	0	319,982
2043	0	8,992,278	0	1,103,719	0	563,138	0	290,893
2044	0	8,992,278	0	1,041,244	0	521,424	0	264,448
2045	0	8,992,278	0	982,306	0	482,800	0	240,407
2046	1,285,037	8,992,278	132,430	926,704	63,884	447,037	31,232	218,552
2047	0	8,992,278	0	874,249	0	413,923	0	198,684
2048	0	8,992,278	0	824,763	0	383,262	0	180,622
2049	0	8,992,278	0	778,078	0	354,872	0	164,201
2050	0	8,992,278	0	734,036	0	328,585	0	149,274
			0					
2051	0	8,992,278	0	692,487	0	304,246	0	135,704
2052	0	8,992,278	0	653,290	0	281,709	0	123,367
2053	0	8,992,278	0	616,311	0	260,842	0	112,152
2054	0	8,992,278	0	581,425	0	241,520	0	101,956
2055	0	8,992,278	0	548,515	0	223,630	0	92,687
2056	0	8,992,278	0	517,467	0	207,065	0	84,261
2057	0	8,992,278	0	488,176	0	191,726	0	76,601
2058	0	8,992,278	0	460,543	0	177,524	0	69,637
2059	0	8,992,278	0	434,475	0	164,375	0	63,307
2060	0	8,992,278	0	409,882	0	152,199	0	57,552
2061	0	8,992,278	0	386,681	0	140,925	0	52,320
TOTAL	**234,295,521**	**399,033,060**	**142,859,493**	**79,502,568**	**122,117,481**	**52,259,903**	**104,733,771**	**35,836,250**

NET PRESENT COST

Discounted at 6%	222,362,061
Discounted at 8%	174,377,384
Discounted at 10%	140,570,021

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: Scenario 2: Kwamashu WWTW to Hazelmere Dam (10Mm³) and Inanda Dam (13Mm³)
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 15,541,729	0	R 10,336,138	0	R 9,068,450	0	R 7,975,365
2015	0	R 115,862,723	0	R 72,693,706	0	R 62,597,024	0	R 54,050,815
2016	0	R 100,320,994	0	R 59,379,842	0	R 50,185,474	0	R 42,545,895
2017	9.2	R 6,941,608	5	R 3,876,158	4	R 3,215,308	4	R 2,676,290
2018	15.1	R 8,263,766	8	R 4,353,249	6	R 3,544,187	5	R 2,896,399
2019	15.8	R 8,328,318	8	R 4,138,919	6	R 3,307,289	5	R 2,653,659
2020	17.1	R 8,448,199	8	R 3,960,846	6	R 3,106,385	5	R 2,447,142
2021	18.3	R 8,558,859	8	R 3,785,592	6	R 2,913,958	5	R 2,253,815
2022	19.3	R 8,651,076	8	R 3,609,792	6	R 2,727,180	5	R 2,070,999
2023	19.9	R 8,706,406	8	R 3,427,244	6	R 2,541,317	4	R 1,894,768
2024	20.5	R 8,761,736	8	R 3,253,797	6	R 2,368,025	4	R 1,733,463
2025	21.1	R 8,817,066	7	R 3,089,004	5	R 2,206,462	4	R 1,585,827
2026	21.8	R 8,881,618	7	R 2,935,490	5	R 2,057,978	4	R 1,452,216
2027	22.4	R 8,936,948	7	R 2,786,583	5	R 1,917,406	3	R 1,328,420
2028	23	R 8,992,278	7	R 2,645,127	5	R 1,786,368	3	R 1,215,132
2029	23	R 8,992,278	6	R 2,495,403	4	R 1,654,044	3	R 1,104,665
2030	23	R 8,992,278	6	R 2,354,154	4	R 1,531,522	3	R 1,004,241
2031	23	R 10,277,316	6	R 2,538,276	4	R 1,620,726	2	R 1,043,411
2032	23	R 8,992,278	5	R 2,095,189	3	R 1,313,034	2	R 829,951
2033	23	R 8,992,278	5	R 1,976,593	3	R 1,215,772	2	R 754,501
2034	23	R 8,992,278	5	R 1,864,710	3	R 1,125,715	2	R 685,910
2035	23	R 8,992,278	4	R 1,759,161	3	R 1,042,328	2	R 623,555
2036	23	R 8,992,278	4	R 1,659,586	2	R 965,119	1	R 566,868
2037	23	R 8,992,278	4	R 1,565,647	2	R 893,629	1	R 515,334
2038	23	R 8,992,278	4	R 1,477,025	2	R 827,434	1	R 468,486
2039	23	R 8,992,278	4	R 1,393,420	2	R 766,143	1	R 425,896
2040	23	R 8,992,278	3	R 1,314,547	2	R 709,391	1	R 387,178
2041	23	R 8,992,278	3	R 1,240,139	2	R 656,844	1	R 351,980
2042	23	R 8,992,278	3	R 1,169,942	2	R 608,189	1	R 319,982
2043	23	R 8,992,278	3	R 1,103,719	1	R 563,138	1	R 290,893
2044	23	R 8,992,278	3	R 1,041,244	1	R 521,424	1	R 264,448
2045	23	R 8,992,278	3	R 982,306	1	R 482,800	1	R 240,407
2046	23	R 10,277,316	2	R 1,059,134	1	R 510,920	1	R 249,784
2047	23	R 8,992,278	2	R 874,249	1	R 413,923	1	R 198,684
2048	23	R 8,992,278	2	R 824,763	1	R 383,262	0	R 180,622
2049	23	R 8,992,278	2	R 778,078	1	R 354,872	0	R 164,201
2050	23	R 8,992,278	2	R 734,036	1	R 328,585	0	R 149,274
2051	23	R 8,992,278	2	R 692,487	1	R 304,246	0	R 135,704
2052	23	R 8,992,278	2	R 653,290	1	R 281,709	0	R 123,367
2053	23	R 8,992,278	2	R 616,311	1	R 260,842	0	R 112,152
2054	23	R 8,992,278	1	R 581,425	1	R 241,520	0	R 101,956
2055	23	R 8,992,278	1	R 548,515	1	R 223,630	0	R 92,687
2056	23	R 8,992,278	1	R 517,467	1	R 207,065	0	R 84,261
2057	23	R 8,992,278	1	R 488,176	0	R 191,726	0	R 76,601
2058	23	R 8,992,278	1	R 460,543	0	R 177,524	0	R 69,637
2059	23	R 8,992,278	1	R 434,475	0	R 164,375	0	R 63,307
2060	23	R 8,992,278	1	R 409,882	0	R 152,199	0	R 57,552
2061	23	R 8,992,278	1	R 386,681	0	R 140,925	0	R 52,320
TOTAL	**982.5**	**R 633,328,581**	**185**	**R 222,362,061**	**119**	**R 174,377,384**	**80**	**R 140,570,021**

URV	**R 1.20**		**R 1.46**		**R 1.75**

Northern WWTW to Inanda Dam – 19,7 million m^3/a

Project Name: Re-Use Options
Option: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
Base year of study cost: Sep-07
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 19.70 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Northern WWTW		Northern WWTW			R 26,100,000	R 26,100,000	R 26,100,000		R 26,100,000	2015	2016	2	R 13,050,000	R -
Pipelines			**Dia**	**Length**										
		Northern WWTW to Inanda Dam	800	22km	R 123,464,000	R 123,464,000	R 123,464,000		R 123,464,000	2015	2016	2	R 61,732,000	R -
Pumpstation		At Northern WWTW			R 22,500,000	R 22,500,000	R 7,200,000	R 15,300,000	R 22,500,000	2015	2016	2	R 3,600,000	R 7,650,000
Sub-Total					**R 172,064,000**	**R 172,064,000**	**R 156,764,000**	**R 15,300,000**	**R 172,064,000**					

Engineering Fees	12%	**R**	**20,647,680.00**	2	R 10,323,840
Land Acquisitions and relocations		**R**	**5,000,000.00**	1	R 5,000,000
Social and Environmental	1%	**R**	**1,720,640.00**	1	R 1,720,640
Sub-Total		**R**	**199,432,320.00**		
VAT	14%	**R**	**27,920,524.80**		
Total		**R**	**227,352,844.80**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.651	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.87	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.651	
Peak factor	1.04			
Average head pumped		m	369.00	**369.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		UNIT/RATE	P1	TOTAL
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	2.7	**2.7**
power absorbed at Qd: (Pd / Pf)		MVA	2.9	**2.9**
		MVAh	68.6	**68.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	3.8	**3.8**
head pumped (Hd)		m	369.00	**369.0**
Energy consumed over 24 hours (continuous use)	24	MWh	65.8	**66**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	4,540,411.86	**R**	**4,540,411.86**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	457,219.47	**R**	**457,219.47**
Transmission surcharge (< 300 km)	%		1.00%	R	45,404.12	**R**	**45,404.12**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848.00**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	343,237.63	**R**	**343,237.63**
Network Charge	R/MVA	R	6,340.00	R	24,148.27	**R**	**24,148.27**
Total annual cost				**R**	**5,423,269.35**	**R**	**5,423,269.35**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.217	m3/s		Pump Station Capacity
Total flow	0.651	m3/s		19.7 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	9.62	4	3	26	1,820,774	36,996	137,644	475,427	2,470,841
2	2018	18.03	4	3	49	3,411,071	36,996	257,864	491,330	4,197,261
3	2019	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
4	2020	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
5	2021	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
6	2022	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
7	2023	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
8	2024	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
9	2025	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
10	2026	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
11	2027	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
12	2028	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
13	2029	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
14	2030	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
15	2031	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
16	2032	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
17	2033	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
18	2034	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
19	2035	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
20	2036	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
21	2037	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
22	2038	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
23	2039	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
24	2040	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
25	2041	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
26	2042	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
27	2043	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
28	2044	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
29	2045	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
30	2046	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
31	2047	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
32	2048	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
33	2049	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
34	2050	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
35	2051	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
36	2052	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
37	2053	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
38	2054	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
39	2055	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
40	2056	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
41	2057	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
42	2058	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
43	2059	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
44	2060	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
45	2061	24.00	4	3	66	4,540,412	36,996	343,238	502,624	5,423,269
	TOTAL					**200,469,555**	**1,664,832**		**22,579,572**	**239,868,685**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	7.900	0.00%	7.90	0.261	0.000	9.62
2018	14.800	0.00%	14.80	0.489	0.000	18.03
2019	19.700	0.00%	19.70	0.651	0.000	24.00
2020	19.700	0.00%	19.70	0.651	0.000	24.00
2021	19.700	0.00%	19.70	0.651	0.000	24.00
2022	19.700	0.00%	19.70	0.651	0.000	24.00
2023	19.700	0.00%	19.70	0.651	0.000	24.00
2024	19.700	0.00%	19.70	0.651	0.000	24.00
2025	19.700	0.00%	19.70	0.651	0.000	24.00
2026	19.700	0.00%	19.70	0.651	0.000	24.00
2027	19.700	0.00%	19.70	0.651	0.000	24.00
2028	19.700	0.00%	19.70	0.651	0.000	24.00
2029	19.700	0.00%	19.70	0.651	0.000	24.00
2030	19.700	0.00%	19.70	0.651	0.000	24.00
2031	19.700	0.00%	19.70	0.651	0.000	24.00
2032	19.700	0.00%	19.70	0.651	0.000	24.00
2033	19.700	0.00%	19.70	0.651	0.000	24.00
2034	19.700	0.00%	19.70	0.651	0.000	24.00
2035	19.700	0.00%	19.70	0.651	0.000	24.00
2036	19.700	0.00%	19.70	0.651	0.000	24.00
2037	19.700	0.00%	19.70	0.651	0.000	24.00
2038	19.700	0.00%	19.70	0.651	0.000	24.00
2039	19.700	0.00%	19.70	0.651	0.000	24.00
2040	19.700	0.00%	19.70	0.651	0.000	24.00
2041	19.700	0.00%	19.70	0.651	0.000	24.00
2042	19.700	0.00%	19.70	0.651	0.000	24.00
2043	19.700	0.00%	19.70	0.651	0.000	24.00
2044	19.700	0.00%	19.70	0.651	0.000	24.00
2045	19.700	0.00%	19.70	0.651	0.000	24.00
2046	19.700	0.00%	19.70	0.651	0.000	24.00
2047	19.700	0.00%	19.70	0.651	0.000	24.00
2048	19.700	0.00%	19.70	0.651	0.000	24.00
2049	19.700	0.00%	19.70	0.651	0.000	24.00
2050	19.700	0.00%	19.70	0.651	0.000	24.00
2051	19.700	0.00%	19.70	0.651	0.000	24.00
2052	19.700	0.00%	19.70	0.651	0.000	24.00
2053	19.700	0.00%	19.70	0.651	0.000	24.00
2054	19.700	0.00%	19.70	0.651	0.000	24.00
2055	19.700	0.00%	19.70	0.651	0.000	24.00
2056	19.700	0.00%	19.70	0.651	0.000	24.00
2057	19.700	0.00%	19.70	0.651	0.000	24.00
2058	19.700	0.00%	19.70	0.651	0.000	24.00
2059	19.700	0.00%	19.70	0.651	0.000	24.00
2060	19.700	0.00%	19.70	0.651	0.000	24.00
2061	19.700	0.00%	19.70	0.651	0.000	24.00

Major overhaul every 15 years:	15.00%	of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00%	of electrical/mechanical cost
Maintenance cost (civil)	0.25%	of civil cost
Maintenance cost (pipelines)	0.50%	of pipeline cost

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING KWAMASHU WWTW		PIPELINE: Kwamashu WWTW to Hazelmere Dam		PUMP STATION AT NORTHERN WWTW				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014	10,323,840											
2015	10,323,840	5,000,000	1,720,640	13,050,000		61,732,000		3,600,000	7,650,000			
2016				13,050,000		61,732,000		3,600,000	7,650,000			
2017					2,530,000		617,320	0		0	630,000	2,470,841
2018					2,530,000		617,320	0		0	630,000	4,197,261
2019					2,530,000		617,320	0		0	630,000	5,423,269
2020					2,530,000		617,320	0		0	630,000	5,423,269
2021					2,530,000		617,320	0		0	630,000	5,423,269
2022					2,530,000		617,320	0		0	630,000	5,423,269
2023					2,530,000		617,320	0		0	630,000	5,423,269
2024					2,530,000		617,320	0		0	630,000	5,423,269
2025					2,530,000		617,320	0		0	630,000	5,423,269
2026					2,530,000		617,320	0		0	630,000	5,423,269
2027					2,530,000		617,320	0		0	630,000	5,423,269
2028					2,530,000		617,320	0		0	630,000	5,423,269
2029					2,530,000		617,320	0		0	630,000	5,423,269
2030					2,530,000		617,320	0		0	630,000	5,423,269
2031					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2032					2,530,000		617,320	0		0	630,000	5,423,269
2033					2,530,000		617,320	0		0	630,000	5,423,269
2034					2,530,000		617,320	0		0	630,000	5,423,269
2035					2,530,000		617,320	0		0	630,000	5,423,269
2036					2,530,000		617,320	0		0	630,000	5,423,269
2037					2,530,000		617,320	0		0	630,000	5,423,269
2038					2,530,000		617,320	0		0	630,000	5,423,269
2039					2,530,000		617,320	0		0	630,000	5,423,269
2040					2,530,000		617,320	0		0	630,000	5,423,269
2041					2,530,000		617,320	0		0	630,000	5,423,269
2042					2,530,000		617,320	0		0	630,000	5,423,269
2043					2,530,000		617,320	0		0	630,000	5,423,269
2044					2,530,000		617,320	0		0	630,000	5,423,269
2045					2,530,000		617,320	0		0	630,000	5,423,269
2046					2,530,000		617,320	0	1,012,500	0	630,000	5,423,269
2047					2,530,000		617,320	0		0	630,000	5,423,269
2048					2,530,000		617,320	0		0	630,000	5,423,269
2049					2,530,000		617,320	0		0	630,000	5,423,269
2050					2,530,000		617,320	0		0	630,000	5,423,269
2051					2,530,000		617,320	0		0	630,000	5,423,269
2052					2,530,000		617,320	0		0	630,000	5,423,269
2053					2,530,000		617,320	0		0	630,000	5,423,269
2054					2,530,000		617,320	0		0	630,000	5,423,269
2055					2,530,000		617,320	0		0	630,000	5,423,269
2056					2,530,000		617,320	0		0	630,000	5,423,269
2057					2,530,000		617,320	0		0	630,000	5,423,269
2058					2,530,000		617,320	0		0	630,000	5,423,269
2059					2,530,000		617,320	0		0	630,000	5,423,269
2060					2,530,000		617,320	0		0	630,000	5,423,269
2061					2,530,000		617,320	0		0	630,000	5,423,269
TOTAL	**20,647,680**	**5,000,000**	**1,720,640**	**26,100,000**	**113,850,000**	**123,464,000**	**27,779,400**	**7,200,000**	**17,325,000**	**0**	**28,350,000**	**239,868,685**

Re-Use Options

All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	10,323,840	0	6,865,943	0	6,023,861	0	5,297,762	0
2015	103,076,480	0	64,671,459	0	55,689,015	0	48,085,939	0
2016	86,032,000	0	50,922,209	0	43,037,419	0	36,485,966	0
2017	0	6,248,161	0	3,488,941	0	2,894,108	0	2,408,937
2018	0	7,974,581	0	4,200,910	0	3,420,161	0	2,795,042
2019	0	9,200,589	0	4,572,411	0	3,653,681	0	2,931,591
2020	0	9,200,589	0	4,313,595	0	3,383,038	0	2,665,083
2021	0	9,200,589	0	4,069,430	0	3,132,442	0	2,422,803
2022	0	9,200,589	0	3,839,084	0	2,900,409	0	2,202,548
2023	0	9,200,589	0	3,621,778	0	2,685,564	0	2,002,316
2024	0	9,200,589	0	3,416,772	0	2,486,634	0	1,820,288
2025	0	9,200,589	0	3,223,369	0	2,302,439	0	1,654,807
2026	0	9,200,589	0	3,040,914	0	2,131,888	0	1,504,370
2027	0	9,200,589	0	2,868,787	0	1,973,970	0	1,367,609
2028	0	9,200,589	0	2,706,403	0	1,827,750	0	1,243,281
2029	0	9,200,589	0	2,553,210	0	1,692,361	0	1,130,255
2030	0	9,200,589	0	2,408,689	0	1,567,001	0	1,027,505
2031	1,012,500	9,200,589	250,066	2,272,348	159,671	1,450,927	102,795	934,095
2032	0	9,200,589	0	2,143,725	0	1,343,451	0	849,178
2033	0	9,200,589	0	2,022,382	0	1,243,936	0	771,980
2034	0	9,200,589	0	1,907,907	0	1,151,793	0	701,800
2035	0	9,200,589	0	1,799,913	0	1,066,475	0	638,000
2036	0	9,200,589	0	1,698,031	0	987,476	0	580,000
2037	0	9,200,589	0	1,601,916	0	914,330	0	527,272
2038	0	9,200,589	0	1,511,241	0	846,602	0	479,339
2039	0	9,200,589	0	1,425,699	0	783,891	0	435,762
2040	0	9,200,589	0	1,344,999	0	725,825	0	396,148
2041	0	9,200,589	0	1,268,867	0	672,060	0	360,134
2042	0	9,200,589	0	1,197,045	0	622,278	0	327,395
2043	0	9,200,589	0	1,129,287	0	576,183	0	297,632
2044	0	9,200,589	0	1,065,366	0	533,503	0	270,574
2045	0	9,200,589	0	1,005,062	0	493,984	0	245,976
2046	1,012,500	9,200,589	104,344	948,172	50,335	457,393	24,608	223,615
2047	0	9,200,589	0	894,501	0	423,512	0	203,286
2048	0	9,200,589	0	843,869	0	392,140	0	184,806
2049	0	9,200,589	0	796,103	0	363,093	0	168,005
2050	0	9,200,589	0	751,041	0	336,197	0	152,732
			0					
2051	0	9,200,589	0	708,529	0	311,294	0	138,847
2052	0	9,200,589	0	668,424	0	288,235	0	126,225
2053	0	9,200,589	0	630,588	0	266,884	0	114,750
2054	0	9,200,589	0	594,895	0	247,115	0	104,318
2055	0	9,200,589	0	561,221	0	228,810	0	94,835
2056	0	9,200,589	0	529,454	0	211,861	0	86,213
2057	0	9,200,589	0	499,485	0	196,168	0	78,376
2058	0	9,200,589	0	471,212	0	181,637	0	71,251
2059	0	9,200,589	0	444,540	0	168,182	0	64,773
2060	0	9,200,589	0	419,377	0	155,724	0	58,885
2061	0	9,200,589	0	395,639	0	144,189	0	53,532
TOTAL	**201,457,320**	**409,848,085**	**122,814,020**	**81,875,131**	**104,960,301**	**53,836,592**	**89,997,070**	**36,916,167**

NET PRESENT COST

Discounted at 6%	204,689,151
Discounted at 8%	158,796,893
Discounted at 10%	126,913,237

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios A - Northern to Inanda Dam - 19.7Mm³/a
DATE: September 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 10,323,840	0	R 6,865,943	0	R 6,023,861	0	R 5,297,762
2015	0	R 103,076,480	0	R 64,671,459	0	R 55,689,015	0	R 48,085,939
2016	0	R 86,032,000	0	R 50,922,209	0	R 43,037,419	0	R 36,485,966
2017	7.9	R 6,248,161	4	R 3,488,941	4	R 2,894,108	3	R 2,408,937
2018	14.8	R 7,974,581	8	R 4,200,910	6	R 3,420,161	5	R 2,795,042
2019	19.7	R 9,200,589	10	R 4,572,411	8	R 3,653,681	6	R 2,931,591
2020	19.7	R 9,200,589	9	R 4,313,595	7	R 3,383,038	6	R 2,665,083
2021	19.7	R 9,200,589	9	R 4,069,430	7	R 3,132,442	5	R 2,422,803
2022	19.7	R 9,200,589	8	R 3,839,084	6	R 2,900,409	5	R 2,202,548
2023	19.7	R 9,200,589	8	R 3,621,778	6	R 2,685,564	4	R 2,002,316
2024	19.7	R 9,200,589	7	R 3,416,772	5	R 2,486,634	4	R 1,820,288
2025	19.7	R 9,200,589	7	R 3,223,369	5	R 2,302,439	4	R 1,654,807
2026	19.7	R 9,200,589	7	R 3,040,914	5	R 2,131,888	3	R 1,504,370
2027	19.7	R 9,200,589	6	R 2,868,787	4	R 1,973,970	3	R 1,367,609
2028	19.7	R 9,200,589	6	R 2,706,403	4	R 1,827,750	3	R 1,243,281
2029	19.7	R 9,200,589	5	R 2,553,210	4	R 1,692,361	2	R 1,130,255
2030	19.7	R 9,200,589	5	R 2,408,689	3	R 1,567,001	2	R 1,027,505
2031	19.7	R 10,213,089	5	R 2,522,414	3	R 1,610,597	2	R 1,036,890
2032	19.7	R 9,200,589	5	R 2,143,725	3	R 1,343,451	2	R 849,178
2033	19.7	R 9,200,589	4	R 2,022,382	3	R 1,243,936	2	R 771,980
2034	19.7	R 9,200,589	4	R 1,907,907	2	R 1,151,793	2	R 701,800
2035	19.7	R 9,200,589	4	R 1,799,913	2	R 1,066,475	1	R 638,000
2036	19.7	R 9,200,589	4	R 1,698,031	2	R 987,476	1	R 580,000
2037	19.7	R 9,200,589	3	R 1,601,916	2	R 914,330	1	R 527,272
2038	19.7	R 9,200,589	3	R 1,511,241	2	R 846,602	1	R 479,339
2039	19.7	R 9,200,589	3	R 1,425,699	2	R 783,891	1	R 435,762
2040	19.7	R 9,200,589	3	R 1,344,999	2	R 725,825	1	R 396,148
2041	19.7	R 9,200,589	3	R 1,268,867	1	R 672,060	1	R 360,134
2042	19.7	R 9,200,589	3	R 1,197,045	1	R 622,278	1	R 327,395
2043	19.7	R 9,200,589	2	R 1,129,287	1	R 576,183	1	R 297,632
2044	19.7	R 9,200,589	2	R 1,065,366	1	R 533,503	1	R 270,574
2045	19.7	R 9,200,589	2	R 1,005,062	1	R 493,984	1	R 245,976
2046	19.7	R 10,213,089	2	R 1,052,515	1	R 507,727	0	R 248,223
2047	19.7	R 9,200,589	2	R 894,501	1	R 423,512	0	R 203,286
2048	19.7	R 9,200,589	2	R 843,869	1	R 392,140	0	R 184,806
2049	19.7	R 9,200,589	2	R 796,103	1	R 363,093	0	R 168,005
2050	19.7	R 9,200,589	2	R 751,041	1	R 336,197	0	R 152,732
2051	19.7	R 9,200,589	2	R 708,529	1	R 311,294	0	R 138,847
2052	19.7	R 9,200,589	1	R 668,424	1	R 288,235	0	R 126,225
2053	19.7	R 9,200,589	1	R 630,588	1	R 266,884	0	R 114,750
2054	19.7	R 9,200,589	1	R 594,895	1	R 247,115	0	R 104,318
2055	19.7	R 9,200,589	1	R 561,221	0	R 228,810	0	R 94,835
2056	19.7	R 9,200,589	1	R 529,454	0	R 211,861	0	R 86,213
2057	19.7	R 9,200,589	1	R 499,485	0	R 196,168	0	R 78,376
2058	19.7	R 9,200,589	1	R 471,212	0	R 181,637	0	R 71,251
2059	19.7	R 9,200,589	1	R 444,540	0	R 168,182	0	R 64,773
2060	19.7	R 9,200,589	1	R 419,377	0	R 155,724	0	R 58,885
2061	19.7	R 9,200,589	1	R 395,639	0	R 144,189	0	R 53,532
TOTAL	**869.8**	**R 611,305,405**	**171**	**R 204,689,151**	**112**	**R 158,796,893**	**76**	**R 126,913,237**
URV				**R 1.20**		**R 1.42**		**R 1.67**

North Coast (to Hazelmere Dam) – Including Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a
- Phoenix WWTW – 5,1 million m^3/a

Component	Type	Name	Characteristics		Total Capital Cost - Sept 2007	
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R	6,800,000
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R	5,900,000
Upgrade Existing Phoenix WWTW		Phoenix WWTW	**No**	1	R	10,100,000
Pipelines			**Dia**	**Length**		
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R	7,650,720
		Verulam to Hazelmere Dam	500mm	8km	R	14,001,120
		Phoenix to Verulam	400mm	6km	R	8,406,720
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R	3,913,938
Pumpstation to Hazelmere Dam		Verulam Pump Station			R	6,491,898
Pumpstation to Hazelmere Dam		Phoenix Pump Station			R	3,913,938
Sub-Total					**R**	**67,178,334**
Engineering Fees	12%				**R**	**8,061,400.08**
Land Acquisitions and relocations					**R**	**5,000,000.00**
Social and Environmental	1%				**R**	**671,783.34**
Sub-Total					**R**	**80,911,517.42**
VAT	14%				**R**	**11,327,612.44**
Total					**R**	**92,239,129.86**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Bl
DATE: SEP 2007

Number of pumps	3	(excluding standby)			
Standby pumps	1				
Flow per pump	0.032	m3/s		Pump Station Capacity	
Total flow	0.096	m3/s		2.9	million m³
Pumps active	350	days per annum	350	49.82888433	weeks
Pumping Peak factor to supply within limited period	1.0429				

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.248	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.33	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.248	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.4	**0.4**
power absorbed at Qd: (Pd / Pf)		MVA	0.4	**0.4**
		MVAh	9.6	**9.6**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.5	**0.5**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	9.2	**9**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	637,092.99	**R**	**637,093**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	64,155.26	**R**	**64,155**
Transmission surcharge (< 300 km)	%		1.00%	R	6,370.93	**R**	**6,371**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	48,161.77	**R**	**48,162**
Network Charge	R/MVA	R	6,340.00	R	3,388.39	**R**	**3,388**
Total annual cost				**R**	**772,017.35**	**R**	**772,017**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: All Scenarios: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.169	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.22	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.169	
Peak factor	1.04			
Average head pumped		m	83.00	**83.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.0	**4.0**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	83.00	**83.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.8	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	264,393.59	**R**	**264,394**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	26,624.43	**R**	**26,624**
Transmission surcharge (< 300 km)	%		1.00%	R	2,643.94	**R**	**2,644**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	19,987.14	**R**	**19,987**
Network Charge	R/MVA	R	6,340.00	R	1,406.18	**R**	**1,406**
Total annual cost				**R**	**327,903.28**	**R**	**327,903**

PHOENIX PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - E
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.056	m3/s	Pump Station Capacity
Total flow	0.169	m3/s	5.1 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS	NUMBER OF PUMPS		MWh	ANNUAL ELECTRICITY COST FOR PUMP STATIONS				
		PUMPED	INSTALLED	ACTIVE	per day	ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
2	2018	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
3	2019	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
4	2020	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
5	2021	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
6	2022	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
7	2023	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
8	2024	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
9	2025	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
10	2026	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
11	2027	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
12	2028	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
13	2029	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
14	2030	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
15	2031	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
16	2032	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
17	2033	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
18	2034	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
19	2035	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
20	2036	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
21	2037	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
22	2038	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
23	2039	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
24	2040	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
25	2041	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
26	2042	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
27	2043	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
28	2044	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
29	2045	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
30	2046	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
31	2047	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
32	2048	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
33	2049	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
34	2050	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
35	2051	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
36	2052	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
37	2053	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
38	2054	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
39	2055	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
40	2056	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
41	2057	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
42	2058	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
43	2059	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
44	2060	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
45	2061	24.00	4	3	4	264,394	14,254	19,987	29,268	327,903
	TOTAL					**11,897,712**	**641,438**		**1,317,077**	**14,755,648**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	5.100	0.00%	5.10	0.169	0.000	24.00
2018	5.100	0.00%	5.10	0.169	0.000	24.00
2019	5.100	0.00%	5.10	0.169	0.000	24.00
2020	5.100	0.00%	5.10	0.169	0.000	24.00
2021	5.100	0.00%	5.10	0.169	0.000	24.00
2022	5.100	0.00%	5.10	0.169	0.000	24.00
2023	5.100	0.00%	5.10	0.169	0.000	24.00
2024	5.100	0.00%	5.10	0.169	0.000	24.00
2025	5.100	0.00%	5.10	0.169	0.000	24.00
2026	5.100	0.00%	5.10	0.169	0.000	24.00
2027	5.100	0.00%	5.10	0.169	0.000	24.00
2028	5.100	0.00%	5.10	0.169	0.000	24.00
2029	5.100	0.00%	5.10	0.169	0.000	24.00
2030	5.100	0.00%	5.10	0.169	0.000	24.00
2031	5.100	0.00%	5.10	0.169	0.000	24.00
2032	5.100	0.00%	5.10	0.169	0.000	24.00
2033	5.100	0.00%	5.10	0.169	0.000	24.00
2034	5.100	0.00%	5.10	0.169	0.000	24.00
2035	5.100	0.00%	5.10	0.169	0.000	24.00
2036	5.100	0.00%	5.10	0.169	0.000	24.00
2037	5.100	0.00%	5.10	0.169	0.000	24.00
2038	5.100	0.00%	5.10	0.169	0.000	24.00
2039	5.100	0.00%	5.10	0.169	0.000	24.00
2040	5.100	0.00%	5.10	0.169	0.000	24.00
2041	5.100	0.00%	5.10	0.169	0.000	24.00
2042	5.100	0.00%	5.10	0.169	0.000	24.00
2043	5.100	0.00%	5.10	0.169	0.000	24.00
2044	5.100	0.00%	5.10	0.169	0.000	24.00
2045	5.100	0.00%	5.10	0.169	0.000	24.00
2046	5.100	0.00%	5.10	0.169	0.000	24.00
2047	5.100	0.00%	5.10	0.169	0.000	24.00
2048	5.100	0.00%	5.10	0.169	0.000	24.00
2049	5.100	0.00%	5.10	0.169	0.000	24.00
2050	5.100	0.00%	5.10	0.169	0.000	24.00
2051	5.100	0.00%	5.10	0.169	0.000	24.00
2052	5.100	0.00%	5.10	0.169	0.000	24.00
2053	5.100	0.00%	5.10	0.169	0.000	24.00
2054	5.100	0.00%	5.10	0.169	0.000	24.00
2055	5.100	0.00%	5.10	0.169	0.000	24.00
2056	5.100	0.00%	5.10	0.169	0.000	24.00
2057	5.100	0.00%	5.10	0.169	0.000	24.00
2058	5.100	0.00%	5.10	0.169	0.000	24.00
2059	5.100	0.00%	5.10	0.169	0.000	24.00
2060	5.100	0.00%	5.10	0.169	0.000	24.00
2061	5.100	0.00%	5.10	0.169	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		UPGRADE EXISTING PHOENIX WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		PIPELINE: Phoenix WWTW to Verulam WWTW	
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014	4,030,700	2,500,000	335,892												
2015	4,030,700	2,500,000	335,892	3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2016				3,400,000		2,950,000		5,050,000		3,825,360		7,000,560		4,203,360	
2017					380,000		310,000		660,000		38,254		70,006		42,034
2018					380,000		310,000		660,000		38,254		70,006		42,034
2019					380,000		310,000		660,000		38,254		70,006		42,034
2020					380,000		310,000		660,000		38,254		70,006		42,034
2021					380,000		310,000		660,000		38,254		70,006		42,034
2022					380,000		310,000		660,000		38,254		70,006		42,034
2023					380,000		310,000		660,000		38,254		70,006		42,034
2024					380,000		310,000		660,000		38,254		70,006		42,034
2025					380,000		310,000		660,000		38,254		70,006		42,034
2026					380,000		310,000		660,000		38,254		70,006		42,034
2027					380,000		310,000		660,000		38,254		70,006		42,034
2028					380,000		310,000		660,000		38,254		70,006		42,034
2029					380,000		310,000		660,000		38,254		70,006		42,034
2030					380,000		310,000		660,000		38,254		70,006		42,034
2031					380,000		310,000		660,000		38,254		70,006		42,034
2032					380,000		310,000		660,000		38,254		70,006		42,034
2033					380,000		310,000		660,000		38,254		70,006		42,034
2034					380,000		310,000		660,000		38,254		70,006		42,034
2035					380,000		310,000		660,000		38,254		70,006		42,034
2036					380,000		310,000		660,000		38,254		70,006		42,034
2037					380,000		310,000		660,000		38,254		70,006		42,034
2038					380,000		310,000		660,000		38,254		70,006		42,034
2039					380,000		310,000		660,000		38,254		70,006		42,034
2040					380,000		310,000		660,000		38,254		70,006		42,034
2041					380,000		310,000		660,000		38,254		70,006		42,034
2042					380,000		310,000		660,000		38,254		70,006		42,034
2043					380,000		310,000		660,000		38,254		70,006		42,034
2044					380,000		310,000		660,000		38,254		70,006		42,034
2045					380,000		310,000		660,000		38,254		70,006		42,034
2046					380,000		310,000		660,000		38,254		70,006		42,034
2047					380,000		310,000		660,000		38,254		70,006		42,034
2048					380,000		310,000		660,000		38,254		70,006		42,034
2049					380,000		310,000		660,000		38,254		70,006		42,034
2050					380,000		310,000		660,000		38,254		70,006		42,034
2051					380,000		310,000		660,000		38,254		70,006		42,034
2052					380,000		310,000		660,000		38,254		70,006		42,034
2053					380,000		310,000		660,000		38,254		70,006		42,034
2054					380,000		310,000		660,000		38,254		70,006		42,034
2055					380,000		310,000		660,000		38,254		70,006		42,034
2056					380,000		310,000		660,000		38,254		70,006		42,034
2057					380,000		310,000		660,000		38,254		70,006		42,034
2058					380,000		310,000		660,000		38,254		70,006		42,034
2059					380,000		310,000		660,000		38,254		70,006		42,034
2060					380,000		310,000		660,000		38,254		70,006		42,034
2061					380,000		310,000		660,000		38,254		70,006		42,034
TOTAL	**8,061,400**	**5,000,000**	**671,783**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**10,100,000**	**29,700,000**	**7,650,720**	**1,721,412**	**14,001,120**	**3,150,252**	**8,406,720**	**1,891,512**

YEAR	TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM					PHOENIX PUMP STATION TO VERULAM WWTW				
	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014															
2015	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2016	704,509	1,252,460				1,136,082	2,109,867				704,509	1,252,460			
2017	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2018	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2019	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2020	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2021	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2022	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2023	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2024	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2025	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2026	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2027	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2028	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2029	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2030	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2031	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2032	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2033	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2034	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2035	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2036	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2037	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2038	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2039	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2040	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2041	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2042	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2043	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2044	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2045	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2046	0	176,127	0	103,719	353,879	0	292,135	0	174,470	394,590	0	176,127	0	103,719	327,903
2047	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2048	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2049	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2050	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2051	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2052	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2053	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2054	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2055	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2056	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2057	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2058	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2059	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2060	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
2061	0		0	103,719	353,879	0		0	174,470	394,590	0		0	103,719	327,903
TOTAL	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**2,272,164**	**4,804,005**	**0**	**7,851,139**	**17,756,540**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**14,755,648**

North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	6,866,592	0	4,566,676	0	4,006,590	0	3,523,647	0
2015	40,455,759	0	25,382,444	0	21,856,988	0	18,872,910	0
2016	33,589,167	0	19,881,376	0	16,802,946	0	14,245,086	0
2017	0	2,958,573	0	1,652,052	0	1,370,392	0	1,140,658
2018	0	2,958,573	0	1,558,539	0	1,268,881	0	1,036,962
2019	0	2,958,573	0	1,470,320	0	1,174,890	0	942,693
2020	0	2,958,573	0	1,387,095	0	1,087,861	0	856,993
2021	0	2,958,573	0	1,308,580	0	1,007,279	0	779,085
2022	0	2,958,573	0	1,234,509	0	932,666	0	708,259
2023	0	2,958,573	0	1,164,631	0	863,579	0	643,872
2024	0	2,958,573	0	1,098,709	0	799,610	0	585,338
2025	0	2,958,573	0	1,036,518	0	740,380	0	532,125
2026	0	2,958,573	0	977,847	0	685,537	0	483,750
2027	0	2,958,573	0	922,497	0	634,757	0	439,773
2028	0	2,958,573	0	870,280	0	587,738	0	399,794
2029	0	2,958,573	0	821,019	0	544,201	0	363,449
2030	0	2,958,573	0	774,546	0	503,890	0	330,408
2031	644,390	2,958,573	159,150	730,704	101,620	466,565	65,422	300,371
2032	0	2,958,573	0	689,343	0	432,005	0	273,064
2033	0	2,958,573	0	650,324	0	400,004	0	248,240
2034	0	2,958,573	0	613,513	0	370,374	0	225,673
2035	0	2,958,573	0	578,786	0	342,939	0	205,157
2036	0	2,958,573	0	546,025	0	317,536	0	186,507
2037	0	2,958,573	0	515,118	0	294,015	0	169,552
2038	0	2,958,573	0	485,960	0	272,236	0	154,138
2039	0	2,958,573	0	458,453	0	252,071	0	140,125
2040	0	2,958,573	0	432,503	0	233,399	0	127,387
2041	0	2,958,573	0	408,021	0	216,110	0	115,806
2042	0	2,958,573	0	384,926	0	200,102	0	105,278
2043	0	2,958,573	0	363,138	0	185,279	0	95,707
2044	0	2,958,573	0	342,583	0	171,555	0	87,007
2045	0	2,958,573	0	323,191	0	158,847	0	79,097
2046	644,390	2,958,573	66,408	304,897	32,035	147,081	15,662	71,906
2047	0	2,958,573	0	287,639	0	136,186	0	65,369
2048	0	2,958,573	0	271,358	0	126,098	0	59,427
2049	0	2,958,573	0	255,998	0	116,757	0	54,024
2050	0	2,958,573	0	241,507	0	108,109	0	49,113
			0					
2051	0	2,958,573	0	227,837	0	100,101	0	44,648
2052	0	2,958,573	0	214,941	0	92,686	0	40,589
2053	0	2,958,573	0	202,774	0	85,820	0	36,899
2054	0	2,958,573	0	191,296	0	79,463	0	33,545
2055	0	2,958,573	0	180,468	0	73,577	0	30,495
2056	0	2,958,573	0	170,253	0	68,127	0	27,723
2057	0	2,958,573	0	160,616	0	63,080	0	25,203
2058	0	2,958,573	0	151,525	0	58,408	0	22,912
2059	0	2,958,573	0	142,948	0	54,081	0	20,829
2060	0	2,958,573	0	134,856	0	50,075	0	18,935
2061	0	2,958,573	0	127,223	0	46,366	0	17,214
TOTAL	**82,200,297**	**133,135,790**	**50,056,054**	**27,065,865**	**42,800,179**	**17,920,714**	**36,722,727**	**12,375,100**

NET PRESENT COST

Discounted at 6%	77,121,919
Discounted at 8%	60,720,893
Discounted at 10%	49,097,826

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a), Verulam(2.4Mm³/a), Phoenix(5.1Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 6,866,592	0	R 4,566,676	0	R 4,006,590	0	R 3,523,647
2015	0	R 40,455,759	0	R 25,382,444	0	R 21,856,988	0	R 18,872,910
2016	0	R 33,589,167	0	R 19,881,376	0	R 16,802,946	0	R 14,245,086
2017	10.4	R 2,958,573	6	R 1,652,052	5	R 1,370,392	4	R 1,140,658
2018	10.4	R 2,958,573	5	R 1,558,539	4	R 1,268,881	4	R 1,036,962
2019	10.4	R 2,958,573	5	R 1,470,320	4	R 1,174,890	3	R 942,693
2020	10.4	R 2,958,573	5	R 1,387,095	4	R 1,087,861	3	R 856,993
2021	10.4	R 2,958,573	5	R 1,308,580	4	R 1,007,279	3	R 779,085
2022	10.4	R 2,958,573	4	R 1,234,509	3	R 932,666	2	R 708,259
2023	10.4	R 2,958,573	4	R 1,164,631	3	R 863,579	2	R 643,872
2024	10.4	R 2,958,573	4	R 1,098,709	3	R 799,610	2	R 585,338
2025	10.4	R 2,958,573	4	R 1,036,518	3	R 740,380	2	R 532,125
2026	10.4	R 2,958,573	3	R 977,847	2	R 685,537	2	R 483,750
2027	10.4	R 2,958,573	3	R 922,497	2	R 634,757	2	R 439,773
2028	10.4	R 2,958,573	3	R 870,280	2	R 587,738	1	R 399,794
2029	10.4	R 2,958,573	3	R 821,019	2	R 544,201	1	R 363,449
2030	10.4	R 2,958,573	3	R 774,546	2	R 503,890	1	R 330,408
2031	10.4	R 3,602,963	3	R 889,855	2	R 568,185	1	R 365,793
2032	10.4	R 2,958,573	2	R 689,343	2	R 432,005	1	R 273,064
2033	10.4	R 2,958,573	2	R 650,324	1	R 400,004	1	R 248,240
2034	10.4	R 2,958,573	2	R 613,513	1	R 370,374	1	R 225,673
2035	10.4	R 2,958,573	2	R 578,786	1	R 342,939	1	R 205,157
2036	10.4	R 2,958,573	2	R 546,025	1	R 317,536	1	R 186,507
2037	10.4	R 2,958,573	2	R 515,118	1	R 294,015	1	R 169,552
2038	10.4	R 2,958,573	2	R 485,960	1	R 272,236	1	R 154,138
2039	10.4	R 2,958,573	2	R 458,453	1	R 252,071	0	R 140,125
2040	10.4	R 2,958,573	2	R 432,503	1	R 233,399	0	R 127,387
2041	10.4	R 2,958,573	1	R 408,021	1	R 216,110	0	R 115,806
2042	10.4	R 2,958,573	1	R 384,926	1	R 200,102	0	R 105,278
2043	10.4	R 2,958,573	1	R 363,138	1	R 185,279	0	R 95,707
2044	10.4	R 2,958,573	1	R 342,583	1	R 171,555	0	R 87,007
2045	10.4	R 2,958,573	1	R 323,191	1	R 158,847	0	R 79,097
2046	10.4	R 3,602,963	1	R 371,305	1	R 179,116	0	R 87,568
2047	10.4	R 2,958,573	1	R 287,639	0	R 136,186	0	R 65,369
2048	10.4	R 2,958,573	1	R 271,358	0	R 126,098	0	R 59,427
2049	10.4	R 2,958,573	1	R 255,998	0	R 116,757	0	R 54,024
2050	10.4	R 2,958,573	1	R 241,507	0	R 108,109	0	R 49,113
2051	10.4	R 2,958,573	1	R 227,837	0	R 100,101	0	R 44,648
2052	10.4	R 2,958,573	1	R 214,941	0	R 92,686	0	R 40,589
2053	10.4	R 2,958,573	1	R 202,774	0	R 85,820	0	R 36,899
2054	10.4	R 2,958,573	1	R 191,296	0	R 79,463	0	R 33,545
2055	10.4	R 2,958,573	1	R 180,468	0	R 73,577	0	R 30,495
2056	10.4	R 2,958,573	1	R 170,253	0	R 68,127	0	R 27,723
2057	10.4	R 2,958,573	1	R 160,616	0	R 63,080	0	R 25,203
2058	10.4	R 2,958,573	1	R 151,525	0	R 58,408	0	R 22,912
2059	10.4	R 2,958,573	1	R 142,948	0	R 54,081	0	R 20,829
2060	10.4	R 2,958,573	0	R 134,856	0	R 50,075	0	R 18,935
2061	10.4	R 2,958,573	0	R 127,223	0	R 46,366	0	R 17,214
TOTAL	**468**	**R 215,336,087**	**95**	**R 77,121,919**	**63**	**R 60,720,893**	**44**	**R 49,097,826**

URV				**R 0.81**		**R 0.96**		**R 1.13**

North Coast (to Hazelmere Dam) – Excluding Phoenix

- Tongaat WWTW – 2,9 million m^3/a
- Verulem WWTW – 2,4 million m^3/a

Project Name: Re-Use Options
Option: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
Base year of study cost: Sep 2007
Escalation Factor 1 **Sep 2007**

Phase 1 **Commision year:** 2017 **Output:** 5.30 m³/a

Component	Type	Name	Characteristics		Total Cost Sept 2007	Total Cost Ecalated	Capital Costs Civil	Mech & Elect	Total Capital	Timing Start	Timing End	Duration	Construction Cash Flow per year - CIVIL	Construction Cash Flow per year - Mech & Elect
Upgrade Existing Tongaat WWTW		Tongaat WWTW	**No**	1	R 6,800,000	R 6,800,000	R 6,800,000		R 6,800,000	2015	2016	2	R 3,400,000	R -
Upgrade Existing Verulam WWTW		Verulam WWTW	**No**	1	R 5,900,000	R 5,900,000	R 5,900,000		R 5,900,000	2015	2016	2	R 2,950,000	R -
Pipelines			**Dia**	**Length**										
		Tongaat WWTW to Hazelmere Dam	350mm	6km	R 7,650,720	R 7,650,720	R 7,650,720		R 7,650,720	2015	2016	2	R 3,825,360	R -
		Verulam to Hazelmere Dam	300mm	8km	R 9,283,680	R 9,283,680	R 9,283,680		R 9,283,680	2015	2016	2	R 4,641,840	R -
Pumpstation to Hazelmere Dam		Tongaat Pump Station			R 3,913,938	R 3,913,938	R 1,409,018	R 2,504,920	R 3,913,938	2015	2016	2	R 704,509	R 1,252,460
Pumpstation to Hazelmere Dam		Verulam Pump Station			R 2,359,728	R 2,359,728	R 873,099	R 1,486,629	R 2,359,728	2015	2016	2	R 436,550	R 743,314
Sub-Total					**R 35,908,066**	**R 35,908,066**	**R 31,916,517**	**R 3,991,549**	**R 35,908,066**					

Engineering Fees	12%	**R 4,308,967.92**	2	R 2,154,484
Land Acquisitions and relocations		**R 3,000,000.00**	2	R 1,500,000
Social and Environmental	1%	**R 359,080.66**	2	R 179,540
Sub-Total		**R 43,576,114.58**		
VAT	14%	**R 6,100,656.04**		
Total		**R 49,676,770.62**		

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.096	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.13	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.096	
Peak factor	1.04			
Average head pumped		m	158.00	**158.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.2	**0.2**
power absorbed at Qd: (Pd / Pf)		MVA	0.2	**0.2**
		MVAh	4.3	**4.3**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	158.00	**158.0**
Energy consumed over 24 hours (continuous use)	24	MWh	4.1	**4**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	286,192.17	**R**	**286,192**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	28,819.55	**R**	**28,820**
Transmission surcharge (< 300 km)	%		1.00%	R	2,861.92	**R**	**2,862**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	21,635.02	**R**	**21,635**
Network Charge	R/MVA	R	6,340.00	R	1,522.12	**R**	**1,522**
Total annual cost				**R**	**353,878.78**	**R**	**353,879**

TONGAAT PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)		
Standby pumps	1			
Flow per pump	0.032	m3/s		Pump Station Capacity
Total flow	0.096	m3/s		2.9 million m³
Pumps active	350	days per annum	350	49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429			

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
2	2018	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
3	2019	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
4	2020	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
5	2021	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
6	2022	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
7	2023	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
8	2024	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
9	2025	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
10	2026	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
11	2027	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
12	2028	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
13	2029	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
14	2030	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
15	2031	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
16	2032	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
17	2033	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
18	2034	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
19	2035	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
20	2036	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
21	2037	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
22	2038	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
23	2039	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
24	2040	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
25	2041	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
26	2042	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
27	2043	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
28	2044	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
29	2045	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
30	2046	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
31	2047	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
32	2048	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
33	2049	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
34	2050	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
35	2051	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
36	2052	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
37	2053	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
38	2054	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
39	2055	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
40	2056	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
41	2057	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
42	2058	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
43	2059	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
44	2060	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
45	2061	24.00	4	3	4	286,192	14,370	21,635	31,681	353,879
	TOTAL					**12,878,647**	**646,655**		**1,425,666**	**15,924,545**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.900	0.00%	2.90	0.096	0.000	24.00
2018	2.900	0.00%	2.90	0.096	0.000	24.00
2019	2.900	0.00%	2.90	0.096	0.000	24.00
2020	2.900	0.00%	2.90	0.096	0.000	24.00
2021	2.900	0.00%	2.90	0.096	0.000	24.00
2022	2.900	0.00%	2.90	0.096	0.000	24.00
2023	2.900	0.00%	2.90	0.096	0.000	24.00
2024	2.900	0.00%	2.90	0.096	0.000	24.00
2025	2.900	0.00%	2.90	0.096	0.000	24.00
2026	2.900	0.00%	2.90	0.096	0.000	24.00
2027	2.900	0.00%	2.90	0.096	0.000	24.00
2028	2.900	0.00%	2.90	0.096	0.000	24.00
2029	2.900	0.00%	2.90	0.096	0.000	24.00
2030	2.900	0.00%	2.90	0.096	0.000	24.00
2031	2.900	0.00%	2.90	0.096	0.000	24.00
2032	2.900	0.00%	2.90	0.096	0.000	24.00
2033	2.900	0.00%	2.90	0.096	0.000	24.00
2034	2.900	0.00%	2.90	0.096	0.000	24.00
2035	2.900	0.00%	2.90	0.096	0.000	24.00
2036	2.900	0.00%	2.90	0.096	0.000	24.00
2037	2.900	0.00%	2.90	0.096	0.000	24.00
2038	2.900	0.00%	2.90	0.096	0.000	24.00
2039	2.900	0.00%	2.90	0.096	0.000	24.00
2040	2.900	0.00%	2.90	0.096	0.000	24.00
2041	2.900	0.00%	2.90	0.096	0.000	24.00
2042	2.900	0.00%	2.90	0.096	0.000	24.00
2043	2.900	0.00%	2.90	0.096	0.000	24.00
2044	2.900	0.00%	2.90	0.096	0.000	24.00
2045	2.900	0.00%	2.90	0.096	0.000	24.00
2046	2.900	0.00%	2.90	0.096	0.000	24.00
2047	2.900	0.00%	2.90	0.096	0.000	24.00
2048	2.900	0.00%	2.90	0.096	0.000	24.00
2049	2.900	0.00%	2.90	0.096	0.000	24.00
2050	2.900	0.00%	2.90	0.096	0.000	24.00
2051	2.900	0.00%	2.90	0.096	0.000	24.00
2052	2.900	0.00%	2.90	0.096	0.000	24.00
2053	2.900	0.00%	2.90	0.096	0.000	24.00
2054	2.900	0.00%	2.90	0.096	0.000	24.00
2055	2.900	0.00%	2.90	0.096	0.000	24.00
2056	2.900	0.00%	2.90	0.096	0.000	24.00
2057	2.900	0.00%	2.90	0.096	0.000	24.00
2058	2.900	0.00%	2.90	0.096	0.000	24.00
2059	2.900	0.00%	2.90	0.096	0.000	24.00
2060	2.900	0.00%	2.90	0.096	0.000	24.00
2061	2.900	0.00%	2.90	0.096	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 350 day average flow		m3/s	0.079	
installed capacity (Qi = Qp x (1 + Ps))		m3/s	0.11	
Required peak capacity (Qp = Q365 x Peak factor)		m3/s	0.079	
Peak factor	1.04			
Average head pumped		m	136.00	**136.00**
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)		%	90.0%	
Efficiency of motor (Em)		%	97.0%	
Average loss in efficiency between major overhauls (Eo)		%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))		%	86.0%	
MW/MVA ratio (power factor Pf)		-	0.96	
Standby allowance (Ps)		%	33.3%	

ELECTRICITY COST CALCULATIONS

DESCRIPTION		*UNIT/RATE*	*P1*	*TOTAL*
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)		MW	0.1	**0.1**
power absorbed at Qd: (Pd / Pf)		MVA	0.1	**0.1**
		MVAh	3.1	**3.1**
power absorbed at Qi: (Pd x Pf x (1 + Ps))		MVA	0.2	**0.2**
head pumped (Hd)		m	136.00	**136.0**
Energy consumed over 24 hours (continuous use)	24	MWh	3.0	**3**

(continued...)

ELECTRICITY COST CALCULATIONS

ANNUAL COST OF ELECTRICITY (24 hr operation) @ Design Capacity							
All tariffs include a VAT % of			0%				
Demand charge N/A to Miniflex	R / MW	R	-	R	-	**R**	**-**
Energy charge	R / MWh	R	197.10	R	203,869.76	**R**	**203,870**
Reactive energy charge - Not concidered-high effic	R / MVAh	R	-	R	-		
Voltage surcharge (> 132 kV)	% / R		10.07%	R	20,529.68	**R**	**20,530**
Transmission surcharge (< 300 km)	%		1.00%	R	2,038.70	**R**	**2,039**
Administration Charge	R/day	R	35.20	R	12,848.00	**R**	**12,848**
Rate Rebalancing Levy/Subsidy	R/MWh	R	14.90	R	15,411.77	**R**	**15,412**
Network Charge	R/MVA	R	6,340.00	R	1,084.29	**R**	**1,084**
Total annual cost				**R**	**255,782.19**	**R**	**255,782**

VERULEM PUMP STATION

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

Number of pumps	3	(excluding standby)	
Standby pumps	1		
Flow per pump	0.026	m3/s	Pump Station Capacity
Total flow	0.079	m3/s	2.4 million m³
Pumps active	350	days per annum	350 49.82888433 weeks
Pumping Peak factor to supply within limited period	1.0429		

NET PRESENT COST OF CAPITAL AND ELECTRICITY COSTS

	YEAR	HOURS PUMPED	NUMBER OF PUMPS INSTALLED	NUMBER OF PUMPS ACTIVE	MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS ENERGY	Netw+Admin	LEVY	SURCHARGE	TOTAL
	2000									
	2001									
	2002									
	2003									
	2004									
	2005									
	2006									
	2007									
	2008									
	2009									
	2010									
	2011									
	2012									
	2013									
	2014									
	2015									
	2016									
1	2017	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
2	2018	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
3	2019	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
4	2020	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
5	2021	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
6	2022	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
7	2023	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
8	2024	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
9	2025	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
10	2026	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
11	2027	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
12	2028	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
13	2029	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
14	2030	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
15	2031	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
16	2032	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
17	2033	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
18	2034	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
19	2035	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
20	2036	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
21	2037	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
22	2038	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
23	2039	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
24	2040	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
25	2041	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
26	2042	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
27	2043	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
28	2044	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
29	2045	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
30	2046	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
31	2047	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
32	2048	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
33	2049	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
34	2050	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
35	2051	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
36	2052	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
37	2053	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
38	2054	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
39	2055	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
40	2056	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
41	2057	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
42	2058	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
43	2059	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
44	2060	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
45	2061	24.00	4	3	4	286,192	13,932	21,635	22,568	344,328
	TOTAL					**12,878,647**	**626,953**		**1,015,577**	**15,494,754**

DEMAND PROJECTIONS AND REQUIRED PUMPING RATE & TIME

YEAR	NET DEMAND million m3/yr	LOSSES %	GROSS DEMAND million m3/yr	GROSS DEMAND m3/s	MAX YIELD m3/s	HOURS h
2000	0.000	0.00%	0.00	0.000	0.000	0.00
2001	0.000	0.00%	0.00	0.000	0.000	0.00
2002	0.000	0.00%	0.00	0.000	0.000	0.00
2003	0.000	0.00%	0.00	0.000	0.000	0.00
2004	0.000	0.00%	0.00	0.000	0.000	0.00
2005	0.000	0.00%	0.00	0.000	0.000	0.00
2006	0.000	0.00%	0.00	0.000	0.000	0.00
2007	0.000	0.00%	0.00	0.000	0.000	0.00
2008	0.000	0.00%	0.00	0.000	0.000	0.00
2009	0.000	0.00%	0.00	0.000	0.000	0.00
2010	0.000	0.00%	0.00	0.000	0.000	0.00
2011	0.000	0.00%	0.00	0.000	0.000	0.00
2012	0.000	0.00%	0.00	0.000	0.000	0.00
2013	0.000	0.00%	0.00	0.000	0.000	0.00
2014	0.000	0.00%	0.00	0.000	0.000	0.00
2015	0.000	0.00%	0.00	0.000	0.000	0.00
2016	0.000	0.00%	0.00	0.000	0.000	0.00
2017	2.400	0.00%	2.40	0.079	0.000	24.00
2018	2.400	0.00%	2.40	0.079	0.000	24.00
2019	2.400	0.00%	2.40	0.079	0.000	24.00
2020	2.400	0.00%	2.40	0.079	0.000	24.00
2021	2.400	0.00%	2.40	0.079	0.000	24.00
2022	2.400	0.00%	2.40	0.079	0.000	24.00
2023	2.400	0.00%	2.40	0.079	0.000	24.00
2024	2.400	0.00%	2.40	0.079	0.000	24.00
2025	2.400	0.00%	2.40	0.079	0.000	24.00
2026	2.400	0.00%	2.40	0.079	0.000	24.00
2027	2.400	0.00%	2.40	0.079	0.000	24.00
2028	2.400	0.00%	2.40	0.079	0.000	24.00
2029	2.400	0.00%	2.40	0.079	0.000	24.00
2030	2.400	0.00%	2.40	0.079	0.000	24.00
2031	2.400	0.00%	2.40	0.079	0.000	24.00
2032	2.400	0.00%	2.40	0.079	0.000	24.00
2033	2.400	0.00%	2.40	0.079	0.000	24.00
2034	2.400	0.00%	2.40	0.079	0.000	24.00
2035	2.400	0.00%	2.40	0.079	0.000	24.00
2036	2.400	0.00%	2.40	0.079	0.000	24.00
2037	2.400	0.00%	2.40	0.079	0.000	24.00
2038	2.400	0.00%	2.40	0.079	0.000	24.00
2039	2.400	0.00%	2.40	0.079	0.000	24.00
2040	2.400	0.00%	2.40	0.079	0.000	24.00
2041	2.400	0.00%	2.40	0.079	0.000	24.00
2042	2.400	0.00%	2.40	0.079	0.000	24.00
2043	2.400	0.00%	2.40	0.079	0.000	24.00
2044	2.400	0.00%	2.40	0.079	0.000	24.00
2045	2.400	0.00%	2.40	0.079	0.000	24.00
2046	2.400	0.00%	2.40	0.079	0.000	24.00
2047	2.400	0.00%	2.40	0.079	0.000	24.00
2048	2.400	0.00%	2.40	0.079	0.000	24.00
2049	2.400	0.00%	2.40	0.079	0.000	24.00
2050	2.400	0.00%	2.40	0.079	0.000	24.00
2051	2.400	0.00%	2.40	0.079	0.000	24.00
2052	2.400	0.00%	2.40	0.079	0.000	24.00
2053	2.400	0.00%	2.40	0.079	0.000	24.00
2054	2.400	0.00%	2.40	0.079	0.000	24.00
2055	2.400	0.00%	2.40	0.079	0.000	24.00
2056	2.400	0.00%	2.40	0.079	0.000	24.00
2057	2.400	0.00%	2.40	0.079	0.000	24.00
2058	2.400	0.00%	2.40	0.079	0.000	24.00
2059	2.400	0.00%	2.40	0.079	0.000	24.00
2060	2.400	0.00%	2.40	0.079	0.000	24.00
2061	2.400	0.00%	2.40	0.079	0.000	24.00

Major overhaul every 15 years:	15.00% of initial capital cost of pump and motor
Maintenance cost (mechanical & electrical)	4.00% of electrical/mechanical cost
Maintenance cost (civil)	0.25% of civil cost
Maintenance cost (pipelines)	0.50% of pipeline cost

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	Engineering Fees	Land Acquisitions and relocations	Environmental & Social Studies	UPGRADE EXISTING TONGAAT WWTW		UPGRADE EXISTING VERULAM WWTW		PIPELINE: Tongaat WWTW to Hazelmere Dam		PIPELINE: Verulam WWTW to Hazelmere Dam		TONGAAT PUMP STATION TO HAZELMERE DAM					VERULAM PUMP STATION TO HAZELMERE DAM				
				CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY	CAPITAL CIVIL	E & M	ESKOM	MAINTENANCE & OPERATION	ELECTRICITY
2007																					
2008																					
2009																					
2010																					
2011																					
2012																					
2013																					
2014	2,154,484	1,500,000	179,540																		
2015	2,154,484	1,500,000	179,540	3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2016				3,400,000		2,950,000		3,825,360		4,641,840		704,509	1,252,460				436,550	743,314			
2017					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2018					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2019					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2020					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2021					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2022					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2023					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2024					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2025					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2026					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2027					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2028					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2029					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2030					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2031					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2032					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2033					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2034					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2035					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2036					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2037					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2038					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2039					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2040					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2041					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2042					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2043					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2044					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2045					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2046					380,000		310,000		38,254		46,418	0	176,127	0	103,719	353,879	0	106,188	0	61,648	344,328
2047					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2048					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2049					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2050					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2051					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2052					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2053					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2054					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2055					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2056					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2057					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2058					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2059					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2060					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
2061					380,000		310,000		38,254		46,418	0		0	103,719	353,879	0		0	61,648	344,328
TOTAL	**4,308,968**	**3,000,000**	**359,081**	**6,800,000**	**17,100,000**	**5,900,000**	**13,950,000**	**7,650,720**	**1,721,412**	**9,283,680**	**2,088,828**	**1,409,018**	**2,857,175**	**0**	**4,667,371**	**15,924,545**	**873,099**	**1,699,004**	**0**	**2,774,155**	**15,494,754**

Re-Use Options

North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0
2014	3,834,024	0	2,549,845	0	2,237,116	0	1,967,461	0
2015	21,788,057	0	13,670,097	0	11,771,409	0	10,164,290	0
2016	17,954,033	0	10,626,965	0	8,981,486	0	7,614,263	0
2017	0	1,638,246	0	914,788	0	758,825	0	631,615
2018	0	1,638,246	0	863,007	0	702,616	0	574,195
2019	0	1,638,246	0	814,158	0	650,570	0	521,996
2020	0	1,638,246	0	768,074	0	602,380	0	474,541
2021	0	1,638,246	0	724,598	0	557,759	0	431,401
2022	0	1,638,246	0	683,583	0	516,443	0	392,183
2023	0	1,638,246	0	644,889	0	478,188	0	356,530
2024	0	1,638,246	0	608,386	0	442,767	0	324,118
2025	0	1,638,246	0	573,949	0	409,969	0	294,653
2026	0	1,638,246	0	541,462	0	379,601	0	267,866
2027	0	1,638,246	0	510,813	0	351,483	0	243,515
2028	0	1,638,246	0	481,899	0	325,447	0	221,377
2029	0	1,638,246	0	454,622	0	301,340	0	201,252
2030	0	1,638,246	0	428,888	0	279,018	0	182,956
2031	282,315	1,638,246	69,726	404,612	44,521	258,350	28,662	166,324
2032	0	1,638,246	0	381,709	0	239,213	0	151,204
2033	0	1,638,246	0	360,103	0	221,494	0	137,458
2034	0	1,638,246	0	339,720	0	205,087	0	124,962
2035	0	1,638,246	0	320,490	0	189,895	0	113,601
2036	0	1,638,246	0	302,349	0	175,829	0	103,274
2037	0	1,638,246	0	285,235	0	162,805	0	93,886
2038	0	1,638,246	0	269,090	0	150,745	0	85,350
2039	0	1,638,246	0	253,858	0	139,579	0	77,591
2040	0	1,638,246	0	239,489	0	129,239	0	70,538
2041	0	1,638,246	0	225,933	0	119,666	0	64,125
2042	0	1,638,246	0	213,144	0	110,802	0	58,296
2043	0	1,638,246	0	201,080	0	102,594	0	52,996
2044	0	1,638,246	0	189,698	0	94,995	0	48,178
2045	0	1,638,246	0	178,960	0	87,958	0	43,798
2046	282,315	1,638,246	29,094	168,830	14,035	81,443	6,862	39,817
2047	0	1,638,246	0	159,274	0	75,410	0	36,197
2048	0	1,638,246	0	150,258	0	69,824	0	32,906
2049	0	1,638,246	0	141,753	0	64,652	0	29,915
2050	0	1,638,246	0	133,729	0	59,863	0	27,195
			0					
2051	0	1,638,246	0	126,160	0	55,429	0	24,723
2052	0	1,638,246	0	119,019	0	51,323	0	22,475
2053	0	1,638,246	0	112,282	0	47,521	0	20,432
2054	0	1,638,246	0	105,926	0	44,001	0	18,575
2055	0	1,638,246	0	99,930	0	40,742	0	16,886
2056	0	1,638,246	0	94,274	0	37,724	0	15,351
2057	0	1,638,246	0	88,938	0	34,929	0	13,955
2058	0	1,638,246	0	83,903	0	32,342	0	12,687
2059	0	1,638,246	0	79,154	0	29,946	0	11,533
2060	0	1,638,246	0	74,674	0	27,728	0	10,485
2061	0	1,638,246	0	70,447	0	25,674	0	9,532
TOTAL	**44,140,745**	**73,721,065**	**26,945,726**	**14,987,137**	**23,048,568**	**9,923,208**	**19,781,537**	**6,852,444**

NET PRESENT COST

Discounted at 6%	41,932,864
Discounted at 8%	32,971,776
Discounted at 10%	26,633,981

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: North Coast: Tongaat(2.9Mm³/a) and Verulam(2.4Mm³/a) to Hazelmere Dam - Block Demand
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
	Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
2007	0	R -	0	R -	0	R -	0	R -
2008	0	R -	0	R -	0	R -	0	R -
2009	0	R -	0	R -	0	R -	0	R -
2010	0	R -	0	R -	0	R -	0	R -
2011	0	R -	0	R -	0	R -	0	R -
2012	0	R -	0	R -	0	R -	0	R -
2013	0	R -	0	R -	0	R -	0	R -
2014	0	R 3,834,024	0	R 2,549,845	0	R 2,237,116	0	R 1,967,461
2015	0	R 21,788,057	0	R 13,670,097	0	R 11,771,409	0	R 10,164,290
2016	0	R 17,954,033	0	R 10,626,965	0	R 8,981,486	0	R 7,614,263
2017	5.3	R 1,638,246	3	R 914,788	2	R 758,825	2	R 631,615
2018	5.3	R 1,638,246	3	R 863,007	2	R 702,616	2	R 574,195
2019	5.3	R 1,638,246	3	R 814,158	2	R 650,570	2	R 521,996
2020	5.3	R 1,638,246	2	R 768,074	2	R 602,380	2	R 474,541
2021	5.3	R 1,638,246	2	R 724,598	2	R 557,759	1	R 431,401
2022	5.3	R 1,638,246	2	R 683,583	2	R 516,443	1	R 392,183
2023	5.3	R 1,638,246	2	R 644,889	2	R 478,188	1	R 356,530
2024	5.3	R 1,638,246	2	R 608,386	1	R 442,767	1	R 324,118
2025	5.3	R 1,638,246	2	R 573,949	1	R 409,969	1	R 294,653
2026	5.3	R 1,638,246	2	R 541,462	1	R 379,601	1	R 267,866
2027	5.3	R 1,638,246	2	R 510,813	1	R 351,483	1	R 243,515
2028	5.3	R 1,638,246	2	R 481,899	1	R 325,447	1	R 221,377
2029	5.3	R 1,638,246	1	R 454,622	1	R 301,340	1	R 201,252
2030	5.3	R 1,638,246	1	R 428,888	1	R 279,018	1	R 182,956
2031	5.3	R 1,920,561	1	R 474,337	1	R 302,871	1	R 194,986
2032	5.3	R 1,638,246	1	R 381,709	1	R 239,213	0	R 151,204
2033	5.3	R 1,638,246	1	R 360,103	1	R 221,494	0	R 137,458
2034	5.3	R 1,638,246	1	R 339,720	1	R 205,087	0	R 124,962
2035	5.3	R 1,638,246	1	R 320,490	1	R 189,895	0	R 113,601
2036	5.3	R 1,638,246	1	R 302,349	1	R 175,829	0	R 103,274
2037	5.3	R 1,638,246	1	R 285,235	1	R 162,805	0	R 93,886
2038	5.3	R 1,638,246	1	R 269,090	0	R 150,745	0	R 85,350
2039	5.3	R 1,638,246	1	R 253,858	0	R 139,579	0	R 77,591
2040	5.3	R 1,638,246	1	R 239,489	0	R 129,239	0	R 70,538
2041	5.3	R 1,638,246	1	R 225,933	0	R 119,666	0	R 64,125
2042	5.3	R 1,638,246	1	R 213,144	0	R 110,802	0	R 58,296
2043	5.3	R 1,638,246	1	R 201,080	0	R 102,594	0	R 52,996
2044	5.3	R 1,638,246	1	R 189,698	0	R 94,995	0	R 48,178
2045	5.3	R 1,638,246	1	R 178,960	0	R 87,958	0	R 43,798
2046	5.3	R 1,920,561	1	R 197,924	0	R 95,478	0	R 46,678
2047	5.3	R 1,638,246	1	R 159,274	0	R 75,410	0	R 36,197
2048	5.3	R 1,638,246	0	R 150,258	0	R 69,824	0	R 32,906
2049	5.3	R 1,638,246	0	R 141,753	0	R 64,652	0	R 29,915
2050	5.3	R 1,638,246	0	R 133,729	0	R 59,863	0	R 27,195
2051	5.3	R 1,638,246	0	R 126,160	0	R 55,429	0	R 24,723
2052	5.3	R 1,638,246	0	R 119,019	0	R 51,323	0	R 22,475
2053	5.3	R 1,638,246	0	R 112,282	0	R 47,521	0	R 20,432
2054	5.3	R 1,638,246	0	R 105,926	0	R 44,001	0	R 18,575
2055	5.3	R 1,638,246	0	R 99,930	0	R 40,742	0	R 16,886
2056	5.3	R 1,638,246	0	R 94,274	0	R 37,724	0	R 15,351
2057	5.3	R 1,638,246	0	R 88,938	0	R 34,929	0	R 13,955
2058	5.3	R 1,638,246	0	R 83,903	0	R 32,342	0	R 12,687
2059	5.3	R 1,638,246	0	R 79,154	0	R 29,946	0	R 11,533
2060	5.3	R 1,638,246	0	R 74,674	0	R 27,728	0	R 10,485
2061	5.3	R 1,638,246	0	R 70,447	0	R 25,674	0	R 9,532
TOTAL	**238.5**	**R 117,861,810**	**48**	**R 41,932,864**	**32**	**R 32,971,776**	**22**	**R 26,633,981**
URV				**R 0.86**		**R 1.03**		**R 1.20**

Appendix D.7

Economic Analyses:

Scenarios

SCENARIO 1A

(Including Phoenix WWTW)

SCENARIO 1A - Incl Phoenix WWTW

YEAR	TUGELA SUPPORT		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM		NORTHERN WWTW RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007									60,977,198			
2008	28,993,434								60,977,198			
2009	28,993,434		6,866,592		9,638,952				68,812,418			
2010	246,444,192		40,455,759		96,570,044				79,119,021			
2011	246,611,953		33,589,167		80,324,600				87,518,570			
2012		8,854,981		2,958,573		5,282,489				3,922,854		
2013		8,887,528		2,958,573		5,541,034				4,355,262		
2014		8,936,348		2,958,573		5,774,560	10,323,840			4,658,445		
2015		8,968,896		2,958,573		6,016,425	103,076,480			4,951,688		
2016		9,017,716		2,958,573		6,258,291	86,032,000			5,254,871	282,511,663	
2017		9,050,263		2,958,573		6,450,115		4,671,865		5,563,024	555,666,629	
2018		9,099,084		2,958,573		6,575,218		6,598,449		5,563,024	1,093,302,452	
2019		9,147,905		2,958,573		6,658,620		8,249,807		5,563,024	1,217,944,256	
2020		9,180,452		2,958,573		6,742,022		9,200,589		5,563,024		16,537,735
2021		9,229,272		2,958,573		6,858,785		9,200,589		5,563,024		16,873,404
2022		9,294,367		2,958,573		6,975,548		9,200,589		5,563,024		17,083,197
2023		9,538,470		2,958,573		6,975,548		9,200,589		5,563,024		17,292,990
2024		9,717,479		2,958,573		6,975,548		9,200,589		5,563,024		17,502,783
2025		9,912,761		2,958,573		6,975,548		9,200,589		5,563,024		17,709,349
2026	1,305,000	10,091,770	644,390	2,958,573	2,385,000	6,975,548		9,200,589	1,699,930	5,563,024		17,919,142
2027		10,287,053		2,958,573		6,975,548		9,200,589		5,563,024		18,109,569
2028		10,482,335		2,958,573		6,975,548		9,200,589		5,563,024		18,299,997
2029		10,661,344		2,958,573		6,975,548		9,200,589		5,563,024		18,493,652
2030		10,872,900		2,958,573		6,975,548		9,200,589		5,563,024		18,684,080
2031		11,068,183		2,958,573		6,975,548	1,012,500	9,200,589		5,563,024		18,874,507
2032		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		19,126,259
2033		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		19,332,825
2034		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024	6,366,905	19,536,163
2035		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		19,742,728
2036		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		19,949,294
2037		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		20,155,859
2038		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		20,359,197
2039		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		20,568,990
2040		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		20,772,328
2041	1,305,000	11,068,183	644,390	2,958,573	2,385,000	6,975,548		9,200,589	1,699,930	5,563,024		20,978,894
2042		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2043		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2044		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2045		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2046		11,068,183		2,958,573		6,975,548	1,012,500	9,200,589		5,563,024		21,117,680
2047		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2048		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2049		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024	6,366,905	21,117,680
2050		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2051		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2052		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2053		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2054		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2055		11,068,183		2,958,573		6,975,548		9,200,589		5,563,024		21,117,680
2056		11,068,183		2,958,573		6,975,548	-22,496,647	9,200,589		5,563,024	-563,293,460	21,117,680
TOTAL	553,653,013	469,003,682	82,200,297	133,135,790	191,303,596	306,301,724	178,960,673	359,941,928	360,804,265	245,664,075	2,598,865,350	730,668,140

SCENARIO 1A - Incl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	89,970,632		84,877,955	0	83,306,141	0	81,791,484	0
2009	114,311,396		101,736,736	0	98,003,597	0	94,472,228	0
2010	462,589,016		388,398,658	0	367,218,075	0	347,549,974	0
2011	448,044,290		354,893,043	0	329,325,928	0	306,020,278	0
2012	0	21,018,896	0	15,706,542	0	14,305,108	0	13,051,081
2013	0	21,742,398	0	15,327,532	0	13,701,399	0	12,273,017
2014	10,323,840	22,327,927	6,865,943	14,849,347	6,023,861	13,028,131	5,297,762	11,457,757
2015	103,076,480	22,895,582	64,671,459	14,364,971	55,689,015	12,369,771	48,085,939	10,680,958
2016	368,543,663	23,489,451	218,140,428	13,903,370	184,363,587	11,750,574	156,298,490	9,961,820
2017	555,666,629	28,693,841	310,281,343	16,022,491	257,381,164	13,290,800	214,233,540	11,062,718
2018	1,093,302,452	30,794,349	575,938,093	16,222,079	468,898,682	13,207,168	383,195,840	10,793,231
2019	1,217,944,256	32,577,929	605,280,982	16,190,233	483,662,421	12,937,144	388,074,574	10,380,332
2020	0	50,182,395	0	23,527,465	0	18,451,962	0	14,536,052
2021	0	50,683,647	0	22,417,426	0	17,255,807	0	13,346,588
2022	0	51,075,297	0	21,311,937	0	16,101,064	0	12,227,020
2023	0	51,529,193	0	20,284,276	0	15,040,880	0	11,214,254
2024	0	51,917,996	0	19,280,496	0	14,031,822	0	10,271,699
2025	0	52,319,844	0	18,329,932	0	13,092,990	0	9,410,184
2026	6,034,320	52,708,646	1,994,421	17,420,893	1,398,225	12,213,229	986,659	8,618,285
2027	0	53,094,356	0	16,555,071	0	11,391,299	0	7,892,138
2028	0	53,480,066	0	15,731,450	0	10,624,123	0	7,226,792
2029	0	53,852,730	0	14,944,407	0	9,905,699	0	6,615,591
2030	0	54,254,714	0	14,203,736	0	9,240,407	0	6,059,067
2031	1,012,500	54,640,424	250,066	13,495,013	159,671	8,616,759	102,795	5,547,402
2032	0	54,892,176	0	12,789,802	0	8,015,241	0	5,066,328
2033	0	55,098,741	0	12,111,256	0	7,449,447	0	4,623,085
2034	6,366,905	55,302,079	1,320,292	11,467,879	797,053	6,923,091	485,653	4,218,315
2035	0	55,508,645	0	10,859,164	0	6,434,214	0	3,849,155
2036	0	55,715,211	0	10,282,618	0	5,979,775	0	3,512,254
2037	0	55,921,776	0	9,736,548	0	5,557,357	0	3,204,796
2038	0	56,125,114	0	9,218,822	0	5,164,411	0	2,924,045
2039	0	56,334,907	0	8,729,511	0	4,799,737	0	2,668,159
2040	0	56,538,245	0	8,265,113	0	4,460,242	0	2,434,354
2041	6,034,320	56,744,811	832,202	7,825,764	440,779	4,144,942	236,198	2,221,134
2042	0	56,883,597	0	7,400,853	0	3,847,296	0	2,024,152
2043	0	56,883,597	0	6,981,937	0	3,562,311	0	1,840,138
2044	0	56,883,597	0	6,586,733	0	3,298,436	0	1,672,853
2045	0	56,883,597	0	6,213,899	0	3,054,108	0	1,520,775
2046	1,012,500	56,883,597	104,344	5,862,169	50,335	2,827,877	24,608	1,382,523
2047	0	56,883,597	0	5,530,348	0	2,618,405	0	1,256,839
2048	0	56,883,597	0	5,217,309	0	2,424,449	0	1,142,581
2049	6,366,905	56,883,597	550,912	4,921,990	251,264	2,244,860	116,261	1,038,710
2050	0	56,883,597	0	4,643,387	0	2,078,574	0	944,282
2051	0	56,883,597	0	4,380,553	0	1,924,606	0	858,438
2052	0	56,883,597	0	4,132,598	0	1,782,042	0	780,398
2053	0	56,883,597	0	3,898,677	0	1,650,039	0	709,453
2054	0	56,883,597	0	3,677,997	0	1,527,814	0	644,957
2055	0	56,883,597	0	3,469,809	0	1,414,643	0	586,325
2056	-585,790,107	56,883,597	-33,709,680	3,273,404	-13,488,946	1,309,854	-5,489,091	533,022
TOTAL	**3,965,787,194**	**2,244,715,338**	**2,743,404,393**	**517,566,802**	**2,384,458,050**	**355,049,907**	**2,082,460,391**	**254,283,054**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 1A - Incl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008	0	R 89,970,632	0	R 84,877,955	0	R 83,306,141	0	R 81,791,484
	2009	0	R 114,311,396	0	R 101,736,736	0	R 98,003,597	0	R 94,472,228
	2010	0	R 462,589,016	0	R 388,398,658	0	R 367,218,075	0	R 347,549,974
	2011	0	R 448,044,290	0	R 354,893,043	0	R 329,325,928	0	R 306,020,278
1	2012	54.3	R 21,018,896	41	R 15,706,542	37	R 14,305,108	34	R 13,051,081
2	2013	66.3	R 21,742,398	47	R 15,327,532	42	R 13,701,399	37	R 12,273,017
3	2014	75.5	R 32,651,767	50	R 21,715,290	44	R 19,051,992	39	R 16,755,519
4	2015	84.5	R 125,972,062	53	R 79,036,430	46	R 68,058,785	39	R 58,766,897
5	2016	93.8	R 392,035,130	56	R 232,043,798	47	R 196,114,160	40	R 166,260,310
6	2017	104.1	R 584,360,470	58	R 326,303,834	48	R 270,671,964	40	R 225,296,258
7	2018	113.6	R 1,124,096,801	60	R 592,160,172	49	R 482,105,850	40	R 393,989,071
8	2019	121.5	R 1,250,522,185	60	R 621,471,215	48	R 496,599,565	39	R 398,454,906
9	2020	131.6	R 50,182,395	62	R 23,527,465	48	R 18,451,962	38	R 14,536,052
10	2021	143.7	R 50,683,647	64	R 22,417,426	49	R 17,255,807	38	R 13,346,588
11	2022	152.0	R 51,075,297	63	R 21,311,937	48	R 16,101,064	36	R 12,227,020
12	2023	160.0	R 51,529,193	63	R 20,284,276	47	R 15,040,880	35	R 11,214,254
13	2024	167.6	R 51,917,996	62	R 19,280,496	45	R 14,031,822	33	R 10,271,699
14	2025	175.2	R 52,319,844	61	R 18,329,932	44	R 13,092,990	32	R 9,410,184
15	2026	182.8	R 58,742,966	60	R 19,415,314	42	R 13,611,454	30	R 9,604,944
16	2027	189.9	R 53,094,356	59	R 16,555,071	41	R 11,391,299	28	R 7,892,138
17	2028	197.0	R 53,480,066	58	R 15,731,450	39	R 10,624,123	27	R 7,226,792
18	2029	204.1	R 53,852,730	57	R 14,944,407	38	R 9,905,699	25	R 6,615,591
19	2030	211.3	R 54,254,714	55	R 14,203,736	36	R 9,240,407	24	R 6,059,067
20	2031	218.4	R 55,652,924	54	R 13,745,078	34	R 8,776,429	22	R 5,650,196
21	2032	226.2	R 54,892,176	53	R 12,789,802	33	R 8,015,241	21	R 5,066,328
22	2033	232.6	R 55,098,741	51	R 12,111,256	31	R 7,449,447	20	R 4,623,085
23	2034	238.9	R 61,668,985	50	R 12,788,171	30	R 7,720,144	18	R 4,703,967
24	2035	245.3	R 55,508,645	48	R 10,859,164	28	R 6,434,214	17	R 3,849,155
25	2036	251.7	R 55,715,211	46	R 10,282,618	27	R 5,979,775	16	R 3,512,254
26	2037	258.1	R 55,921,776	45	R 9,736,548	26	R 5,557,357	15	R 3,204,796
27	2038	264.4	R 56,125,114	43	R 9,218,822	24	R 5,164,411	14	R 2,924,045
28	2039	270.9	R 56,334,907	42	R 8,729,511	23	R 4,799,737	13	R 2,668,159
29	2040	277.2	R 56,538,245	41	R 8,265,113	22	R 4,460,242	12	R 2,434,354
30	2041	283.6	R 62,779,130	39	R 8,657,966	21	R 4,585,721	11	R 2,457,333
31	2042	287.9	R 56,883,597	37	R 7,400,853	19	R 3,847,296	10	R 2,024,152
32	2043	287.9	R 56,883,597	35	R 6,981,937	18	R 3,562,311	9	R 1,840,138
33	2044	287.9	R 56,883,597	33	R 6,586,733	17	R 3,298,436	8	R 1,672,853
34	2045	287.9	R 56,883,597	31	R 6,213,899	15	R 3,054,108	8	R 1,520,775
35	2046	287.9	R 57,896,097	30	R 5,966,512	14	R 2,878,212	7	R 1,407,131
36	2047	287.9	R 56,883,597	28	R 5,530,348	13	R 2,618,405	6	R 1,256,839
37	2048	287.9	R 56,883,597	26	R 5,217,309	12	R 2,424,449	6	R 1,142,581
38	2049	287.9	R 63,250,502	25	R 5,472,902	11	R 2,496,125	5	R 1,154,971
39	2050	287.9	R 56,883,597	24	R 4,643,387	11	R 2,078,574	5	R 944,282
40	2051	287.9	R 56,883,597	22	R 4,380,553	10	R 1,924,606	4	R 858,438
41	2052	287.9	R 56,883,597	21	R 4,132,598	9	R 1,782,042	4	R 780,398
42	2053	287.9	R 56,883,597	20	R 3,898,677	8	R 1,650,039	4	R 709,453
43	2054	287.9	R 56,883,597	19	R 3,677,997	8	R 1,527,814	3	R 644,957
44	2055	287.9	R 56,883,597	18	R 3,469,809	7	R 1,414,643	3	R 586,325
45	2056	287.9	R -528,906,510	17	R -30,436,276	7	R -12,179,092	3	R -4,956,069
	TOTAL	**9714.6**	**R 6,210,504,549**	**1987**	**R 3,260,971,195**	**1317**	**R 2,739,507,957**	**917**	**R 2,336,743,445**
	URV				**R 1.64**		**R 2.08**		**R 2.55**

SCENARIO 1A

(Excluding Phoenix WWTW)

SCENARIO 1A - Excl Phoenix WWTW

YEAR	TUGELA SUPPORT		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM		NORTHERN WWTW RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007									60,977,198			
2008	28,993,434								60,977,198			
2009	28,993,434		3,834,024		9,638,952				68,812,418			
2010	246,444,192		21,788,057		96,570,044				79,119,021			
2011	246,611,953		17,954,033		80,324,600				87,518,570			
2012		8,854,981		2,298,246		5,282,489				3,922,854		
2013		8,887,528		2,298,246		5,541,034				4,355,262		
2014		8,936,348		2,298,246		5,774,560	10,323,840			4,658,445		
2015		8,968,896		2,298,246		6,016,425	103,076,480			4,951,688		
2016		9,017,716		2,298,246		6,258,291	86,032,000			5,254,871	282,511,663	
2017		9,050,263		2,298,246		6,450,115		4,671,865		5,563,024	555,666,629	
2018		9,099,084		2,298,246		6,575,218		6,598,449		5,563,024	1,093,302,452	
2019		9,147,905		2,298,246		6,658,620		8,249,807		5,563,024	1,217,944,256	
2020		9,180,452		2,298,246		6,742,022		9,200,589		5,563,024		16,537,735
2021		9,229,272		2,298,246		6,858,785		9,200,589		5,563,024		16,873,404
2022		9,294,367		2,298,246		6,975,548		9,200,589		5,563,024		17,083,197
2023		9,538,470		2,298,246		6,975,548		9,200,589		5,563,024		17,292,990
2024		9,717,479		2,298,246		6,975,548		9,200,589		5,563,024		17,502,783
2025		9,912,761		2,298,246		6,975,548		9,200,589		5,563,024		17,709,349
2026	1,305,000	10,091,770	282,315	2,298,246	2,385,000	6,975,548		9,200,589	1,699,930	5,563,024		17,919,142
2027		10,287,053		2,298,246		6,975,548		9,200,589		5,563,024		18,109,569
2028		10,482,335		2,298,246		6,975,548		9,200,589		5,563,024		18,299,997
2029		10,661,344		2,298,246		6,975,548		9,200,589		5,563,024		18,493,652
2030		10,872,900		2,298,246		6,975,548		9,200,589		5,563,024		18,684,080
2031		11,068,183		2,298,246		6,975,548	1,012,500	9,200,589		5,563,024		18,874,507
2032		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		19,126,259
2033		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		19,332,825
2034		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024	6,366,905	19,536,163
2035		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		19,742,728
2036		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		19,949,294
2037		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		20,155,859
2038		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		20,359,197
2039		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		20,568,990
2040		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		20,772,328
2041	1,305,000	11,068,183	282,315	2,298,246	2,385,000	6,975,548		9,200,589	1,699,930	5,563,024		20,978,894
2042		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2043		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2044		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2045		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2046		11,068,183		2,298,246		6,975,548	1,012,500	9,200,589		5,563,024		21,117,680
2047		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2048		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2049		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024	6,366,905	21,117,680
2050		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2051		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2052		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2053		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2054		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2055		11,068,183		2,298,246		6,975,548		9,200,589		5,563,024		21,117,680
2056		11,068,183		2,298,246		6,975,548	-22,496,647	9,200,589		5,563,024	-563,293,460	21,117,680
TOTAL	553,653,013	469,003,682	44,140,745	103,421,065	191,303,596	306,301,724	178,960,673	359,941,928	360,804,265	245,664,075	2,598,865,350	730,668,140

SCENARIO 1A - Excl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	89,970,632		84,877,955	0	83,306,141	0	81,791,484	0
2009	111,278,829		99,037,761	0	95,403,660	0	91,965,974	0
2010	443,921,314		372,724,896	0	352,399,052	0	333,524,654	0
2011	432,409,156		342,508,552	0	317,833,638	0	295,341,271	0
2012	0	20,358,569	0	15,213,107	0	13,855,700	0	12,641,070
2013	0	21,082,071	0	14,862,028	0	13,285,281	0	11,900,279
2014	10,323,840	21,667,600	6,865,943	14,410,191	6,023,861	12,642,836	5,297,762	11,118,905
2015	103,076,480	22,235,255	64,671,459	13,950,674	55,689,015	12,013,016	48,085,939	10,372,910
2016	368,543,663	22,829,124	218,140,428	13,512,523	184,363,587	11,420,246	156,298,490	9,681,777
2017	555,666,629	28,033,513	310,281,343	15,653,768	257,381,164	12,984,941	214,233,540	10,808,133
2018	1,093,302,452	30,134,021	575,938,093	15,874,227	468,898,682	12,923,965	383,195,840	10,561,791
2019	1,217,944,256	31,917,602	605,280,982	15,862,070	483,662,421	12,674,919	388,074,574	10,169,932
2020	0	49,522,068	0	23,217,878	0	18,209,161	0	14,344,779
2021	0	50,023,320	0	22,125,363	0	17,030,992	0	13,172,704
2022	0	50,414,970	0	21,036,405	0	15,892,901	0	12,068,943
2023	0	50,868,866	0	20,024,340	0	14,848,137	0	11,070,547
2024	0	51,257,668	0	19,035,274	0	13,853,356	0	10,141,056
2025	0	51,659,516	0	18,098,591	0	12,927,744	0	9,291,418
2026	5,672,245	52,048,319	1,874,751	17,202,646	1,314,328	12,060,223	927,457	8,510,316
2027	0	52,434,029	0	16,349,178	0	11,249,627	0	7,793,984
2028	0	52,819,739	0	15,537,212	0	10,492,945	0	7,137,561
2029	0	53,192,403	0	14,761,163	0	9,784,238	0	6,534,473
2030	0	53,594,387	0	14,030,864	0	9,127,943	0	5,985,322
2031	1,012,500	53,980,097	250,066	13,331,926	159,671	8,512,626	102,795	5,480,362
2032	0	54,231,849	0	12,635,946	0	7,918,821	0	5,005,383
2033	0	54,438,414	0	11,966,109	0	7,360,170	0	4,567,680
2034	6,366,905	54,641,752	1,320,292	11,330,948	797,053	6,840,427	485,653	4,167,946
2035	0	54,848,318	0	10,729,984	0	6,357,673	0	3,803,366
2036	0	55,054,883	0	10,160,750	0	5,908,904	0	3,470,627
2037	0	55,261,449	0	9,621,578	0	5,491,735	0	3,166,954
2038	0	55,464,787	0	9,110,360	0	5,103,651	0	2,889,642
2039	0	55,674,580	0	8,627,188	0	4,743,477	0	2,636,884
2040	0	55,877,918	0	8,168,582	0	4,408,149	0	2,405,922
2041	5,672,245	56,084,483	782,268	7,734,697	414,331	4,096,708	222,026	2,195,288
2042	0	56,223,270	0	7,314,941	0	3,802,635	0	2,000,655
2043	0	56,223,270	0	6,900,888	0	3,520,958	0	1,818,777
2044	0	56,223,270	0	6,510,271	0	3,260,147	0	1,653,434
2045	0	56,223,270	0	6,141,765	0	3,018,654	0	1,503,121
2046	1,012,500	56,223,270	104,344	5,794,118	50,335	2,795,050	24,608	1,366,474
2047	0	56,223,270	0	5,466,149	0	2,588,010	0	1,242,249
2048	0	56,223,270	0	5,156,745	0	2,396,305	0	1,129,317
2049	6,366,905	56,223,270	550,912	4,864,853	251,264	2,218,801	116,261	1,026,652
2050	0	56,223,270	0	4,589,484	0	2,054,445	0	933,320
2051	0	56,223,270	0	4,329,702	0	1,902,264	0	848,473
2052	0	56,223,270	0	4,084,625	0	1,761,356	0	771,339
2053	0	56,223,270	0	3,853,420	0	1,630,885	0	701,217
2054	0	56,223,270	0	3,635,301	0	1,510,079	0	637,470
2055	0	56,223,270	0	3,429,530	0	1,398,221	0	579,518
2056	-585,790,107	56,223,270	-33,709,680	3,235,405	-13,488,946	1,294,649	-5,489,091	526,835
TOTAL	**3,927,727,642**	**2,215,000,613**	**2,712,477,562**	**509,482,768**	**2,355,436,453**	**349,172,971**	**2,055,176,435**	**249,834,806**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 1A - Excl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008	0	R 89,970,632	0	R 84,877,955	0	R 83,306,141	0	R 81,791,484
	2009	0	R 111,278,829	0	R 99,037,761	0	R 95,403,660	0	R 91,965,974
	2010	0	R 443,921,314	0	R 372,724,896	0	R 352,399,052	0	R 333,524,654
	2011	0	R 432,409,156	0	R 342,508,552	0	R 317,833,638	0	R 295,341,271
1	2012	49.2	R 20,358,569	37	R 15,213,107	33	R 13,855,700	31	R 12,641,070
2	2013	61.2	R 21,082,071	43	R 14,862,028	39	R 13,285,281	35	R 11,900,279
3	2014	70.4	R 31,991,440	47	R 21,276,134	41	R 18,666,698	36	R 16,416,667
4	2015	79.4	R 125,311,735	50	R 78,622,133	43	R 67,702,031	37	R 58,458,849
5	2016	88.7	R 391,374,803	53	R 231,652,951	44	R 195,783,832	38	R 165,980,267
6	2017	99.0	R 583,700,143	55	R 325,935,111	46	R 270,366,105	38	R 225,041,673
7	2018	108.5	R 1,123,436,473	57	R 591,812,320	47	R 481,822,647	38	R 393,757,630
8	2019	116.4	R 1,249,861,858	58	R 621,143,052	46	R 496,337,340	37	R 398,244,506
9	2020	126.5	R 49,522,068	59	R 23,217,878	47	R 18,209,161	37	R 14,344,779
10	2021	138.6	R 50,023,320	61	R 22,125,363	47	R 17,030,992	36	R 13,172,704
11	2022	146.9	R 50,414,970	61	R 21,036,405	46	R 15,892,901	35	R 12,068,943
12	2023	154.9	R 50,868,866	61	R 20,024,340	45	R 14,848,137	34	R 11,070,547
13	2024	162.5	R 51,257,668	60	R 19,035,274	44	R 13,853,356	32	R 10,141,056
14	2025	170.1	R 51,659,516	60	R 18,098,591	43	R 12,927,744	31	R 9,291,418
15	2026	177.7	R 57,720,563	59	R 19,077,397	41	R 13,374,551	29	R 9,437,773
16	2027	184.8	R 52,434,029	58	R 16,349,178	40	R 11,249,627	27	R 7,793,984
17	2028	191.9	R 52,819,739	56	R 15,537,212	38	R 10,492,945	26	R 7,137,561
18	2029	199.0	R 53,192,403	55	R 14,761,163	37	R 9,784,238	24	R 6,534,473
19	2030	206.2	R 53,594,387	54	R 14,030,864	35	R 9,127,943	23	R 5,985,322
20	2031	213.3	R 54,992,597	53	R 13,581,992	34	R 8,672,296	22	R 5,583,156
21	2032	221.1	R 54,231,849	52	R 12,635,946	32	R 7,918,821	20	R 5,005,383
22	2033	227.5	R 54,438,414	50	R 11,966,109	31	R 7,360,170	19	R 4,567,680
23	2034	233.8	R 61,008,657	48	R 12,651,240	29	R 7,637,480	18	R 4,653,599
24	2035	240.2	R 54,848,318	47	R 10,729,984	28	R 6,357,673	17	R 3,803,366
25	2036	246.6	R 55,054,883	46	R 10,160,750	26	R 5,908,904	16	R 3,470,627
26	2037	253.0	R 55,261,449	44	R 9,621,578	25	R 5,491,735	14	R 3,166,954
27	2038	259.3	R 55,464,787	43	R 9,110,360	24	R 5,103,651	14	R 2,889,642
28	2039	265.8	R 55,674,580	41	R 8,627,188	23	R 4,743,477	13	R 2,636,884
29	2040	272.1	R 55,877,918	40	R 8,168,582	21	R 4,408,149	12	R 2,405,922
30	2041	278.5	R 61,756,728	38	R 8,516,965	20	R 4,511,039	11	R 2,417,314
31	2042	282.8	R 56,223,270	37	R 7,314,941	19	R 3,802,635	10	R 2,000,655
32	2043	282.8	R 56,223,270	35	R 6,900,888	18	R 3,520,958	9	R 1,818,777
33	2044	282.8	R 56,223,270	33	R 6,510,271	16	R 3,260,147	8	R 1,653,434
34	2045	282.8	R 56,223,270	31	R 6,141,765	15	R 3,018,654	8	R 1,503,121
35	2046	282.8	R 57,235,770	29	R 5,898,462	14	R 2,845,385	7	R 1,391,082
36	2047	282.8	R 56,223,270	27	R 5,466,149	13	R 2,588,010	6	R 1,242,249
37	2048	282.8	R 56,223,270	26	R 5,156,745	12	R 2,396,305	6	R 1,129,317
38	2049	282.8	R 62,590,175	24	R 5,415,765	11	R 2,470,065	5	R 1,142,914
39	2050	282.8	R 56,223,270	23	R 4,589,484	10	R 2,054,445	5	R 933,320
40	2051	282.8	R 56,223,270	22	R 4,329,702	10	R 1,902,264	4	R 848,473
41	2052	282.8	R 56,223,270	21	R 4,084,625	9	R 1,761,356	4	R 771,339
42	2053	282.8	R 56,223,270	19	R 3,853,420	8	R 1,630,885	4	R 701,217
43	2054	282.8	R 56,223,270	18	R 3,635,301	8	R 1,510,079	3	R 637,470
44	2055	282.8	R 56,223,270	17	R 3,429,530	7	R 1,398,221	3	R 579,518
45	2056	282.8	R -529,566,838	16	R -30,474,275	7	R -12,194,297	3	R -4,962,256
	TOTAL	**9485.1**	**R 6,142,730,271**	**1924**	**R 3,221,960,330**	**1272**	**R 2,704,609,424**	**882**	**R 2,305,011,241**
	URV				**R 1.67**		**R 2.13**		**R 2.61**

SCENARIO 1B

(Including Phoenix WWTW)

SCENARIO 1B - Incl Phoenix WWTW

YEAR	TUGELA SUPPORT		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM & INANDA		NORTHERN RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007									60,977,198			
2008	28,993,434								60,977,198			
2009	28,993,434		6,866,592		9,109,072				68,812,418			
2010	246,444,192		40,455,759		59,388,095				79,119,021			
2011	246,611,953		33,589,167		50,279,023				87,518,570			
2012		8,865,856		2,958,573	0	3,909,246				3,922,854		
2013		8,898,403		2,958,573	0	4,184,608				4,355,262		
2014		8,947,223		2,958,573	5,664,919	4,433,322				4,658,445		
2015		8,979,771		2,958,573	49,801,207	4,690,919	10,323,840			4,951,688		
2016		9,093,685		2,958,573	44,136,288	4,912,985	103,076,480			5,254,871		
2017		9,793,448		2,958,573	0	6,260,999	86,032,000			5,563,024	282,511,663	
2018		10,005,004		2,958,573	0	8,087,434		4,346,597		5,563,024	555,666,629	
2019		10,200,287		2,958,573	0	8,087,434		5,997,956		5,563,024	1,093,302,452	
2020		10,476,937		2,958,573	0	8,087,434		8,224,787		5,563,024	1,217,944,256	
2021		10,769,861		2,958,573	0	8,087,434		9,200,589		5,563,024		16,582,921
2022		11,013,964		2,958,573	0	8,087,434		9,200,589		5,563,024		16,792,714
2023		11,192,973		2,958,573	0	8,087,434		9,200,589		5,563,024		17,002,507
2024		11,388,255		2,958,573	0	8,087,434		9,200,589		5,563,024		17,212,300
2025		11,567,264		2,958,573	0	8,087,434		9,200,589		5,563,024		17,418,866
2026	1,305,000	11,762,547	644,390	2,958,573	439,544	8,087,434		9,200,589	1,699,930	5,563,024		17,628,659
2027		11,957,829		2,958,573	0	8,087,434		9,200,589		5,563,024		17,819,086
2028		12,136,838		2,958,573	0	8,087,434		9,200,589		5,563,024		18,009,514
2029		12,348,395		2,958,573	0	8,087,434		9,200,589		5,563,024		18,203,169
2030		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		18,390,369
2031		12,543,677		2,958,573	570,266	8,087,434		9,200,589		5,563,024		18,584,025
2032		12,543,677		2,958,573	0	8,087,434	1,012,500	9,200,589		5,563,024		18,874,507
2033		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		19,126,259
2034		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024	6,366,905	19,332,825
2035		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		19,536,163
2036		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		19,742,728
2037		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		19,949,294
2038		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		20,155,859
2039		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		20,359,197
2040		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		20,568,990
2041	1,305,000	12,543,677	644,390	2,958,573	439,544	8,087,434		9,200,589	1,699,930	5,563,024		20,772,328
2042		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		20,978,894
2043		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2044		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2045		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2046		12,543,677		2,958,573	570,266	8,087,434		9,200,589		5,563,024		21,117,680
2047		12,543,677		2,958,573	0	8,087,434	1,012,500	9,200,589		5,563,024		21,117,680
2048		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2049		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024	6,366,905	21,117,680
2050		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2051		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2052		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2053		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2054		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2055		12,543,677		2,958,573	0	8,087,434		9,200,589		5,563,024		21,117,680
2056		12,543,677		2,958,573	-11,257,023	8,087,434	-26,590,976	9,200,589		5,563,024	-633,280,683	21,117,680
TOTAL	553,653,013	528,077,822	82,200,297	133,135,790	209,141,199	343,801,990	174,866,344	349,790,557	360,804,265	245,664,075	2,528,878,127	708,688,694

SCENARIO 1B - Incl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	89,970,632		84,877,955	0	83,306,141	0	81,791,484	0
2009	113,781,516		101,265,144	0	97,549,311	0	94,034,311	0
2010	425,407,066		357,179,976	0	337,701,845	0	319,614,625	0
2011	417,998,713		331,094,131	0	307,241,532	0	285,498,745	0
2012	0	19,656,529	0	14,688,502	0	13,377,903	0	12,205,158
2013	0	20,396,846	0	14,378,972	0	12,853,473	0	11,513,488
2014	5,664,919	20,997,564	3,767,494	13,964,579	3,305,426	12,251,877	2,906,999	10,775,070
2015	60,125,047	21,580,950	37,723,198	13,540,155	32,483,692	11,659,516	28,048,778	10,067,672
2016	147,212,768	22,220,114	87,135,011	13,152,051	73,643,035	11,115,589	62,432,584	9,423,497
2017	368,543,663	24,576,044	205,792,856	13,723,135	170,707,025	11,383,464	142,089,536	9,475,129
2018	555,666,629	30,960,632	292,718,248	16,309,675	238,315,893	13,278,484	194,757,764	10,851,513
2019	1,093,302,452	32,807,273	543,337,824	16,304,209	434,165,446	13,028,219	348,359,854	10,453,408
2020	1,217,944,256	35,310,754	571,019,794	16,555,060	447,835,575	12,983,691	352,795,067	10,228,268
2021	0	53,162,401	0	23,513,781	0	18,099,727	0	13,999,322
2022	0	53,616,298	0	22,372,208	0	16,902,093	0	12,835,315
2023	0	54,005,100	0	21,258,907	0	15,763,574	0	11,753,083
2024	0	54,410,176	0	20,206,003	0	14,705,381	0	10,764,763
2025	0	54,795,750	0	19,197,351	0	13,712,583	0	9,855,497
2026	4,088,864	55,200,826	1,351,423	18,244,591	947,439	12,790,697	668,562	9,025,776
2027	0	55,586,536	0	17,332,145	0	11,925,992	0	8,262,584
2028	0	55,955,973	0	16,459,752	0	11,115,976	0	7,561,363
2029	0	56,361,184	0	15,640,516	0	10,367,105	0	6,923,745
2030	0	56,743,666	0	14,855,336	0	9,664,314	0	6,337,028
2031	570,266	56,937,322	140,843	14,062,297	89,931	8,978,978	57,897	5,780,596
2032	1,012,500	57,227,804	235,911	13,334,000	147,843	8,356,284	93,450	5,281,897
2033	0	57,479,556	0	12,634,583	0	7,771,337	0	4,822,848
2034	6,366,905	57,686,122	1,320,292	11,962,253	797,053	7,221,542	485,653	4,400,164
2035	0	57,889,460	0	11,324,923	0	6,710,183	0	4,014,249
2036	0	58,096,025	0	10,722,013	0	6,235,302	0	3,662,339
2037	0	58,302,591	0	10,151,072	0	5,793,956	0	3,341,237
2038	0	58,509,156	0	9,610,412	0	5,383,781	0	3,048,250
2039	0	58,712,494	0	9,097,935	0	5,002,307	0	2,780,767
2040	0	58,922,287	0	8,613,627	0	4,648,316	0	2,537,003
2041	4,088,864	59,125,625	563,901	8,154,106	298,672	4,318,849	160,048	2,314,326
2042	0	59,332,191	0	7,719,428	0	4,012,906	0	2,111,283
2043	0	59,470,977	0	7,299,514	0	3,724,345	0	1,923,838
2044	0	59,470,977	0	6,886,334	0	3,448,467	0	1,748,943
2045	0	59,470,977	0	6,496,541	0	3,193,025	0	1,589,948
2046	570,266	59,470,977	58,769	6,128,812	28,350	2,956,505	13,860	1,445,408
2047	1,012,500	59,470,977	98,437	5,781,898	46,606	2,737,505	22,371	1,314,007
2048	0	59,470,977	0	5,454,621	0	2,534,726	0	1,194,552
2049	6,366,905	59,470,977	550,912	5,145,869	251,264	2,346,969	116,261	1,085,956
2050	0	59,470,977	0	4,854,593	0	2,173,119	0	987,233
2051	0	59,470,977	0	4,579,805	0	2,012,148	0	897,484
2052	0	59,470,977	0	4,320,571	0	1,863,100	0	815,895
2053	0	59,470,977	0	4,076,010	0	1,725,092	0	741,723
2054	0	59,470,977	0	3,845,293	0	1,597,308	0	674,293
2055	0	59,470,977	0	3,627,635	0	1,478,989	0	612,994
2056	-671,128,682	59,470,977	-38,620,545	3,422,297	-15,454,031	1,369,434	-6,288,749	557,267
TOTAL	**3,909,543,246**	**2,309,158,928**	**2,642,588,775**	**521,003,369**	**2,274,385,245**	**354,574,130**	**1,968,636,299**	**251,996,180**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 1B - Incl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007		R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008		R 89,970,632	0	R 84,877,955	0	R 83,306,141	0	R 81,791,484
	2009		R 113,781,516	0	R 101,265,144	0	R 97,549,311	0	R 94,034,311
	2010		R 425,407,066	0	R 357,179,976	0	R 337,701,845	0	R 319,614,625
	2011		R 417,998,713	0	R 331,094,131	0	R 307,241,532	0	R 285,498,745
1	2012	54.3	R 19,656,529	41	R 14,688,502	37	R 13,377,903	34	R 12,205,158
2	2013	66.3	R 20,396,846	47	R 14,378,972	42	R 12,853,473	37	R 11,513,488
3	2014	75.5	R 26,662,482	50	R 17,732,074	44	R 15,557,302	39	R 13,682,069
4	2015	84.5	R 81,705,997	53	R 51,263,353	46	R 44,143,208	39	R 38,116,450
5	2016	96.3	R 169,434,898	57	R 100,287,062	48	R 84,758,624	41	R 71,856,082
6	2017	105.9	R 393,119,707	59	R 219,515,991	49	R 182,090,488	41	R 151,564,665
7	2018	114.9	R 586,627,261	61	R 309,027,923	49	R 251,594,377	40	R 205,609,276
8	2019	122.7	R 1,126,109,725	61	R 559,642,033	49	R 447,193,665	39	R 358,813,262
9	2020	133.3	R 1,253,255,010	62	R 587,574,854	49	R 460,819,266	39	R 363,023,335
10	2021	145.5	R 53,162,401	64	R 23,513,781	50	R 18,099,727	38	R 13,999,322
11	2022	153.5	R 53,616,298	64	R 22,372,208	48	R 16,902,093	37	R 12,835,315
12	2023	161.1	R 54,005,100	63	R 21,258,907	47	R 15,763,574	35	R 11,753,083
13	2024	168.8	R 54,410,176	63	R 20,206,003	46	R 14,705,381	33	R 10,764,763
14	2025	176.3	R 54,795,750	62	R 19,197,351	44	R 13,712,583	32	R 9,855,497
15	2026	184.0	R 59,289,690	61	R 19,596,014	43	R 13,738,136	30	R 9,694,338
16	2027	191.1	R 55,586,536	60	R 17,332,145	41	R 11,925,992	28	R 8,262,584
17	2028	198.1	R 55,955,973	58	R 16,459,752	39	R 11,115,976	27	R 7,561,363
18	2029	205.4	R 56,361,184	57	R 15,640,516	38	R 10,367,105	25	R 6,923,745
19	2030	212.4	R 56,743,666	56	R 14,855,336	36	R 9,664,314	24	R 6,337,028
20	2031	218.4	R 57,507,588	54	R 14,203,140	34	R 9,068,908	22	R 5,838,492
21	2032	227.4	R 58,240,304	53	R 13,569,911	33	R 8,504,127	21	R 5,375,347
22	2033	235.2	R 57,479,556	52	R 12,634,583	32	R 7,771,337	20	R 4,822,848
23	2034	241.6	R 64,053,027	50	R 13,282,545	30	R 8,018,595	18	R 4,885,817
24	2035	247.9	R 57,889,460	48	R 11,324,923	29	R 6,710,183	17	R 4,014,249
25	2036	254.3	R 58,096,025	47	R 10,722,013	27	R 6,235,302	16	R 3,662,339
26	2037	260.7	R 58,302,591	45	R 10,151,072	26	R 5,793,956	15	R 3,341,237
27	2038	267.1	R 58,509,156	44	R 9,610,412	25	R 5,383,781	14	R 3,048,250
28	2039	273.4	R 58,712,494	42	R 9,097,935	23	R 5,002,307	13	R 2,780,767
29	2040	279.9	R 58,922,287	41	R 8,613,627	22	R 4,648,316	12	R 2,537,003
30	2041	286.2	R 63,214,489	39	R 8,718,007	21	R 4,617,522	11	R 2,474,374
31	2042	292.6	R 59,332,191	38	R 7,719,428	20	R 4,012,906	10	R 2,111,283
32	2043	296.9	R 59,470,977	36	R 7,299,514	19	R 3,724,345	10	R 1,923,838
33	2044	296.9	R 59,470,977	34	R 6,886,334	17	R 3,448,467	9	R 1,748,943
34	2045	296.9	R 59,470,977	32	R 6,496,541	16	R 3,193,025	8	R 1,589,948
35	2046	296.9	R 60,041,243	31	R 6,187,581	15	R 2,984,855	7	R 1,459,268
36	2047	296.9	R 60,483,477	29	R 5,880,336	14	R 2,784,111	7	R 1,336,378
37	2048	296.9	R 59,470,977	27	R 5,454,621	13	R 2,534,726	6	R 1,194,552
38	2049	296.9	R 65,837,882	26	R 5,696,781	12	R 2,598,233	5	R 1,202,218
39	2050	296.9	R 59,470,977	24	R 4,854,593	11	R 2,173,119	5	R 987,233
40	2051	296.9	R 59,470,977	23	R 4,579,805	10	R 2,012,148	4	R 897,484
41	2052	296.9	R 59,470,977	22	R 4,320,571	9	R 1,863,100	4	R 815,895
42	2053	296.9	R 59,470,977	20	R 4,076,010	9	R 1,725,092	4	R 741,723
43	2054	296.9	R 59,470,977	19	R 3,845,293	8	R 1,597,308	3	R 674,293
44	2055	296.9	R 59,470,977	18	R 3,627,635	7	R 1,478,989	3	R 612,994
45	2056	296.9	R -611,657,705	17	R -35,198,248	7	R -14,084,597	3	R -5,731,481
	TOTAL	**9891.2**	**R 6,218,704,190**	**2012**	**R 3,163,592,144**	**1332**	**R 2,628,959,375**	**926**	**R 2,220,632,479**
	URV				**R 1.57**		**R 1.97**		**R 2.40**

SCENARIO 1B

(Excluding Phoenix WWTW)

SCENARIO 1B - Excl Phoenix WWTW

YEAR	TUGELA SUPPORT		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM & INANDA		NORTHERN RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007									60,977,198			
2008	28,993,434								60,977,198			
2009	28,993,434		3,834,024		9,109,072				68,812,418			
2010	246,444,192		21,788,057		59,388,095				79,119,021			
2011	246,611,953		17,954,033		50,279,023				87,518,570			
2012		8,865,856		2,298,246	0	3,909,246				3,922,854		
2013		8,898,403		2,298,246	0	4,184,608				4,355,262		
2014		8,947,223		2,298,246	5,664,919	4,433,322				4,658,445		
2015		8,979,771		2,298,246	49,801,207	4,690,919	10,323,840			4,951,688		
2016		9,093,685		2,298,246	44,136,288	4,912,985	103,076,480			5,254,871		
2017		9,793,448		2,298,246	0	6,260,999	86,032,000			5,563,024	282,511,663	
2018		10,005,004		2,298,246	0	8,087,434		4,346,597		5,563,024	555,666,629	
2019		10,200,287		2,298,246	0	8,087,434		5,997,956		5,563,024	1,093,302,452	
2020		10,476,937		2,298,246	0	8,087,434		8,224,787		5,563,024	1,217,944,256	
2021		10,769,861		2,298,246	0	8,087,434		9,200,589		5,563,024		16,582,921
2022		11,013,964		2,298,246	0	8,087,434		9,200,589		5,563,024		16,792,714
2023		11,192,973		2,298,246	0	8,087,434		9,200,589		5,563,024		17,002,507
2024		11,388,255		2,298,246	0	8,087,434		9,200,589		5,563,024		17,212,300
2025		11,567,264		2,298,246	0	8,087,434		9,200,589		5,563,024		17,418,866
2026	1,305,000	11,762,547	282,315	2,298,246	439,544	8,087,434		9,200,589	1,699,930	5,563,024		17,628,659
2027		11,957,829		2,298,246	0	8,087,434		9,200,589		5,563,024		17,819,086
2028		12,136,838		2,298,246	0	8,087,434		9,200,589		5,563,024		18,009,514
2029		12,348,395		2,298,246	0	8,087,434		9,200,589		5,563,024		18,203,169
2030		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		18,390,369
2031		12,543,677		2,298,246	570,266	8,087,434		9,200,589		5,563,024		18,584,025
2032		12,543,677		2,298,246	0	8,087,434	1,012,500	9,200,589		5,563,024		18,874,507
2033		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		19,126,259
2034		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024	6,366,905	19,332,825
2035		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		19,536,163
2036		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		19,742,728
2037		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		19,949,294
2038		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		20,155,859
2039		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		20,359,197
2040		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		20,568,990
2041	1,305,000	12,543,677	282,315	2,298,246	439,544	8,087,434		9,200,589	1,699,930	5,563,024		20,772,328
2042		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		20,978,894
2043		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2044		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2045		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2046		12,543,677		2,298,246	570,266	8,087,434		9,200,589		5,563,024		21,117,680
2047		12,543,677		2,298,246	0	8,087,434	1,012,500	9,200,589		5,563,024		21,117,680
2048		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2049		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024	6,366,905	21,117,680
2050		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2051		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2052		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2053		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2054		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2055		12,543,677		2,298,246	0	8,087,434		9,200,589		5,563,024		21,117,680
2056		12,543,677		2,298,246	-11,257,023	8,087,434	-26,590,976	9,200,589		5,563,024	-633,280,683	21,117,680
TOTAL	553,653,013	528,077,822	44,140,745	103,421,065	209,141,199	343,801,990	174,866,344	349,790,557	360,804,265	245,664,075	2,528,878,127	708,688,694

SCENARIO 1B - Excl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	89,970,632		84,877,955	0	83,306,141	0	81,791,484	0
2009	110,748,948		98,566,170	0	94,949,373	0	91,528,057	0
2010	406,739,365		341,506,214	0	322,882,822	0	305,589,305	0
2011	402,363,579		318,709,641	0	295,749,242	0	274,819,738	0
2012	0	18,996,201	0	14,195,067	0	12,928,495	0	11,795,147
2013	0	19,736,519	0	13,913,467	0	12,437,355	0	11,140,750
2014	5,664,919	20,337,237	3,767,494	13,525,424	3,305,426	11,866,582	2,906,999	10,436,218
2015	60,125,047	20,920,623	37,723,198	13,125,858	32,483,692	11,302,762	28,048,778	9,759,625
2016	147,212,768	21,559,787	87,135,011	12,761,205	73,643,035	10,785,261	62,432,584	9,143,454
2017	368,543,663	23,915,717	205,792,856	13,354,411	170,707,025	11,077,604	142,089,536	9,220,544
2018	555,666,629	30,300,305	292,718,248	15,961,823	238,315,893	12,995,281	194,757,764	10,620,072
2019	1,093,302,452	32,146,945	543,337,824	15,976,047	434,165,446	12,765,994	348,359,854	10,243,008
2020	1,217,944,256	34,650,427	571,019,794	16,245,472	447,835,575	12,740,890	352,795,067	10,036,994
2021	0	52,502,074	0	23,221,718	0	17,874,911	0	13,825,437
2022	0	52,955,971	0	22,096,676	0	16,693,930	0	12,677,238
2023	0	53,344,773	0	20,998,972	0	15,570,831	0	11,609,377
2024	0	53,749,848	0	19,960,781	0	14,526,915	0	10,634,121
2025	0	54,135,423	0	18,966,009	0	13,547,337	0	9,736,732
2026	3,726,789	54,540,499	1,231,752	18,026,344	863,542	12,637,691	609,360	8,917,807
2027	0	54,926,209	0	17,126,252	0	11,784,320	0	8,164,431
2028	0	55,295,645	0	16,265,513	0	10,984,798	0	7,472,132
2029	0	55,700,857	0	15,457,272	0	10,245,644	0	6,842,626
2030	0	56,083,339	0	14,682,465	0	9,551,850	0	6,263,284
2031	570,266	56,276,994	140,843	13,899,210	89,931	8,874,845	57,897	5,713,556
2032	1,012,500	56,567,477	235,911	13,180,145	147,843	8,259,865	93,450	5,220,952
2033	0	56,819,229	0	12,489,436	0	7,682,060	0	4,767,443
2034	6,366,905	57,025,794	1,320,292	11,825,322	797,053	7,138,878	485,653	4,349,796
2035	0	57,229,132	0	11,195,743	0	6,633,642	0	3,968,460
2036	0	57,435,698	0	10,600,145	0	6,164,431	0	3,620,712
2037	0	57,642,264	0	10,036,102	0	5,728,334	0	3,303,395
2038	0	57,848,829	0	9,501,950	0	5,323,021	0	3,013,848
2039	0	58,052,167	0	8,995,613	0	4,946,047	0	2,749,492
2040	0	58,261,960	0	8,517,096	0	4,596,224	0	2,508,571
2041	3,726,789	58,465,298	513,967	8,063,039	272,224	4,270,616	145,876	2,288,479
2042	0	58,671,864	0	7,633,516	0	3,968,245	0	2,087,786
2043	0	58,810,650	0	7,218,465	0	3,682,992	0	1,902,477
2044	0	58,810,650	0	6,809,872	0	3,410,178	0	1,729,524
2045	0	58,810,650	0	6,424,408	0	3,157,572	0	1,572,295
2046	570,266	58,810,650	58,769	6,060,762	28,350	2,923,678	13,860	1,429,359
2047	1,012,500	58,810,650	98,437	5,717,700	46,606	2,707,109	22,371	1,299,417
2048	0	58,810,650	0	5,394,057	0	2,506,583	0	1,181,288
2049	6,366,905	58,810,650	550,912	5,088,733	251,264	2,320,910	116,261	1,073,898
2050	0	58,810,650	0	4,800,691	0	2,148,990	0	976,271
2051	0	58,810,650	0	4,528,954	0	1,989,806	0	887,519
2052	0	58,810,650	0	4,272,598	0	1,842,413	0	806,836
2053	0	58,810,650	0	4,030,753	0	1,705,938	0	733,487
2054	0	58,810,650	0	3,802,597	0	1,579,572	0	666,806
2055	0	58,810,650	0	3,587,356	0	1,462,567	0	606,188
2056	-671,128,682	58,810,650	-38,620,545	3,384,298	-15,454,031	1,354,229	-6,288,749	551,080
TOTAL	**3,871,483,693**	**2,279,444,203**	**2,611,661,943**	**512,919,335**	**2,245,363,649**	**348,697,194**	**1,941,352,343**	**247,547,931**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 1B - Excl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007		R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008		R 89,970,632	0	R 84,877,955	0	R 83,306,141	0	R 81,791,484
	2009		R 110,748,948	0	R 98,566,170	0	R 94,949,373	0	R 91,528,057
	2010		R 406,739,365	0	R 341,506,214	0	R 322,882,822	0	R 305,589,305
	2011		R 402,363,579	0	R 318,709,641	0	R 295,749,242	0	R 274,819,738
1	2012	49.2	R 18,996,201	37	R 14,195,067	33	R 12,928,495	31	R 11,795,147
2	2013	61.2	R 19,736,519	43	R 13,913,467	39	R 12,437,355	35	R 11,140,750
3	2014	70.4	R 26,002,155	47	R 17,292,918	41	R 15,172,008	36	R 13,343,217
4	2015	79.4	R 81,045,669	50	R 50,849,056	43	R 43,786,453	37	R 37,808,403
5	2016	91.2	R 168,774,571	54	R 99,896,216	46	R 84,428,296	39	R 71,576,038
6	2017	100.8	R 392,459,380	56	R 219,147,268	47	R 181,784,629	39	R 151,310,080
7	2018	109.8	R 585,966,934	58	R 308,680,071	47	R 251,311,174	38	R 205,377,836
8	2019	117.6	R 1,125,449,398	58	R 559,313,871	47	R 446,931,440	37	R 358,602,862
9	2020	128.2	R 1,252,594,683	60	R 587,265,267	47	R 460,576,465	37	R 362,832,062
10	2021	140.4	R 52,502,074	62	R 23,221,718	48	R 17,874,911	37	R 13,825,437
11	2022	148.4	R 52,955,971	62	R 22,096,676	47	R 16,693,930	36	R 12,677,238
12	2023	156.0	R 53,344,773	61	R 20,998,972	46	R 15,570,831	34	R 11,609,377
13	2024	163.7	R 53,749,848	61	R 19,960,781	44	R 14,526,915	32	R 10,634,121
14	2025	171.2	R 54,135,423	60	R 18,966,009	43	R 13,547,337	31	R 9,736,732
15	2026	178.9	R 58,267,288	59	R 19,258,097	41	R 13,501,233	29	R 9,527,167
16	2027	186.0	R 54,926,209	58	R 17,126,252	40	R 11,784,320	28	R 8,164,431
17	2028	193.0	R 55,295,645	57	R 16,265,513	38	R 10,984,798	26	R 7,472,132
18	2029	200.3	R 55,700,857	56	R 15,457,272	37	R 10,245,644	25	R 6,842,626
19	2030	207.3	R 56,083,339	54	R 14,682,465	35	R 9,551,850	23	R 6,263,284
20	2031	213.3	R 56,847,260	53	R 14,040,054	34	R 8,964,775	22	R 5,771,452
21	2032	222.3	R 57,579,977	52	R 13,416,056	32	R 8,407,708	21	R 5,314,401
22	2033	230.1	R 56,819,229	51	R 12,489,436	31	R 7,682,060	19	R 4,767,443
23	2034	236.5	R 63,392,700	49	R 13,145,614	30	R 7,935,930	18	R 4,835,448
24	2035	242.8	R 57,229,132	47	R 11,195,743	28	R 6,633,642	17	R 3,968,460
25	2036	249.2	R 57,435,698	46	R 10,600,145	27	R 6,164,431	16	R 3,620,712
26	2037	255.6	R 57,642,264	45	R 10,036,102	25	R 5,728,334	15	R 3,303,395
27	2038	262.0	R 57,848,829	43	R 9,501,950	24	R 5,323,021	14	R 3,013,848
28	2039	268.3	R 58,052,167	42	R 8,995,613	23	R 4,946,047	13	R 2,749,492
29	2040	274.8	R 58,261,960	40	R 8,517,096	22	R 4,596,224	12	R 2,508,571
30	2041	281.1	R 62,192,087	39	R 8,577,006	21	R 4,542,840	11	R 2,434,355
31	2042	287.5	R 58,671,864	37	R 7,633,516	19	R 3,968,245	10	R 2,087,786
32	2043	291.8	R 58,810,650	36	R 7,218,465	18	R 3,682,992	9	R 1,902,477
33	2044	291.8	R 58,810,650	34	R 6,809,872	17	R 3,410,178	9	R 1,729,524
34	2045	291.8	R 58,810,650	32	R 6,424,408	16	R 3,157,572	8	R 1,572,295
35	2046	291.8	R 59,380,916	30	R 6,119,531	15	R 2,952,028	7	R 1,443,219
36	2047	291.8	R 59,823,150	28	R 5,816,138	13	R 2,753,715	6	R 1,321,788
37	2048	291.8	R 58,810,650	27	R 5,394,057	12	R 2,506,583	6	R 1,181,288
38	2049	291.8	R 65,177,555	25	R 5,639,644	12	R 2,572,174	5	R 1,190,160
39	2050	291.8	R 58,810,650	24	R 4,800,691	11	R 2,148,990	5	R 976,271
40	2051	291.8	R 58,810,650	22	R 4,528,954	10	R 1,989,806	4	R 887,519
41	2052	291.8	R 58,810,650	21	R 4,272,598	9	R 1,842,413	4	R 806,836
42	2053	291.8	R 58,810,650	20	R 4,030,753	8	R 1,705,938	4	R 733,487
43	2054	291.8	R 58,810,650	19	R 3,802,597	8	R 1,579,572	3	R 666,806
44	2055	291.8	R 58,810,650	18	R 3,587,356	7	R 1,462,567	3	R 606,188
45	2056	291.8	R -612,318,032	17	R -35,236,247	7	R -14,099,803	3	R -5,737,669
	TOTAL	**9661.7**	**R 6,150,929,913**	**1949**	**R 3,124,581,278**	**1287**	**R 2,594,060,843**	**892**	**R 2,188,900,275**

URV					**R 1.60**		**R 2.02**		**R 2.45**

SCENARIO 2

(Including Phoenix WWTW)

SCENARIO 2 - Incl Phoenix WWTW

YEAR	ISITHUNDU DAM		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM & INANDA		NORTHERN WWTW RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007									60,977,198			
2008									60,977,198			
2009			6,866,592		9,522,470				68,812,418			
2010			40,455,759		53,042,664				79,119,021			
2011	41,786,938		33,589,167		43,520,194				87,518,570			
2012	49,871,938		0	2,958,573	0	3,772,092			0	3,922,854		
2013	226,926,508		0	2,958,573	0	4,057,964			0	4,355,262		
2014	177,054,570		0	2,958,573	6,019,260	4,316,171			0	4,658,445		
2015	276,393,810		0	2,958,573	62,820,060	4,445,274			0	4,951,688		
2016	333,810,997		0	2,958,573	56,800,800	4,445,274	10,323,840		0	5,254,871		
2017	0	12,858,639	0	2,958,573	0	6,201,772	103,076,480		0	5,563,024	282,511,663	
2018	0	13,194,280	0	2,958,573	0	8,086,588	86,032,000		0	5,563,024	555,666,629	
2019	0	13,436,689	0	2,958,573	0	8,992,278	0	4,997,132	0	5,563,024	1,093,302,452	
2020	0	13,679,097	0	2,958,573	0	8,992,278	0	7,223,964	0	5,563,024	1,217,944,256	
2021	0	13,996,092	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	16,453,817
2022	0	14,331,734	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	16,663,610
2023	0	14,592,788	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	16,873,404
2024	0	14,816,550	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	17,083,197
2025	0	15,021,664	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	17,292,990
2026	0	15,245,425	644,390	2,958,573	343,817	8,992,278	0	9,200,589	1,699,930	5,563,024	0	17,499,555
2027	0	15,450,540	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	17,689,983
2028	0	15,674,301	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	17,880,411
2029	0	15,898,062	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	18,074,066
2030	0	16,140,470	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	18,264,493
2031	1,542,098	16,364,232	0	2,958,573	941,220	8,992,278	0	9,200,589	0	5,563,024	0	18,454,921
2032	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	18,874,507
2033	0	16,364,232	0	2,958,573	0	8,992,278	1,012,500	9,200,589	0	5,563,024	0	19,126,259
2034	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	19,332,825
2035	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	6,366,905	19,536,163
2036	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	19,742,728
2037	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	19,949,294
2038	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	20,155,859
2039	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	20,359,197
2040	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	20,568,990
2041	0	16,364,232	644,390	2,958,573	343,817	8,992,278	0	9,200,589	1,699,930	5,563,024	0	20,772,328
2042	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	20,978,894
2043	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2044	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2045	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2046	1,542,098	16,364,232	0	2,958,573	941,220	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2047	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2048	0	16,364,232	0	2,958,573	0	8,992,278	1,012,500	9,200,589	0	5,563,024	0	21,117,680
2049	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2050	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	6,366,905	21,117,680
2051	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2052	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2053	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2054	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2055	0	16,364,232	0	2,958,573	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2056	-123,385,673	16,364,232	0	2,958,573	-14,273,753	8,992,278	-31,495,305	9,200,589	0	5,563,024	-633,705,143	21,117,680
TOTAL	**985,543,284**	**629,806,352**	**82,200,297**	**133,135,790**	**220,021,768**	**377,031,706**	**169,962,015**	**343,442,313**	**360,804,265**	**245,664,075**	**2,528,453,667**	**707,275,011**

SCENARIO 2 - Incl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	60,977,198		57,525,659	0	56,460,369	0	55,433,816	0
2009	85,201,479		75,829,013	0	73,046,536	0	70,414,446	0
2010	172,617,444		144,932,934	0	137,029,292	0	129,690,040	0
2011	206,414,869		163,499,909	0	151,721,091	0	140,984,133	0
2012	49,871,938	10,653,519	37,267,213	7,960,929	33,942,003	7,250,606	30,966,550	6,614,997
2013	226,926,508	11,371,799	159,974,234	8,016,670	143,002,193	7,166,163	128,094,098	6,419,084
2014	183,073,830	11,933,189	121,754,553	7,936,252	106,821,821	6,962,901	93,945,822	6,123,613
2015	339,213,870	12,355,535	212,826,978	7,752,016	183,266,699	6,675,311	158,245,774	5,763,948
2016	400,935,637	12,658,718	237,313,187	7,492,676	200,567,638	6,332,511	170,035,849	5,368,532
2017	385,588,143	27,582,008	215,310,405	15,401,649	178,601,917	12,775,806	148,660,921	10,634,058
2018	641,698,629	29,802,465	338,038,833	15,699,567	275,213,543	12,781,766	224,911,455	10,445,582
2019	1,093,302,452	35,947,696	543,337,824	17,864,904	434,165,446	14,275,325	348,359,854	11,454,044
2020	1,217,944,256	38,416,936	571,019,794	18,011,358	447,835,575	14,125,827	352,795,067	11,128,018
2021	0	57,164,374	0	25,283,858	0	19,462,242	0	15,053,166
2022	0	57,709,809	0	24,080,287	0	18,192,538	0	13,815,269
2023	0	58,180,656	0	22,902,599	0	16,982,379	0	12,661,806
2024	0	58,614,211	0	21,767,232	0	15,841,601	0	11,596,509
2025	0	59,029,118	0	20,680,485	0	14,771,980	0	10,616,906
2026	2,688,137	59,459,445	888,464	19,652,120	622,874	13,777,471	439,532	9,722,094
2027	0	59,854,987	0	18,663,068	0	12,841,780	0	8,897,062
2028	0	60,269,176	0	17,728,504	0	11,972,818	0	8,144,208
2029	0	60,686,593	0	16,840,839	0	11,162,723	0	7,455,104
2030	0	61,119,428	0	16,000,899	0	10,409,573	0	6,825,705
2031	2,483,318	61,533,617	613,326	15,197,483	391,618	9,703,811	252,120	6,247,237
2032	0	61,953,203	0	14,435,012	0	9,046,277	0	5,718,033
2033	1,012,500	62,204,955	222,558	13,673,273	136,892	8,410,220	84,954	5,219,335
2034	0	62,411,521	0	12,942,149	0	7,813,100	0	4,760,606
2035	6,366,905	62,614,859	1,245,559	12,249,354	738,012	7,257,921	441,503	4,341,924
2036	0	62,821,424	0	11,594,117	0	6,742,468	0	3,960,225
2037	0	63,027,990	0	10,973,812	0	6,263,553	0	3,612,043
2038	0	63,234,555	0	10,386,582	0	5,818,594	0	3,294,437
2039	0	63,437,893	0	9,830,171	0	5,404,911	0	3,004,573
2040	0	63,647,686	0	9,304,415	0	5,021,098	0	2,740,463
2041	2,688,137	63,851,024	370,725	8,805,793	196,356	4,664,018	105,220	2,499,290
2042	0	64,057,590	0	8,334,227	0	4,332,506	0	2,279,432
2043	0	64,196,376	0	7,879,513	0	4,020,271	0	2,076,700
2044	0	64,196,376	0	7,433,503	0	3,722,473	0	1,887,909
2045	0	64,196,376	0	7,012,738	0	3,446,734	0	1,716,281
2046	2,483,318	64,196,376	255,920	6,615,791	123,454	3,191,421	60,356	1,560,256
2047	0	64,196,376	0	6,241,312	0	2,955,019	0	1,418,414
2048	1,012,500	64,196,376	92,866	5,888,030	43,154	2,736,129	20,337	1,289,468
2049	0	64,196,376	0	5,554,746	0	2,533,453	0	1,172,243
2050	6,366,905	64,196,376	519,728	5,240,326	232,652	2,345,789	105,692	1,065,676
2051	0	64,196,376	0	4,943,704	0	2,172,027	0	968,796
2052	0	64,196,376	0	4,663,871	0	2,011,136	0	880,724
2053	0	64,196,376	0	4,399,879	0	1,862,163	0	800,658
2054	0	64,196,376	0	4,150,829	0	1,724,225	0	727,871
2055	0	64,196,376	0	3,915,876	0	1,596,505	0	661,701
2056	-802,859,874	64,196,376	-46,201,104	3,694,223	-18,487,396	1,478,245	-7,523,123	601,546
TOTAL	**4,346,985,296**	**2,436,355,247**	**2,897,615,776**	**525,096,639**	**2,466,648,935**	**350,035,389**	**2,107,501,614**	**243,245,549**

NET PRESENT COST

Discounted at 6%	3,422,712,415
Discounted at 8%	2,816,684,325
Discounted at 10%	2,350,747,163

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 2 - Incl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007		R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008		R 60,977,198	0	R 57,525,659	0	R 56,460,369	0	R 55,433,816
	2009		R 85,201,479	0	R 75,829,013	0	R 73,046,536	0	R 70,414,446
	2010		R 172,617,444	0	R 144,932,934	0	R 137,029,292	0	R 129,690,040
	2011		R 206,414,869	0	R 163,499,909	0	R 151,721,091	0	R 140,984,133
1	2012	40.1	R 60,525,457	30	R 45,228,142	27	R 41,192,609	25	R 37,581,547
2	2013	51.9	R 238,298,307	37	R 167,990,903	33	R 150,168,355	29	R 134,513,182
3	2014	60.8	R 195,007,019	40	R 129,690,805	35	R 113,784,723	31	R 100,069,435
4	2015	68.1	R 351,569,405	43	R 220,578,994	37	R 189,942,010	32	R 164,009,722
5	2016	74.2	R 413,596,371	44	R 244,805,863	37	R 206,900,149	31	R 175,404,381
6	2017	109.5	R 413,170,150	61	R 230,712,054	51	R 191,377,723	42	R 159,294,979
7	2018	119.0	R 671,501,094	63	R 353,738,400	51	R 287,995,309	42	R 235,357,037
8	2019	126.9	R 1,129,250,148	63	R 561,202,727	50	R 448,440,771	40	R 359,813,898
9	2020	137.1	R 1,256,361,192	64	R 589,031,153	50	R 461,961,403	40	R 363,923,085
10	2021	149.2	R 57,164,374	66	R 25,283,858	51	R 19,462,242	39	R 15,053,166
11	2022	157.5	R 57,709,809	66	R 24,080,287	50	R 18,192,538	38	R 13,815,269
12	2023	165.4	R 58,180,656	65	R 22,902,599	48	R 16,982,379	36	R 12,661,806
13	2024	173.1	R 58,614,211	64	R 21,767,232	47	R 15,841,601	34	R 11,596,509
14	2025	180.7	R 59,029,118	63	R 20,680,485	45	R 14,771,980	33	R 10,616,906
15	2026	188.3	R 62,147,582	62	R 20,540,585	44	R 14,400,345	31	R 10,161,626
16	2027	195.3	R 59,854,987	61	R 18,663,068	42	R 12,841,780	29	R 8,897,062
17	2028	202.4	R 60,269,176	60	R 17,728,504	40	R 11,972,818	27	R 8,144,208
18	2029	209.6	R 60,686,593	58	R 16,840,839	39	R 11,162,723	26	R 7,455,104
19	2030	216.8	R 61,119,428	57	R 16,000,899	37	R 10,409,573	24	R 6,825,705
20	2031	223.9	R 64,016,935	55	R 15,810,810	35	R 10,095,428	23	R 6,499,358
21	2032	236.9	R 61,953,203	55	R 14,435,012	35	R 9,046,277	22	R 5,718,033
22	2033	244.7	R 63,217,455	54	R 13,895,831	33	R 8,547,111	21	R 5,304,289
23	2034	251.1	R 62,411,521	52	R 12,942,149	31	R 7,813,100	19	R 4,760,606
24	2035	257.4	R 68,981,764	50	R 13,494,912	30	R 7,995,933	18	R 4,783,427
25	2036	263.8	R 62,821,424	49	R 11,594,117	28	R 6,742,468	17	R 3,960,225
26	2037	270.2	R 63,027,990	47	R 10,973,812	27	R 6,263,553	15	R 3,612,043
27	2038	276.6	R 63,234,555	45	R 10,386,582	25	R 5,818,594	14	R 3,294,437
28	2039	282.9	R 63,437,893	44	R 9,830,171	24	R 5,404,911	13	R 3,004,573
29	2040	289.4	R 63,647,686	42	R 9,304,415	23	R 5,021,098	12	R 2,740,463
30	2041	295.7	R 66,539,162	41	R 9,176,518	22	R 4,860,373	12	R 2,604,510
31	2042	302.1	R 64,057,590	39	R 8,334,227	20	R 4,332,506	11	R 2,279,432
32	2043	306.4	R 64,196,376	38	R 7,879,513	19	R 4,020,271	10	R 2,076,700
33	2044	306.4	R 64,196,376	35	R 7,433,503	18	R 3,722,473	9	R 1,887,909
34	2045	306.4	R 64,196,376	33	R 7,012,738	16	R 3,446,734	8	R 1,716,281
35	2046	306.4	R 66,679,694	32	R 6,871,711	15	R 3,314,875	7	R 1,620,611
36	2047	306.4	R 64,196,376	30	R 6,241,312	14	R 2,955,019	7	R 1,418,414
37	2048	306.4	R 65,208,876	28	R 5,980,896	13	R 2,779,283	6	R 1,309,805
38	2049	306.4	R 64,196,376	27	R 5,554,746	12	R 2,533,453	6	R 1,172,243
39	2050	306.4	R 70,563,281	25	R 5,760,054	11	R 2,578,441	5	R 1,171,368
40	2051	306.4	R 64,196,376	24	R 4,943,704	10	R 2,172,027	5	R 968,796
41	2052	306.4	R 64,196,376	22	R 4,663,871	10	R 2,011,136	4	R 880,724
42	2053	306.4	R 64,196,376	21	R 4,399,879	9	R 1,862,163	4	R 800,658
43	2054	306.4	R 64,196,376	20	R 4,150,829	8	R 1,724,225	3	R 727,871
44	2055	306.4	R 64,196,376	19	R 3,915,876	8	R 1,596,505	3	R 661,701
45	2056	306.4	R -738,663,498	18	R -42,506,881	7	R -17,009,150	3	R -6,921,577
	TOTAL	**10110.2**	**R 6,783,342,559**	**2011**	**R 3,422,712,415**	**1319**	**R 2,816,684,325**	**907**	**R 2,350,747,163**

URV					**R 1.70**		**R 2.14**		**R 2.59**

SCENARIO 2

(Excluding Phoenix WWTW)

SCENARIO 2 - Excl Phoenix WWTW

YEAR	ISITHUNDU DAM		NORTH COAST RE-USE (3XWWTW)		KWAMASHU WWTW TO HAZELM & INANDA		NORTHERN WWTW RE-USE		SPRING GROVE DAM		SMITHFIELD DAM	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007									60,977,198			
2008									60,977,198			
2009			3,834,024		9,522,470				68,812,418			
2010			21,788,057		53,042,664				79,119,021			
2011	41,786,938		17,954,033		43,520,194				87,518,570			
2012	49,871,938		0	2,298,246	0	3,772,092			0	3,922,854		
2013	226,926,508		0	2,298,246	0	4,057,964			0	4,355,262		
2014	177,054,570		0	2,298,246	6,019,260	4,316,171			0	4,658,445		
2015	276,393,810		0	2,298,246	62,820,060	4,445,274			0	4,951,688		
2016	333,810,997		0	2,298,246	56,800,800	4,445,274	10,323,840		0	5,254,871		
2017	0	12,858,639	0	2,298,246	0	6,201,772	103,076,480		0	5,563,024	282,511,663	
2018	0	13,194,280	0	2,298,246	0	8,086,588	86,032,000		0	5,563,024	555,666,629	
2019	0	13,436,689	0	2,298,246	0	8,992,278	0	4,997,132	0	5,563,024	1,093,302,452	
2020	0	13,679,097	0	2,298,246	0	8,992,278	0	7,223,964	0	5,563,024	1,217,944,256	
2021	0	13,996,092	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	16,453,817
2022	0	14,331,734	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	16,663,610
2023	0	14,592,788	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	16,873,404
2024	0	14,816,550	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	17,083,197
2025	0	15,021,664	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	17,292,990
2026	0	15,245,425	282,315	2,298,246	343,817	8,992,278	0	9,200,589	1,699,930	5,563,024	0	17,499,555
2027	0	15,450,540	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	17,689,983
2028	0	15,674,301	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	17,880,411
2029	0	15,898,062	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	18,074,066
2030	0	16,140,470	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	18,264,493
2031	1,542,098	16,364,232	0	2,298,246	941,220	8,992,278	0	9,200,589	0	5,563,024	0	18,454,921
2032	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	18,874,507
2033	0	16,364,232	0	2,298,246	0	8,992,278	1,012,500	9,200,589	0	5,563,024	0	19,126,259
2034	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	19,332,825
2035	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	6,366,905	19,536,163
2036	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	19,742,728
2037	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	19,949,294
2038	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	20,155,859
2039	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	20,359,197
2040	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	20,568,990
2041	0	16,364,232	282,315	2,298,246	343,817	8,992,278	0	9,200,589	1,699,930	5,563,024	0	20,772,328
2042	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	20,978,894
2043	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2044	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2045	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2046	1,542,098	16,364,232	0	2,298,246	941,220	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2047	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2048	0	16,364,232	0	2,298,246	0	8,992,278	1,012,500	9,200,589	0	5,563,024	0	21,117,680
2049	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2050	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	6,366,905	21,117,680
2051	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2052	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2053	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2054	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2055	0	16,364,232	0	2,298,246	0	8,992,278	0	9,200,589	0	5,563,024	0	21,117,680
2056	-123,385,673	16,364,232	0	2,298,246	-14,273,753	8,992,278	-31,495,305	9,200,589	0	5,563,024	-633,705,143	21,117,680
TOTAL	985,543,284	629,806,352	44,140,745	103,421,065	220,021,768	377,031,706	169,962,015	343,442,313	360,804,265	245,664,075	2,528,453,667	707,275,011

SCENARIO 2 - Excl Phoenix WWTW

YEAR	TOTAL ANNUAL COST		NET PRESENT COST (2007) AT 6%		NET PRESENT COST (2007) AT 8%		NET PRESENT COST (2007) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007	60,977,198		60,977,198	0	60,977,198	0	60,977,198	0
2008	60,977,198		57,525,659	0	56,460,369	0	55,433,816	0
2009	82,168,912		73,130,039	0	70,446,598	0	67,908,192	0
2010	153,949,742		129,259,172	0	122,210,269	0	115,664,720	0
2011	190,779,735		151,115,419	0	140,228,800	0	130,305,126	0
2012	49,871,938	9,993,192	37,267,213	7,467,494	33,942,003	6,801,198	30,966,550	6,204,986
2013	226,926,508	10,711,472	159,974,234	7,551,165	143,002,193	6,750,044	128,094,098	6,046,347
2014	183,073,830	11,272,862	121,754,553	7,497,097	106,821,821	6,577,607	93,945,822	5,784,761
2015	339,213,870	11,695,208	212,826,978	7,337,718	183,266,699	6,318,557	158,245,774	5,455,901
2016	400,935,637	11,998,391	237,313,187	7,101,829	200,567,638	6,002,183	170,035,849	5,088,489
2017	385,588,143	26,921,680	215,310,405	15,032,926	178,601,917	12,469,947	148,660,921	10,379,473
2018	641,698,629	29,142,138	338,038,833	15,351,715	275,213,543	12,498,563	224,911,455	10,214,142
2019	1,093,302,452	35,287,369	543,337,824	17,536,741	434,165,446	14,013,100	348,359,854	11,243,643
2020	1,217,944,256	37,756,608	571,019,794	17,701,771	447,835,575	13,883,027	352,795,067	10,936,745
2021	0	56,504,046	0	24,991,794	0	19,237,426	0	14,879,281
2022	0	57,049,481	0	23,804,755	0	17,984,376	0	13,657,192
2023	0	57,520,329	0	22,642,664	0	16,789,636	0	12,518,100
2024	0	57,953,884	0	21,522,010	0	15,663,135	0	11,465,867
2025	0	58,368,791	0	20,449,144	0	14,606,733	0	10,498,140
2026	2,326,062	58,799,118	768,794	19,433,874	538,977	13,624,465	380,330	9,614,126
2027	0	59,194,660	0	18,457,175	0	12,700,108	0	8,798,909
2028	0	59,608,849	0	17,534,265	0	11,841,640	0	8,054,978
2029	0	60,026,265	0	16,657,595	0	11,041,262	0	7,373,985
2030	0	60,459,101	0	15,828,027	0	10,297,109	0	6,751,961
2031	2,483,318	60,873,290	613,326	15,034,397	391,618	9,599,677	252,120	6,180,197
2032	0	61,292,876	0	14,281,156	0	8,949,857	0	5,657,087
2033	1,012,500	61,544,628	222,558	13,528,126	136,892	8,320,942	84,954	5,163,930
2034	0	61,751,194	0	12,805,219	0	7,730,435	0	4,710,238
2035	6,366,905	61,954,531	1,245,559	12,120,174	738,012	7,181,380	441,503	4,296,135
2036	0	62,161,097	0	11,472,249	0	6,671,596	0	3,918,599
2037	0	62,367,663	0	10,858,842	0	6,197,932	0	3,574,201
2038	0	62,574,228	0	10,278,120	0	5,757,833	0	3,260,035
2039	0	62,777,566	0	9,727,848	0	5,348,651	0	2,973,299
2040	0	62,987,359	0	9,207,884	0	4,969,005	0	2,712,032
2041	2,326,062	63,190,697	320,791	8,714,726	169,908	4,615,784	91,048	2,473,443
2042	0	63,397,263	0	8,248,315	0	4,287,845	0	2,255,935
2043	0	63,536,049	0	7,798,464	0	3,978,918	0	2,055,339
2044	0	63,536,049	0	7,357,041	0	3,684,183	0	1,868,490
2045	0	63,536,049	0	6,940,605	0	3,411,281	0	1,698,628
2046	2,483,318	63,536,049	255,920	6,547,740	123,454	3,158,594	60,356	1,544,207
2047	0	63,536,049	0	6,177,114	0	2,924,624	0	1,403,824
2048	1,012,500	63,536,049	92,866	5,827,466	43,154	2,707,985	20,337	1,276,204
2049	0	63,536,049	0	5,497,609	0	2,507,393	0	1,160,185
2050	6,366,905	63,536,049	519,728	5,186,424	232,652	2,321,661	105,692	1,054,714
2051	0	63,536,049	0	4,892,853	0	2,149,686	0	958,831
2052	0	63,536,049	0	4,615,899	0	1,990,450	0	871,665
2053	0	63,536,049	0	4,354,621	0	1,843,009	0	792,422
2054	0	63,536,049	0	4,108,133	0	1,706,490	0	720,384
2055	0	63,536,049	0	3,875,598	0	1,580,083	0	654,894
2056	-802,859,874	63,536,049	-46,201,104	3,656,224	-18,487,396	1,463,040	-7,523,123	595,359
TOTAL	**4,308,925,743**	**2,406,640,522**	**2,866,688,944**	**517,012,605**	**2,437,627,339**	**344,158,453**	**2,080,217,658**	**238,797,301**

PROJECT: KWAZULU NATAL WATER RECONCILIATION STRATEGY STUDY
OPTION: SCENARIO 2 - Excl Phoenix WWTW
DATE: SEP 2007

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES

	Year	Net Demand	Total annual costs	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
		Mm³/a	(excl VAT)	Demand	Costs	Demand	Costs	Demand	Costs
	2000								
	2001								
	2002								
	2003								
	2004								
	2005								
	2006								
	2007		R 60,977,198	0	R 60,977,198	0	R 60,977,198	0	R 60,977,198
	2008		R 60,977,198	0	R 57,525,659	0	R 56,460,369	0	R 55,433,816
	2009		R 82,168,912	0	R 73,130,039	0	R 70,446,598	0	R 67,908,192
	2010		R 153,949,742	0	R 129,259,172	0	R 122,210,269	0	R 115,664,720
	2011		R 190,779,735	0	R 151,115,419	0	R 140,228,800	0	R 130,305,126
1	2012	35.0	R 59,865,129	26	R 44,734,707	24	R 40,743,201	22	R 37,171,535
2	2013	46.8	R 237,637,980	33	R 167,525,399	29	R 149,752,237	26	R 134,140,444
3	2014	55.7	R 194,346,692	37	R 129,251,650	33	R 113,399,428	29	R 99,730,583
4	2015	63.0	R 350,909,078	40	R 220,164,697	34	R 189,585,256	29	R 163,701,675
5	2016	69.1	R 412,936,044	41	R 244,415,017	35	R 206,569,821	29	R 175,124,338
6	2017	104.4	R 412,509,823	58	R 230,343,331	48	R 191,071,864	40	R 159,040,394
7	2018	113.9	R 670,840,767	60	R 353,390,548	49	R 287,712,106	40	R 235,125,596
8	2019	121.8	R 1,128,589,821	61	R 560,874,565	48	R 448,178,546	39	R 359,603,498
9	2020	132.0	R 1,255,700,864	62	R 588,721,565	49	R 461,718,602	38	R 363,731,812
10	2021	144.1	R 56,504,046	64	R 24,991,794	49	R 19,237,426	38	R 14,879,281
11	2022	152.4	R 57,049,481	64	R 23,804,755	48	R 17,984,376	36	R 13,657,192
12	2023	160.3	R 57,520,329	63	R 22,642,664	47	R 16,789,636	35	R 12,518,100
13	2024	168.0	R 57,953,884	62	R 21,522,010	45	R 15,663,135	33	R 11,465,867
14	2025	175.6	R 58,368,791	62	R 20,449,144	44	R 14,606,733	32	R 10,498,140
15	2026	183.2	R 61,125,180	61	R 20,202,667	42	R 14,163,442	30	R 9,994,455
16	2027	190.2	R 59,194,660	59	R 18,457,175	41	R 12,700,108	28	R 8,798,909
17	2028	197.3	R 59,608,849	58	R 17,534,265	39	R 11,841,640	27	R 8,054,978
18	2029	204.5	R 60,026,265	57	R 16,657,595	38	R 11,041,262	25	R 7,373,985
19	2030	211.7	R 60,459,101	55	R 15,828,027	36	R 10,297,109	24	R 6,751,961
20	2031	218.8	R 63,356,608	54	R 15,647,723	35	R 9,991,295	22	R 6,432,318
21	2032	231.8	R 61,292,876	54	R 14,281,156	34	R 8,949,857	21	R 5,657,087
22	2033	239.6	R 62,557,128	53	R 13,750,684	32	R 8,457,834	20	R 5,248,884
23	2034	246.0	R 61,751,194	51	R 12,805,219	31	R 7,730,435	19	R 4,710,238
24	2035	252.3	R 68,321,437	49	R 13,365,732	29	R 7,919,392	17	R 4,737,637
25	2036	258.7	R 62,161,097	48	R 11,472,249	28	R 6,671,596	16	R 3,918,599
26	2037	265.1	R 62,367,663	46	R 10,858,842	26	R 6,197,932	15	R 3,574,201
27	2038	271.5	R 62,574,228	45	R 10,278,120	25	R 5,757,833	14	R 3,260,035
28	2039	277.8	R 62,777,566	43	R 9,727,848	24	R 5,348,651	13	R 2,973,299
29	2040	284.3	R 62,987,359	42	R 9,207,884	22	R 4,969,005	12	R 2,712,032
30	2041	290.6	R 65,516,759	40	R 9,035,517	21	R 4,785,692	11	R 2,564,491
31	2042	297.0	R 63,397,263	39	R 8,248,315	20	R 4,287,845	11	R 2,255,935
32	2043	301.3	R 63,536,049	37	R 7,798,464	19	R 3,978,918	10	R 2,055,339
33	2044	301.3	R 63,536,049	35	R 7,357,041	17	R 3,684,183	9	R 1,868,490
34	2045	301.3	R 63,536,049	33	R 6,940,605	16	R 3,411,281	8	R 1,698,628
35	2046	301.3	R 66,019,367	31	R 6,803,660	15	R 3,282,048	7	R 1,604,562
36	2047	301.3	R 63,536,049	29	R 6,177,114	14	R 2,924,624	7	R 1,403,824
37	2048	301.3	R 64,548,549	28	R 5,920,331	13	R 2,751,139	6	R 1,296,541
38	2049	301.3	R 63,536,049	26	R 5,497,609	12	R 2,507,393	6	R 1,160,185
39	2050	301.3	R 69,902,954	25	R 5,706,152	11	R 2,554,313	5	R 1,160,406
40	2051	301.3	R 63,536,049	23	R 4,892,853	10	R 2,149,686	5	R 958,831
41	2052	301.3	R 63,536,049	22	R 4,615,899	9	R 1,990,450	4	R 871,665
42	2053	301.3	R 63,536,049	21	R 4,354,621	9	R 1,843,009	4	R 792,422
43	2054	301.3	R 63,536,049	19	R 4,108,133	8	R 1,706,490	3	R 720,384
44	2055	301.3	R 63,536,049	18	R 3,875,598	7	R 1,580,083	3	R 654,894
45	2056	301.3	R -739,323,825	17	R -42,544,880	7	R -17,024,356	3	R -6,927,765
	TOTAL	**9880.7**	**R 6,715,568,282**	**1949**	**R 3,383,701,549**	**1273**	**R 2,781,785,792**	**872**	**R 2,319,014,958**

URV					**R 1.74**		**R 2.18**		**R 2.66**