5. ALTERNATIVES

One of the objectives of an EIA is to avoid and minimise negative impacts where-ever possible. The primary tool for avoiding impacts is to consider alternatives. An alternative is a possible course of action, in place of another, that would generally meet the same purpose and need defined by the development proposal but which would avoid or minimize negative impacts or enhance project benefits.

Alternatives must be practical, feasible, relevant, reasonable and viable. They can be in terms of:

- Activity (project) alternatives (e.g. incineration rather than landfill);
- Location;
- Scheduling (Timing);
- Technology (Process);
- Design;
- Different use of land;
- Demand;
- Inputs; or
- Routing.

It is also a requirement of the Regulations that the “No-go”/“Do nothing” option be comparatively assessed.

Previous investigations done in the feasibility phase of the project assessed alternative dam sites for the project. These assessments have been reviewed, are summarised in section 5.2 and are considered adequate for the EIA requirements. Further studies on alternative dam sites will therefore not be undertaken in the impact assessment phase of this study. Project level alternatives that have been considered are discussed in section 5.3.

5.1 A DIFFERENT ACTIVITY THAT ACHIEVES THE SAME OBJECTIVE AS THE PROJECT

This project involves spending money on the development of water related infrastructure in order to stimulate social and economic development in the study area by providing water for domestic, industrial and agricultural use as well as by creating jobs directly associated with the construction and operation of the project. Additional knock on and downstream activities also generate jobs and income to the area.

An activity alternative would be to consider different uses for the same financial investment that could improve the quality of life and generate an equivalent number of jobs and income to the area.

As the applicant for this project is the Department of Water Affairs who has a mandate to develop water resources infrastructure and not to implement development projects of a different nature, it is not feasible to investigate such alternatives. The EIA will however investigate the economic development plans of the Eastern Cape Provincial Government and review the proposed project against this framework.

5.2 DAM SITE ALTERNATIVES

Location alternatives would be building the dam/s at a different site. The following information was extracted from the *Feasibility Study for the Mzimvubu Water Project* (DWA, 2013c).

5.2.1 Introduction

Alternative dam sites, which included 20 sites, were identified and assessed through focussed and detailed investigations and feasibility level analyses in order to determine the most promising and cost beneficial options **(Figure 19)**.

The following 20 dam sites were identified:

- Dam 2 and Siqingeni in the Upper Mzimvubu River;
- Bokspruit, Luzi and Dam B in the Mzintlava River;
- Thabeng, Somabadi and Ntlabeni in the Kinira River;
- Pitseng, Hlabakazi, Mpindweni, Mangwaneni and Ku-Mdyobe in the Tina River;
- Nomhala, Ntabelanga, Malepelepe, Laleni and Gongo in the Tsitsa River; and
- Mbokazi in the Mzimvubu River.

These sites underwent a dam site screening process based on the following set of criteria:

- Capital cost;
- Megawatts produced;
- Agriculture potential (irrigation);
- Forestry potential;
- Population to be served;
- Accessibility / proximity to main transport infrastructure; and
- Potential use of dams in long term water transfer schemes.

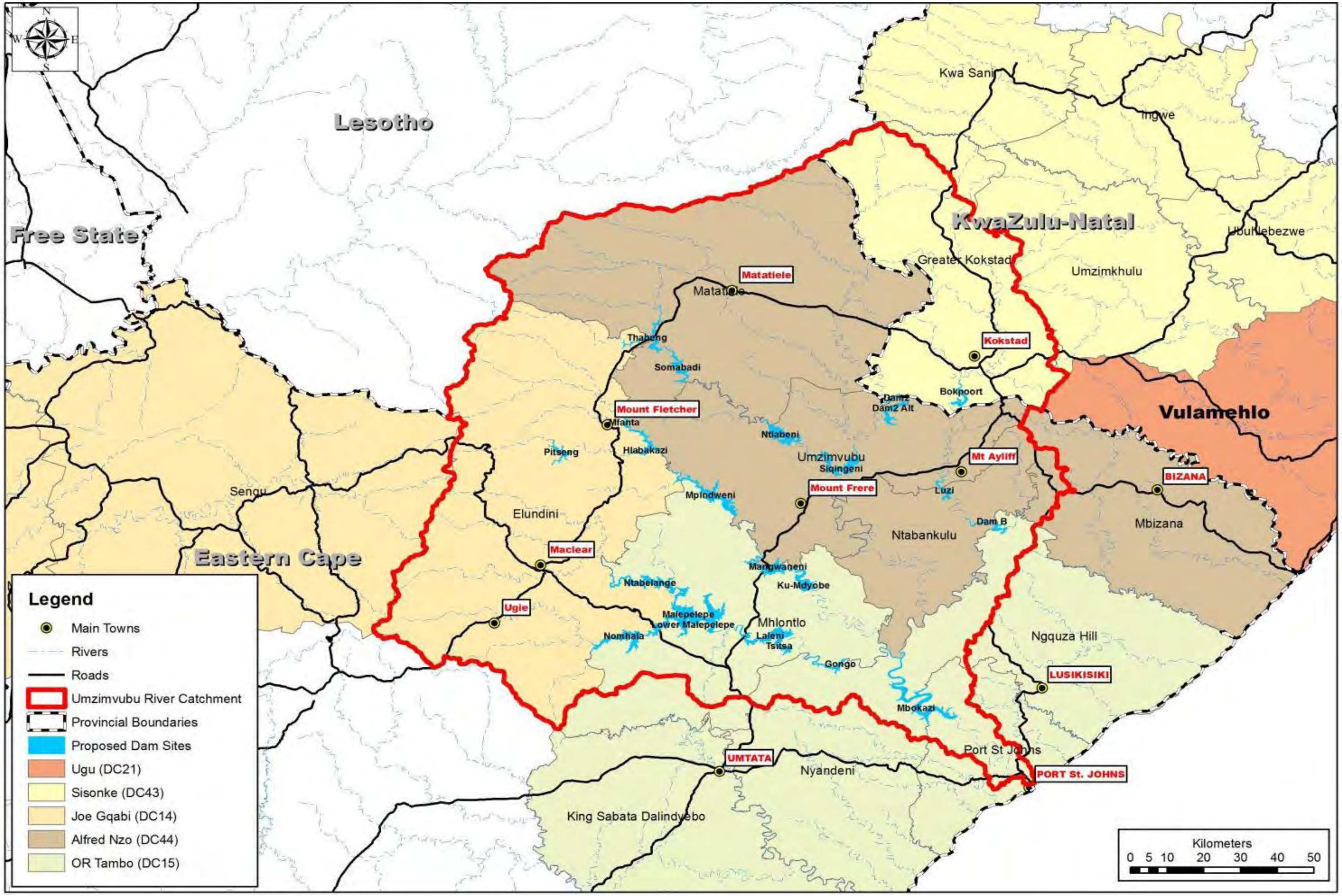

Figure 19: 20 potential dam sites identified in the feasibility study

5.2.2 Dam Site Screening and Selection Process

The three most suitable dam sites were identified and underwent further investigation. The criteria used in order to facilitate the selection of these sites covered technical, economic, social and environmental considerations and included the following:

- **Technical and Economic Considerations**
  - Yield – net (effective) The amount of water that the dam can store for beneficial use;
  - Capital cost;
  - Unit Reference Value (URV) – the relative cost of water produced;
  - Accessibility;
  - Hydropower potential (capex/MW);
  - Sedimentation; and
  - Forestry potential;

- **Environmental and Social Considerations**
  - Potential for irrigated agriculture;
  - Potential for domestic water supply;
  - Environmental impacts; and
  - Job creation.

Although the potential for the proposed dams to transfer water to other catchments was considered, it was decided to not include this as a selection criterion because this would be very expensive and is highly unlikely.

Additional desktop studies including Environmental Screening were undertaken for each of the potential dam sites, resulting in scored rankings of the development options.

The highest ranked three dams taken forward for further investigation included (**Figure 20**):

- Ntabelanga Dam on the Tsitsa River;
- Thabeng Dam on the Kinira River; and
- Somabadi Dam on the Kinira River.

Figure 20: Highest ranked dam sites from phase one of the feasibility study

5.2.3 Preliminary Study

A preliminary Study was done to gather more information with regard to the three selected potential dam development projects. The Eastern Cape Provincial Government as well as key stakeholders were involved in the process of selecting the single best dam development scheme to be taken forward into the next, feasibility, phase, of the study.

The main activities undertaken included:

- Stakeholder involvement;
- Environmental screening;
- Water requirements (including domestic water supply, irrigation and hydropower);
- Hydrological investigations;
- Geotechnical investigations; and
- Topographical survey investigations.

In order to improve the accuracy of information required to estimate costs and to check for any fatal flaws that might be present as regards dam wall foundation conditions, the following studies were conducted:

- Core drilling beneath each embankment wall flank of all three shortlisted dam sites;

- Topographical surveys of the impoundment areas of all three dams; and
- Water resources yield assessment (detailed hydrology and yield modelling).

Various organisations from different sectors were contacted in order to obtain information related to previous investigations as well as to obtain other relevant information that would be useful in the analysis that was required to be undertaken.

The types of information collected from the various organisations were as follows:
- Spatial data sets relating to water services planning, population, agricultural potential and existing infrastructure;
- Previous related studies undertaken in the Mzimvubu River catchment including obtaining of reports and hydrological and financial models; and
- Climatological, stream flow and rainfall data.

This data was supplemented by fieldwork where it was considered necessary to enhance the various tasks undertaken during this preliminary analysis.

5.2.4 Environmental Screening

The initially identified potential dam sites (20) underwent a selection process based on ecological and environmental considerations. A suite of tools were used to determine the potential impacts of each of the proposed dams on the rivers concerned. Sites were assessed in terms of:
- The Present Ecological State (PES) of the river;
- The Ecological Importance and Sensitivity (EIS) of the river;
- The National Freshwater Ecosystem Priority Area (NFEPA) status of the river;
- The NFEPA status of the wetlands in the system;
- The proximities of the dams to estuaries; and
- The conservation status of the vegetation types concerned (based on Mucina and Rutherford).

The data was processed and analysed and it was found that none of the 20 potential dam sites were considered to have fatal flaws in terms of environmental impacts. Some of the sites had more severe impact ratings than others, and this was taken into consideration into the multi-criteria decision making process used in the Desktop Study stage. The results were as follows:
- Six sites had PES scores that were a “B” or higher;
- Nine sites had an EIS of “high”;
- One site had an estuary in its proximity;
- Nine sites were likely to inundate, or were upstream of an NFEPA wetland;
- Twelve sites inundated or were upstream of an NFEPA river 1 or 2; and
- Thirteen sites occurred in vegetation types with conservation statuses of “vulnerable” or higher, of which three were classified as “endangered”.

During the environmental screening phase it was found that there were no obvious fatal flaws with regards to the potential impacts of the three shortlisted dams on the estuary, given that:

- The three dams were located relatively high up in the Mzimvubu Catchment, and were each a significant distance from the estuary mouth, which distance significantly reduces the impact on the estuary; and
- The volume of river flow actually to be abstracted, the interference with the natural flow regime, and the sediment trapped, by each dam, is relatively small compared with the overall mean annual runoff and sediment transported to the estuary by the main Mzimvubu River catchment in total.

5.2.5 Reserve Determination

An analysis on the reserve requirements were undertaken in the system and the Kinira River at Thabeng and Somabadi was classified as Class C and the Tsitsa River at Ntabelanga as Class D for Ecological Water Requirements (EWR) determination purposes. These EWR values were then built into the yield modelling as a demand on the system to be drawn before other water requirements are applied.

5.2.6 Topographical Survey

A topographical survey was conducted and included the use of existing information i.e. 1:50 000 mapping with contours at 20 m intervals.

During the initial phase the survey was focussed on the potential inundated land areas above each of the three dam sites, and was undertaken using LiDAR aerial survey methods which produced high resolution imagery and digital terrain models, the latter having an accuracy of a few centimetres and 0.5 m contour intervals.

5.2.7 Geotechnical Investigations (Drilling)

Geotechnical investigations comprised the core drilling of boreholes (40 m deep), one on each flank of each proposed dam wall centreline.

<u>Ntabelanga Dam site:</u> The geotechnical reconnaissance assessments and subsequent drilling at the Ntabelanga Dam site did not identify fatal flaws in the context of geological or geotechnical constraints. The site occupies a steep sided, U-shaped valley profile with a low length to height ratio. There is good founding on dolerite and construction materials appear to be readily available in the basin within relatively short haulage distances.

Conversely, the steep valley sides have proved difficult to access the site for investigation purposes. The left hand side river bank a few hundred metres upstream of the dam show evidence of past sliding, which could be exacerbated during dam filling.

Whilst not appearing to represent an overly onerous constraint to overall stability, these will be further assessed should this site be selected for further detailed investigation. The dam would bring about inundation of roads and agriculture in the basin.

Thabeng Dam site: The investigations undertaken at the Thabeng Dam site did not detect any fatal flaws that would preclude the construction of a dam at this site. The valley sides are particularly steep and whilst this is conducive to a good area to storage ratio it renders mechanical access difficult. The site offers good founding and cut-off conditions, mainly on dolerite and also sedimentary rocks on the left flank.

From the initial assessment undertaken, no good sources of core or rock aggregate were identified in the basin, but these appear to occur in abundance a relatively short distance downstream of the site.

As such areas would not be inundated following completion of the dam their exploitation would incur more stringent environmental and rehabilitation restrictions. A dam at this site would inundate some major infrastructural developments, including roads, pipelines and a water treatment works.

Somabadi Dam Site: The investigations undertaken at the Somabadi Dam Site found no fatal flaws and there is good founding on sandstone. The site occupies a steep U-shaped valley, which is particularly steep on the right flank. Construction materials appear to occur in abundance within relatively short haulage distances of the site.

Vehicular and plant access along the dam axis is made difficult by the steep valley sides. Inundation of roads and cultivated areas would occur in the basin. The pronounced bedding of the sandstone could lead to increased grout takes during grouting of the foundation.

5.2.8 Water Resources Analysis

A detailed hydrological yield analysis was undertaken for the three potential dam sites which involved updating flow and rainfall records, as well as investigating the topography and land usage in the catchment areas. This provided up to date data to build, calibrate, and run yield models (WRYM) for each of the three dam sites.

It was noted that the resulting figures for Mean Annual Runoff (MAR) for all three sites were less than had been produced in previous studies. These new figures have been produced using much more detailed analyses and were considered appropriate to be used for further analyses. Sedimentation rates in each catchment were also reviewed, taking into consideration the land use information gathered, as well as taking cognisance of the recently updated Rooseboom sediment yield mapping of

South Africa. Estimated volumes of sediment trapped by each dam over 50 years were produced for use in the yield modelling.

Following the undertaking of the new topographical surveys, updated water depth verses volume curves were developed to improve the accuracy of the yield models over those run in previous studies.

It can be observed that the Ntabelanga Dam has the highest Yield verses Volume characteristic of the three dams. This does not mean that Ntabelanga is the best dam *per se*, as such comparisons should, inter alia, be based upon the economic aspects including unit cost of water produced.

Following this analysis, the raw water requirements were compared with the yields produced by this range of dam sizes. These were used to match dam size to water requirements, and the costs for each dam size were used in the determination of the URV of raw water produced by each of the various dam options.

The hydropower module of the WRYM model was also used to determine reliable power outputs for each of the dam options investigated.

5.2.9 Water Requirements

The water requirements and potential developments from each of the three recommended dam developments were investigated at a preliminary level. This included domestic requirements, irrigation potential, afforestation potential, riverine and estuarine Reserve requirements, as well as hydropower potential.

The water requirements planning area of each dam included all communities located within the watershed limits adjacent to and below each dam, and extending downstream.

5.2.10 Domestic Water Requirements

The following water demand scenarios were investigated:

- A BASE case supplying only those communities within a 180 m elevation of the river; and
- A HIGH scenario supplying all communities within the full watershed boundary as well as a 15% allowance for supplying additional settlements outside the watershed.

In order to determine the overall potable water demand, the populations to be served and their areal distribution as well as per capita consumption and population growth rates were determined.

5.2.11 Water for Irrigated Agriculture

The soil potential and water stress coverages were defined and located using a geographic information system (GIS), and then further analysed initially to create a BASE water demand scenario. This was undertaken for all of the original potential dam sites.

It was found that only five dams had any appreciable land area that met the identified criteria, these being Somabadi, Thabeng, Pitseng, Ntabelanga and Nomhala.

When combined with other non-agricultural criteria in a ranking matrix, the three highest ranked dams that emerged for further consideration and study were Somabadi, Thabeng, and Ntabelanga. This coincidentally reinforced the decision made to shortlist these three particular dams. The further ground-truthing of these three Dam Sites took place during a site visit to ensure that decisions in Phase 1 were being made on reliable and accurate information and to correlate physical observations with the desktop mapping.

An Initial Screening Process was undertaken to evaluate the irrigation potential of the three candidate dams seeing that it was important to objectively quantify those factors that would contribute to development of a commercially viable irrigation farm.

The three dam sites were evaluated using the following criteria:

- High potential soils;
- Slope < 12%;
- Elevation < 60 m above the river at the dam site, or in the river below the dam site;
- Distance < 5 km from the dam wall or either side of the river below the dam site; and
- Water deficit – medium to high water stress (shortage of natural rainfall).

It was found that:

- 15% of the land area, or 310 400 ha, was identified as being in the higher potential soil category;
- 69% of the land area, or 1 370 876 ha, is identified as having high or medium water stress.

Although Ntabelanga presented the preferred potential for irrigation out of the three study areas with 504 ha of land having good irrigation capability, the area appears segmented by wetlands resulting in an irrigable extent that is not contiguous.

Somabadi presents 1,062 ha of land suitable for irrigation that is fairly contiguous, but has moderate to good irrigation capability presenting slightly reduced growth rates for most crops.

Thabeng (same study area as Somabadi plus low lying land) has a greater proportion on land unsuited to irrigation.

It is thus evident that Ntabelanga would be the first choice as an option for the irrigation development provided additional suitable land for the irrigation development can be found adjacent to the current study area.

5.2.12 Combined Water Demand Projections

In order to determine and compare the dam size and safe yield required for each option, the total raw water demand projections to the year 2050 listed in **Figure 21** were used:

	TOTAL POTABLE WATER DEMAND		IRRIGATION WATER DEMAND (incl 20% losses)		GRAND TOTAL WATER DEMAND	
	BASE	HIGH	BASE	HIGH	BASE	HIGH
	million m^3/a		million m^3/a		million m^3/a	
NTABELANGA	5.71	10.91	2.12	11.06	7.83	21.97
THABENG	4.73	14.38	4.46	9.24	9.19	23.62
SOMABADI	4.13	13.35	4.46	8.12	8.59	21.47

Figure 21: Combined Water Requirements Used for Comparative Analyses

5.2.13 Comparison of Water Requirements with Dam Size Required

It was noted that, in all three cases, the "minimum" sized dam – i.e. one that has a capacity volume equal to the sedimentation volume allowance plus about 10% to 15% - produced a sufficiently reliable yield to supply even the HIGH scenario water demand projections. This is shown in **Figure 22**.

	GRAND TOTAL WATER DEMAND		98% Reliable Dam Yield	EWR	DAM SIZE (GROSS VOLUME INCLUDING SEDIMENT ALLOWANCE)		Dam FSL Water Depth	ESTIMATED CONT. HYDROPOWER THAT CAN BE GENERATED		ESTIMATED MAX PUMPING POWER NEEDED	
	BASE	HIGH						BASE	HIGH	BASE	HIGH
	million m^3/a		million m3/a	million m3/a	MAR x	million m^3	m	MW	MW	MW	MW
NTABELANGA	7.83	21.97	26.80	52.82	0.10	33.00	31.00	0.27	0.27	0.61	1.71
THABENG	9.19	23.62	24.80	84.33	0.20	58.00	33.00	0.35	0.35	0.72	1.84
SOMABADI	8.59	21.47	21.32	104.98	0.15	54.15	44.53	0.40	0.40	0.67	1.67

Shows that each "minimum" sized dam can reliably supply HIGH scenario demand as well as meeting EWR requirements

Figure 22: Size Statistics on the Three Dams

5.2.14 Hydropower Potential

Each dam was assessed to ascertain the amount of reliable (continuous) hydropower that could be generated if a hydropower station were to be built immediately downstream of, or within, each dam wall, with average dam yield released through the turbines at 67% of the maximum head of the dam water depth.

Results indicated that for the “minimum”-sized dams, this output would range from 0.27 to 0.40 MW for the three dams.

Estimations made as to how much power would be required to transfer and treat the raw water and to pump potable water into the systems served by each dam showed that the power requirements for these bulk water supply systems totalled between 0.61 to 0.72 MW for the BASE demand case, to 1.67 to 1.84 MW for the HIGH scenario.

Clearly the requirements for a self-sufficient “hydro-powered” scheme cannot be met by these “minimum” dam sizes.

An analysis was therefore also undertaken to see how much larger/higher the three dams would need to be built to be able to generate the bulk water system power requirements given above. The incremental cost of raising the dam walls and installing hydropower plant for this latter scenario was thus calculated and included in the economic analyses described below.

5.2.15 Economic Comparison of the Three Dam Site Options

Capital cost estimates, prepared for each of the three dam sites, were carried out so that a discounted cash flow analysis could be undertaken to compare the Unit Reference Value (URV) of water supplied by each of the three dams.

Calculating capital costs for the three dams and for various dam sizes enabled a “costing curve” to be produced for the given ranges of dam sizes, which was converted into a dam volume verses cost look-up table on the economic analyses models.

Results show that the Ntabelanga Dam has a lower cost per million m^3 stored than the other two dam options.

Similar costings were derived for hydropower plants and associated infrastructure using various sources. Scenarios were investigated firstly for dams that supplied raw water only to meet potable and irrigation demands, with no hydropower component. The results showed that the Ntabelanga Dam has the lowest URV of water supplied and that URVs for the BASE demand scenario are high for all dams

In addition to the water-supply only case above, a further analysis was undertaken to investigate the incremental cost of upsizing these three dam options so that the dams and the water delivery infrastructure supplied by them could be self-sufficient in energy requirements by hydropower generation at each dam and distribution of the power produced into the supply zone.

Results showed that the levelized cost of power produced is in the range of R 3 245/MWh to R 4 917/MWh, which is very high considering that current bench marking of what are considered to be viable schemes is normally at the R 1 000/MWh level.

It was therefore not considered to be a viable option to include hydropower generation if only a single "minimum-sized" dam solution is selected for further consideration.

5.2.16 Other Considerations for the Selection of a Single Dam Site

The criteria used to compare the three dams included the following:

- Populations Served;
- Land Requirements;
- Irrigation Opportunities;
- Job Creation Opportunities;
- Impacts on Existing Infrastructure;
- Other Regional Water Supply Schemes Existing or Planned ; and
- Ability to Work Conjunctively with Other Major Schemes.

Summary of Analyses and Decision Making Criteria

The "traffic light" colour coding method used in **Tables 6, 7 and 8** show the simple ranking of the economic criteria between the three dams. No differential weighting was applied to these criteria as this requires qualitative rather than quantitative analysis to be undertaken, which can artificially skew results.

Table 6: Comparison of Dams by Numerical & Economic Analyses – Base Demand Case (DWA, 2013c)

BASE CASE CRITERIA			
NUMBERS AND ECONOMICS	**NTABELANGA**	**THABENG**	**SOMABADI**
POPULATION SERVED FOR THIS SCENARIO	134 633	111 564	97 303
TOTAL POPULATION WITHIN 50KM OF DAM	223 686	94 666	116 337
IRRIGATABLE AREAS WITHIN LIMITS SET (ha)	504	1062	1062
COST OF DAM FOR WATER SUPPLY ONLY (R' million)	386	489	500
TOTAL DEMAND SUPPLIED (million m^3/a)	7.83	9.19	8.59
TOTAL WATER AVAILABLE @ 98% (million m^3/a) (minimum dam)	26.80	24.80	21.32
URV OF RAW WATER SUPPLIED (NO HYDROPOWER) (R/m^3)	6.79	8.58	7.34
IS THE ABOVE DAM SELF-SUFFICIENT FOR HYDROPOWER?	NO	NO	NO
INCREMENTAL COST OF RAISING DAM AND HYDRO-PLANT (R' million)	219	278	270
LEVELIZED COST OF ENERGY PRODUCED BY RAISING DAM (R/MWh)	4 334	4 690	4 917

Table 7: Comparison of Dams by Numerical & Economic Analyses – High Demand Case (DWA, 2013c)

HIGH CASE CRITERIA			
NUMBERS AND ECONOMICS	**NTABELANGA**	**THABENG**	**SOMABADI**
POPULATION SERVED FOR THIS SCENARIO	**223 686**	**294 784**	**273 743**
TOTAL POPULATION WITHIN 50KM OF DAM	**223 686**	**94 666**	**116 337**
IRRIGATABLE AREAS WITHIN LIMITS SET (ha)	**2 634**	**2 200**	**1 933**
COST OF DAM FOR WATER SUPPLY ONLY (R' million)	**386**	**489**	**500**
TOTAL DEMAND SUPPLIED (million m^3/a)	**21.97**	**23.62**	**21.47**
TOTAL WATER AVAILABLE @ 98% (million m^3/a) (minimum dam)	**26.80**	**24.80**	**21.32**
URV OF RAW WATER SUPPLIED (NO HYDROPOWER) (R/m^3)	**2.37**	**2.99**	**2.88**
IS THE ABOVE DAM SELF-SUFFICIENT FOR HYDROPOWER?	**NO**	**NO**	**NO**
INCREMENTAL COST OF RAISING DAM AND HYDRO-PLANT (R' million)	**474**	**534**	**656**
LEVELIZED COST OF ENERGY PRODUCED BY RAISING DAM (R/MWh)	**3 245**	**3 418**	**4 777**

Table 8: Comparison of Dams Based on Other Criteria – Both Demand Cases (DWA, 2013c)

OTHER CRITERIA (ENVIRONMENTAL/RESETTLEMENT, JOBS, ETC.)	NTABELANGA	THABENG	SOMABADI
AREA OF LAND INUNDATED (km^2) – NO HYDROPOWER	**7.5**	**7.8**	**5.8**
IMPACTS EXISTING NAT'L ROAD AND OTHER INFRASTRUCTURE?	**LOWER**	**HIGH**	**MODERATE**
OTHER REGIONAL SCHEMES & SOURCES EXISTING /PLANNED?	**YES**	**YES**	**YES**
ABLE TO WORK CONJUNCTIVELY WITH OTHER MAJOR SCHEMES?	**YES**	**NO**	**NO**
SANBI ECOSYSTEM RISK ASSESSMENT RESULTS (CATCHMENTS)	**LOWER**	**HIGHER**	**HIGHER**
JOB CREATION (ESTIMATED NOS. INCL. CATCHMENT MANG'T)			
TEMPORARY DURING CONSTRUCTION	**200 to 300**	**200 to 300**	**200 to 300**
PERMANENT WS OPERATIONAL STAFF	**30 to 50**	**30 to 50**	**30 to 50**
PERMANENT ON IRRIGATED AGRICULTURE SCHEMES (BASE CASE)	**50**	**106**	**106**
PERMANENT ON IRRIGATED AGRICULTURE SCHEMES (HIGH CASE)	**263**	**220**	**193**

Whilst these other criteria show close rankings between the three dams, the Ntabelanga Dam in general scored more green and amber than the other two dams, and the significance of the Ntabelanga Dam being the only scheme able to work conjunctively with the potential Laleni hydropower scheme made it particularly stand out above the other two dams.

Additional Alternative Option for the Ntabelanga Dam

An alternative option for the Ntabelanga Dam was assessed. This involved the Ntabelanga Dam to be built conjunctively with a hydropower scheme downstream on the same river, comprising a new dam at Laleni, located close to and above the Tsitsa falls.

Preliminary analyses undertaken to date, indicates that there could be economies of scale and other cost-benefits by constructing a "large" Ntabelanga Dam to regulate flow to a "small" Laleni Dam, and thence through the hydropower scheme tunnel and powerhouse.

Additional hydrological models were therefore run to investigate two options:

a) A stand-alone Laleni Dam scheme with dam size 0.7 × MAR. This scheme could potentially produce some 35 MW continuous output (and possibly up to 180 MW peaking power at a load factor of 15%); and
b) Using a raised Ntabelanga Dam (1.5 × MAR) conjunctively with a small Laleni Dam (0.18 × MAR). This scheme could potentially produce some 35 MW continuous output at Laleni and a further 2 MW continuous at Ntabelanga (again possibly up to 180 MW peaking power at the same load factor).

High level cost estimations were undertaken, and the incremental cost of implementing the conjunctive scheme over and above building the basic Ntabelanga Dam for water supply only were calculated.

It was found that the conjunctive scheme could produce major cost benefits, including potentially significant surplus revenues emanating from energy sales. The hydropower generation potential of the scheme might also attract private sector interest which could result in a lower requirement for capital financing sourced from the Treasury.

5.2.17 Conclusion

The Ntabelanga Dam site was identified as the preferred site for the following reasons:

- From an economic perspective the Ntabelanga Dam is clearly the highest ranked option, having the lowest capital cost and lowest URV of water produced for all configurations considered above. (It should be noted though that the URV's of raw water produced by all three dams (of "minimum size") are high if only potable and irrigation water requirements are taken into consideration); and
- The additional benefit that the Ntabelanga Dam has over the other two options is that it is well located so that it can be developed to work conjunctively and cost-beneficially with a potential large hydropower scheme on the same river.

It was found that a stand-alone dam at Ntabelanga on the Tsitsa River to supply potable and irrigation water requirements only would be unlikely to be economically viable, but if developed conjunctively with the potential Laleni/Tsitsa falls hydropower scheme, could deliver a viable solution meeting the multi-purpose social and economic upliftment objectives of the scheme.

As dam site alternatives have already been investigated, and as the site selection process included environmental and social criteria, only the preferred dam sites (i.e. Ntabelanga and Laleni) will be investigated in the EIA.

5.2.18 Alternative site for hydropower generation

Eskom considered the Mbokazi site, on the Mzimvubu River, for hydropower generation. The Mbokazi hydropower project was discarded, mainly because of its potential environmental impact (i.e. concerns about the riverine and estuarine ecology) (DWA, 2013c and DWAF, 2005).

No alternative dam sites will be assessed in the Impact Assessment phase of the project.

5.3 PROJECT LEVEL ALTERNATIVES

5.3.1 Hydropower

This section is based on the Mike Muller report to the ECSECC. One option for hydro power would be to engage with an Independent Power Producer to undertake this element of the programme. There is an ongoing process led by the Department of Energy to procure new renewable power supplies from Independent Power Producers (REIPP). The Mzimvubu Water Project hydropower proposal could be developed to a standard that could be submitted through this process. However, this approach may not take full advantage of the potential of the site since the hydro allocations in the REIPPP are quite restrictive. There is an upper cap of 40 MW on small hydro projects and 150 MW has already been procured with just 120 MW still available in the next two windows.

A second option would be for ESKOM, as the country’s major power producer and distributor to be requested to undertake the development of the hydropower component of the project. However, it has previously been investigated by ESKOM and its relatively small scale makes it unlikely to be prioritised.

The final option would be for DWA, TCTA or an Mzimvubu Development Programme Implementing Agency to undertake the development and to liaise directly with the DoE, the electricity regulator and ESKOM as the power purchaser.

For the longer term it is noted that the largest hydropower site in the Mzimvubu basin (Mbokazi), which could make a significant contribution to the national grid (over 500 MW peak supply) was rejected in this round of project selection. This was due to the limited agricultural and water supply benefits as well as to perceived environmental sensitivities that would need to be addressed to enable its construction.

Both base load and peak load hydropower generation are being considered at the Laleni Dam. In order to generate peak power, the design will have to mitigate the potential social and environmental impacts of a variable flow in the river. **These alternative power generation options will be considered in the EIA**.

5.3.2 Alternative power line routes

Three alternative power line routes, linking the hydropower plant downstream of Laleni Dam to the grid, are being considered. The three power line routes correspond to three possible tunnel lengths from Laleni Dam to the hydropower plant. The amount of power generated will in part depend on the length and gradient of the tunnel. **All three alternative routes will be considered in the EIA**.

5.3.3 Alternative dam types

Many different dam types were investigated taking into account the terrain, foundation conditions, available materials, spillway configurations and the cost of the various dam options.

The selected optimum dam type for the Ntabelanga Dam is a mass gravity Roller Compacted Concrete dam, with integrated outlet works and spillway. A typical cross-section of the dam wall is shown on **Figure 23**.

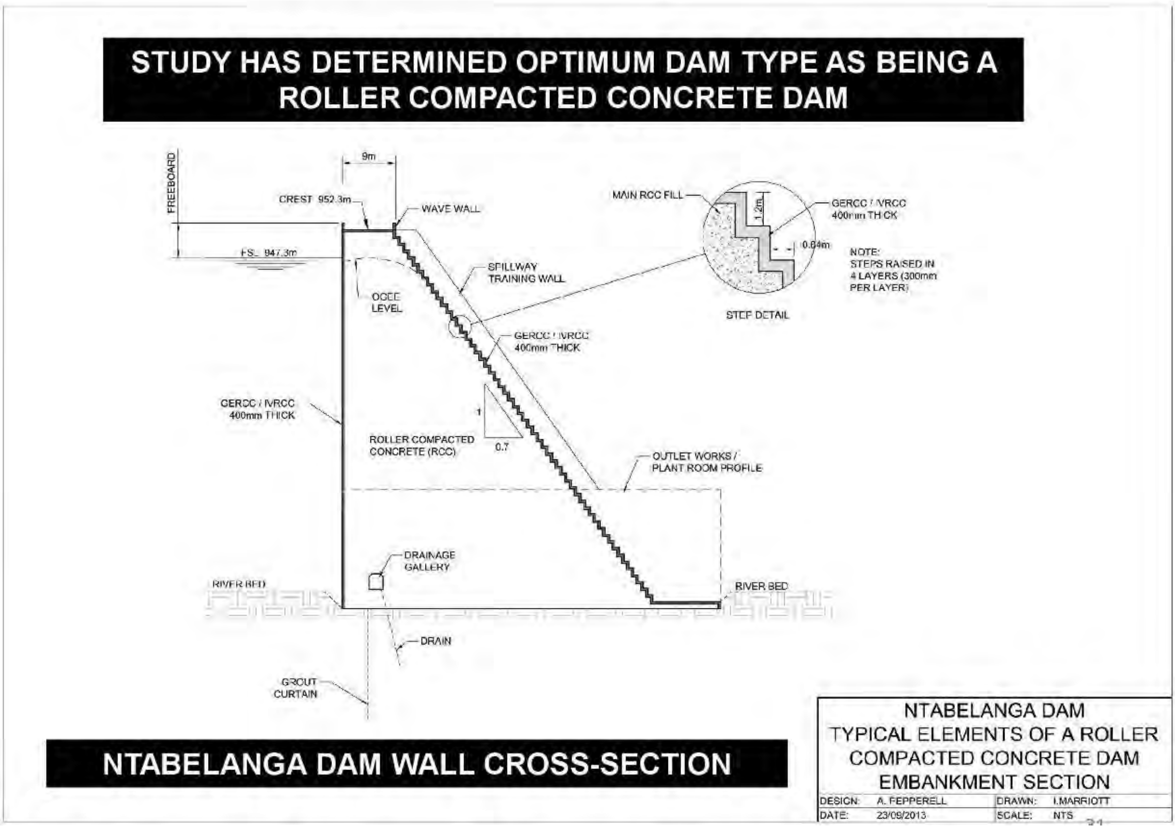

Figure 23: Typical Ntabelanga Dam wall cross-section

The Laleni Dam has only been investigated at high level and optimisation of the dam wall type has not yet been finalised.

The choice of dam type is driven by technical aspects and will not be included in the specialist's studies in the Impact Assessment Phase.

5.3.4 Alternative dam sizes

The Laleni Dam has only been investigated at high level and optimisation of the dam size has not been finalised. **Three different sizes are being proposed and will be considered in the EIA.**

5.3.5 Alternative water supply options

For rural water supply, there is competition between the use of a bulk water supply, based on a single large water source and a number of smaller sources. The advantage of a large source is that it offers controlled conditions to assure the quantity and quality of the water supplied. The disadvantage is that long distribution pipelines are expensive to build and operate, vulnerable to interference, damage and losses and often difficult to access. In the absence of good management, they often fail to deliver reliable supplies to communities at the end of the pipelines.

Where a bulk supply is provided, local municipalities often fail to complete and/or maintain the distribution systems that are their responsibility. Small systems are often cheaper and allow better oversight of their use and maintenance by the beneficiary community but may be less reliable if their operations are not well supported.

The current proposal is for the construction of a large regional scheme. The option of a number of smaller schemes has been considered but the conclusion was reached that, for the large population involved (estimated to grow to almost 600 000 people by 2030) the cost and risks of a large scheme should be accepted because of the difficulties of sustaining a large number of smaller schemes (Muller, 2014).

In view of the above, only the proposed bulk water supply scheme from Ntabelanga Dam will be investigated in the EIA.

5.3.6 Alternative pipeline routes and reservoir positions

The feasibility study has not identified alternatives pipeline routes and reservoir positions. The approach to the impact assessment will therefore be to identify any sensitive areas that should be avoided for consideration by the technical team. Any deviations derived in this manner will be included in the Impact Assessment report.

5.3.7 Alternatives for roads

As for the pipeline routes, no specific road route alternatives have been identified in the feasibility study. The approach to the impact assessment will therefore be to identify any sensitive areas that should be avoided for consideration by the technical team. Any deviations derived in this manner will be included in the Impact Assessment report.

5.3.8 A number of smaller water sources rather than a dam

This section is based on the Mike Muller report to the ECCSECC. For rural water supply a single large water source or a number of smaller sources can be used. The advantage of a large source is that it offers controlled conditions to assure the quantity and quality of the water supplied. The disadvantage is that long distribution pipelines are expensive to build and operate, vulnerable to interference, damage and losses and often difficult to access. In the absence of good management, they often fail to deliver reliable supplies to communities at the ends of the pipes.

Where a bulk supply is provided, local municipalities often fail to complete and/or maintain the distribution systems that are their responsibility. Small systems are often cheaper and allow better oversight of their use and maintenance by the beneficiary community but may be less reliable if their operations are not well supported.

The Mzimvubu Water Project is for the construction of a large regional scheme. The option of a number of smaller schemes has been considered but the conclusion was reached that, for the large population involved the cost and risks of a large scheme should be accepted because of the difficulties of sustaining a large number of smaller schemes.

The smaller schemes alternative will not be considered in the Impact Assessment Phase of the project.

5.4 SUMMARY OF ALTERNATIVES TO BE CONSIDERED IN THE EIA

The alternatives that will be considered in the EIA are therefore:

- Three hydro power tunnel positions and associated power lines;
- Peak versus Base load power generation;
- Three different dam sizes for the Laleni Dam; and
- The no project option.

For the pipeline routes and new roads the specialists will identify any sensitive areas and deviations to avoid these areas will be proposed in consultation with the technical team.

6. PUBLIC PARTICIPATION IN THE SCOPING PHASE

6.1 OBJECTIVES OF THE SCOPING PHASE

The main objectives of the Scoping Study are to:

- Describe the key biophysical and socio-economic characteristics of the affected environment;
- Identify potential environmental issues and impacts to be addressed in the EIA phase;
- Define the legal, policy and planning context for the proposed project;
- Undertake a public participation process that provides opportunities for all interested and affected parties (I&APs) to be involved;
- Identify feasible alternatives that must be assessed in the EIA phase; and
- Define the Plan of Study (PoS) for the EIA phase.

6.2 AUTHORITY CONSULTATION

A pre-application meeting was held at the Department of Environmental Affairs (DEA) offices in Pretoria on 25 March 2014. The purpose of the meeting was to introduce the project to DEA, and agree on the proposed process and programme to be followed as well as associated roles and responsibilities.

As the project is a Strategic Integrated Project (SIP3) and a priority for the Department of Water Affairs, delays in the EIA process should be avoided as far as possible. The programme for the EIA study was presented at the meeting and it was resolved that an Authorities Forum be established for the project, in order to obtain inputs and comments on the draft reports from the various organs of state involved in a timeous manner.

The authorities forum will include representatives from the following organs of state:

- Affected Local and District Municipalities,
- Department of Agriculture,
- Eskom,
- Roads and Transport Departments,
- DEA,
- DWA regional and head office, and
- Department of Energy.

6.3 STAKEHOLDER IDENTIFICATION AND DATABASE

DWA has engaged with a number of stakeholders and role-players on this project during the feasibility study stage. A stakeholder database, including existing I&APs (**Appendix B**) was provided at the beginning of the EIA process, which is updated on an ongoing basis as new stakeholders register on the database.

6.4 PARALLEL STAKEHOLDER LIAISON BY THE DEPARTMENT OF WATER AFFAIRS

There are several parallel stakeholder liaison initiatives for the project as a whole in addition to the public participation process for the EIA. Issues relevant to the EIA identified during these initiatives are incorporated into the process on an ongoing basis.

Table 9 lists the Department's formal and informal liaison structures and activities for this project, their purpose and representivity.

Table 9: Department of Water Affairs formal and informal liaison structures and activities for the Mzimvubu Water Project

Liaison Structure	Purpose	Representivity
Project Steering Committee (PSC) (Meetings take place every second month)	Guidance pertaining to strategic issues related to the project	▪ Department of Water Affairs and other relevant national departments ▪ EC Government ▪ Municipalities in the project area ▪ Key sectors such as conservation
Study Management and Committee (Meetings take place every second month)	To co-ordinate and synchronize all the activities, to ensure efficient communication and to manage components and phases of the project	Department of Water Affairs : Options Analysis and other nominated members
Department of Environmental Affairs 25 March 2014	To discuss the Environmental Impact Assessment	DEA EAP DWA
Authorities Co-ordinating Committee	To facilitate comments on reports required by DEA.	
Eastern Cape Social and Economic Consultative Council (ECSECC) (13 February 2014, 26 March 2014, 6 March 2014)	ECSECC is a multi-stakeholder policy research and development planning organisation dedicated to evolving new forms of development cooperation between government, labour, organised business and developmental non governmental organisations	The ECSECC team is made up of over 40 committed professional and administrative staff. Subject experts, facilitators and development practitioners work in multidisciplinary teams.
Integrated Wild Coast Development Programme Steering Committee (19 February 2014)		

6.5 NOTIFICATION LETTERS, ON-SITE NOTICE AND BACKGROUND INFORMATION DOCUMENT

A letter notifying I&APs of this application for environmental authorisation, as well as the applications for the Water Use Licence, heritage permits, borrow areas approval was sent to all registered stakeholders together with a Background Information Document (BID) (**Appendix B**). Both the English and isiXhosa versions were distributed by the local facilitators as well as placed on the DWA website. The BID covers all the applications that form part of the project. A newspaper advertisement was published in both a local and national newspaper announcing the EIA process for this project and providing contact details for I&APs to register as a stakeholder. An on-site notice was also posted providing a brief background on the project and contact details in order for IAPs to request further information and/or to register as a stakeholder.

6.6 ADVERTISEMENTS AND DRAFT REPORTS FOR COMMENT

Notice of the applications were advertised in the EP Herald on 29 April 2014 the Mthatha Fever on 30 April 2014. The draft scoping report is available to I&APs for comment from the DWA website (http://www.dwaf.gov.za/projects.aspx) and hard copies are also available for perusal. I&APs have thirty (30) days to comment on the draft scoping report.

Copies of the draft Scoping Report are available at the following venues:

Location	Venue
East London	Mrs Glenn Hartwig East Landon Central Library, Reference Library First Floor Gladstone Street East London 5200 (043) 722-4991
Mthatha	Mrs Vuyiswa Lusu Walter Sisulu University Nelson Mandela Drive Unitra, Umtatha 5117, 047-5022382 /2319
Tsolo	Mhlontlo Local Municipality 128 Mthuthuzeli Mpehle Avenue Tsolo 5170

Ntabelanga	Siqhungqwini Junior Secondary School Siqhungqwini A copy will also be given to the local Chief (Chief Mabantla). Tel: 079 397 7131
Laleni	Mhlontlo Local Municipality Technical department Office 26 96 Church Street Qumbu 5180

6.7 PUBLIC MEETINGS

In addition to the public comment period, three public meetings will be held during the week of the 12th of May 2014 near the proposed Ntabelanga dam site, in Tsolo and in Laleni. These meetings will be used to engage with the public, provide information and allow stakeholders to raise any comments or objections, which will be recorded in the Issues and Responses Report (IRR).