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water affairs
Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

# NCWABENI: OFF-CHANNEL STORAGE DAM

# ENVIRONMENTAL IMPACT ASSESSMENT REPORT

## FINAL

**April 2013**

**[NEAS Ref No: DEA/EIA/0000586/2011; DEA Ref. No: 12/12/20/2468]**



# EXECUTIVE SUMMARY

## PROJECT BACKGROUND AND MOTIVATION

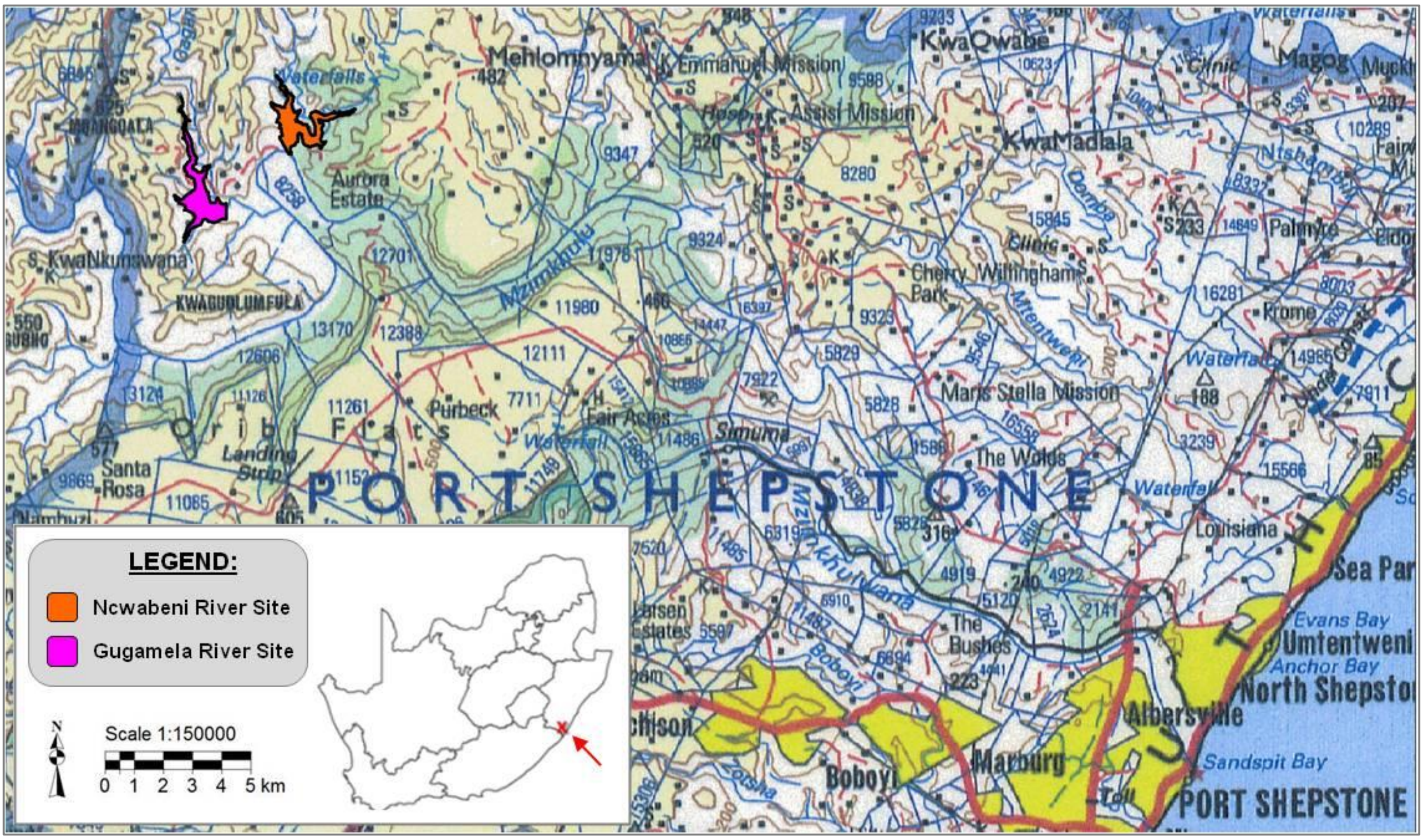
The Mzimkhulu Regional Water Supply Scheme, which forms part of the KwaZulu Natal's Lower South Coast System, supplies water to the coastal region from Hiberdeen to Margate, including Port Shepstone. The water is presently sourced from non-regulated river flows in the Mzimkhulu River. The water is abstracted at the St. Helen's Rock abstraction works near Port Shepstone and is pumped into the water treatment works. From there the water is distributed to the various user nodes.

In order to provide for the water requirements for all user sectors, including the Reserve, the Department of Water Affairs (DWA) has proposed the construction of an off-channel storage (OCS) dam in one of the tributaries to the Mzimkhulu River. The reservoir can be filled from its incremental catchment, supplemented by pumping from the Mzimkhulu River during times of high river flows. During times of low flows, water can be released back into the Mzimkhulu River for abstraction downstream at the existing St. Helen's Rock abstraction works. The two alternative sites that were identified for the OCS dam are situated in the Ncwabeni River (Alternative 2D) and the Gugamela River (Alternative D3A).

## PROJECT LOCATION

The project area is situated in the central part of KZN, approximately 20km north-west of Port Shepstone. The two OCS Dam sites are located close to the southern boundary of Ward 1 of the Umzumbe Local Municipality (KZ213), which falls within the Ugu District Municipality (DC21).

The project area falls under the Nyamande Traditional Authority Ward on land which is registered under the Ngonyama Trust. The land on the opposite bank of the Mzimkhulu River (Gibraltar 8258) is privately owned and commercially farmed.




**Locality Map**

## PROJECT DESCRIPTION

The OCS scheme will consist of the following components:

1. An OCS dam and outlet infrastructure to make measured releases back to the Mzimkhulu River;
2. An abstraction / gauging weir on the Mzimkhulu River;
3. An abstraction works with a mechanism to remove silt; and
4. A pump station and pipeline to deliver water to the dam.

Two alternative schemes for the proposed OCS dam are being considered, namely the Ncwabeni scheme and the Gugamela scheme. The salient parameters for the two dam options (including the abstraction works) are summarised in the table to follow.

**Approximate Parameters of dam options**

| Parameter | Development Option | |
|---|---|---|
| | D2 | D3A |
| Dam type(s) | Composite (concrete gravity/earthfill) | |
| River | Ncwabeni | Gugamela |
| Coordinates of centreline (approximate) | 30°36'27.1"S; 30°14'22.2"E | 30°37'19.2"S; 30°13'35.1"E |
| **Dam Characteristics** | | |
| River bed level (m.a.s.l.) | 122.5 | 131.5 |
| Inundation area ($km^2$) | 0.95 | 0.98 |
| Full supply capacity – Gross ($10^6$ $m^3$) | 15.8 | 16.0 |
| Full supply capacity – Net ($10^6$ $m^3$) | 13.2 | 13.4 |
| Catchment area ($km^2$) | 39.8 | 34.6 |
| Free board height (m) | 3.5 | 3.5 |
| Non-overspill crest level - NOCL (m.a.s.l.) | 171.0 | 180.5 |
| Dam wall height from NOCL to river bed (m) | 48.5 | 49.0 |
| Dam wall height from NOCL to foundation (m) | 49.5 | 51.0 |
| DWA classification | Category III | Category III |
| **Spillway** | | |
| Design flood | 415 | 385 |
| Safety evaluation flood (SEF) | 985 | 905 |
| Spillway type | Side channel with a length of 50m for both dam sites | |
| Spillway length (m) | 100.0 | 70.0 |
| **Pipeline** | | |
| Total length of pipeline (rising plus gravity main) | 600 m | 1 600 m |
| Rising main nominal diameter | 900 mm | 900 mm |
| Flow rate | 1 $m^3/s$ | 1 $m^3/s$ |

The operation of either OCS dam option as part of the greater supply system will be essentially the same. Water will be abstracted from the Mzimkhulu River at St Helen's Rock for treatment and supply as is currently done. The OCS dam will be filled by water abstracted from a new abstraction / gauging weir on the Mzimkhulu River during the high flow months Water will then be released during the low flow months to augment the volume that can be abstracted at St Helens Rock.

## ALTERNATIVES

A number of phases of identifying, comparing and selection of alternative options to meet the growing water demands of the Lower South Coast Water Supply System have been conducted. The construction of an OCS dam as part of a larger scheme of upgrading the current infrastructure and linking it to other existing systems was found to be the preferred alternative.

The following alternatives will be considered during the EIA process:

- Dam sites;
- Dam wall type;
- Abstraction / gauging weir location;
- Borrow areas;
- Power supply; and
- The no-go option.

The EIA Report provides an overview of the project life-cycle (feasibility, planning and design phase, construction, operation and decommissioning).

## EIA PROCESS

The proposed project triggers certain activities listed in Government Notice No. R 544, R 545 and R 546, which require environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations (2010) that were promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

In terms of NEMA, the lead decision-making authority for the environmental assessment is the National Department of Environmental Affairs (DEA), as the project proponent (DWA) is a national department.

Nemai Consulting was appointed by DWA as the independent Environmental Assessment Practitioner (EAP) to undertake the environmental assessment for the proposed Ncwabeni OCS Dam.

The EIA Report lists the various milestones reached during the Scoping phase and provides an overview of the EIA methodology, in terms the need and desirability of the project, the formal EIA process, alignment with the Plan of Study that formed part of the Scoping Report, screening and assessment of alternatives, and impact prediction.

## PROFILE OF THE RECEIVING ENVIRONMENT

The EIA Report provides a general description of the status quo of the receiving environment in the project area, and also provides local and site-specific discussions on those environmental features investigated by the respective specialists. This allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project.

The study area includes the entire footprint of all the project components, which includes the construction domain and surrounding receiving environment.

## SPECIALIST STUDIES

The requisite specialist studies 'triggered' by the findings of the Scoping process, aimed at addressing the key issues and compliance with legal obligations, include:

- Terrestrial Ecology Assessment;
- Heritage Impact Assessment;
- Aquatic and Riverine Assessment;
- Agricultural Impact Assessment;
- Visual Impact Assessment;
- Estuarine Study;
- Socio-Economic Study; and
- Social Impact Assessment.

In addition, DWA also commissioned an Economic Study to consider the strategic need for the project on a regional scale, which included the economic rationale and implications of a no-go option.

The information obtained from the respective specialist studies were incorporated into the EIA report in the following manner:

1. The information was used to complete the description of the receiving environment in a more detailed and site-specific manner;
2. A summary of each specialist study is contained in the report, focusing on the approach to the study, key findings and conclusions drawn;
3. The evaluations performed by the specialists on the alternative dam sites were included in the comparative analysis to identify the most favourable option;
4. The specialists' impacts assessment, and the identified mitigation measures, were included in the overall project impact assessment;

5. Specialist input was obtained to address comments made by Interested and Affected Parties that related to specific environmental features pertaining to each specialist discipline; and
6. Salient recommendations made by the specialists were taken forward to the final EIA Conclusions and Recommendations.

## IMPACT ASSESSMENT

This section of the EIA Report focuses on the pertinent environmental impacts that could potentially be caused by the proposed OCS Dam. The impacts to the environmental features are linked to the project activities, which in broad terms relate to the physical infrastructure, inundation and the operation of the dam. Impacts were identified as follows:

- An appraisal of the project description and the receiving environment;
- Impacts associated with listed activities contained in GN No. R. 544, R. 545 and R. 546, for which authorisation has been applied for;
- Issues highlighted by environmental authorities;
- Findings from specialist studies; and
- Comments received during public participation.

The impacts associated with the listed activities and raised by environmental authorities are discussed on a qualitative level. In order to understand the impacts related to the project's components, the activities and environmental aspects associated with the project life-cycle were identified.

The following potentially significant impacts are evaluated within the EIA Report:

1. Climate;
2. Geology and soil;
3. Surface water;
4. Flora;
5. Fauna;
6. Air Quality;
7. Noise;
8. Social environment;
9. Traffic and access roads; and

10. Visual quality and tourism.

The implications of the no-go option are assessed. The EIA Report concludes that through the mitigation of the identified impacts associated with the various phases of the project life-cycle, and considering the nett benefits that accompany the OCS Dam (as opposed to maintaining the status quo), the no-go option should be rejected in order for the objectives of the project to be met.

Cumulative impacts pertaining to water resource management, the socio-economic environment, transportation network, air quality, biodiversity and visual quality, are also considered.

## ANALYSIS OF ALTERNATIVES

The EIA Report provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option (BPEO).

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts associated with the two options for the location of the OCS, the optimum OCS scheme selected was a Concrete Faced Rockfill Dam at site D2 on the Ncwabeni River (FSL of 167.5 m.a.s.l.) with a broad crested side channel spillway and a diversion weir, abstraction works, pipeline and access road.

## PUBLIC PARTICIPATION

The EIA Report provides a full account of the public participation process that was followed for the EIA phase for the proposed OCS Dam.

## EIA CONCLUSIONS AND RECOMMENDATIONS

With the selection of the BPEO for the location of the OCS dam, the adoption of the mitigation measures include in the EIA Report and the dedicated implementation of the suite of Environmental Management Programmes, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated.

With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

The EIA Report includes various recommendations that emanated from the EIA for the Ncwabeni OCS Dam, which may also influence the conditions of the Environmental Authorisation (where relevant).

# UMBIKO OFINGQIWE

## UMLANDO WEPROJEKHTHI NOKWESEKWA KWAYO

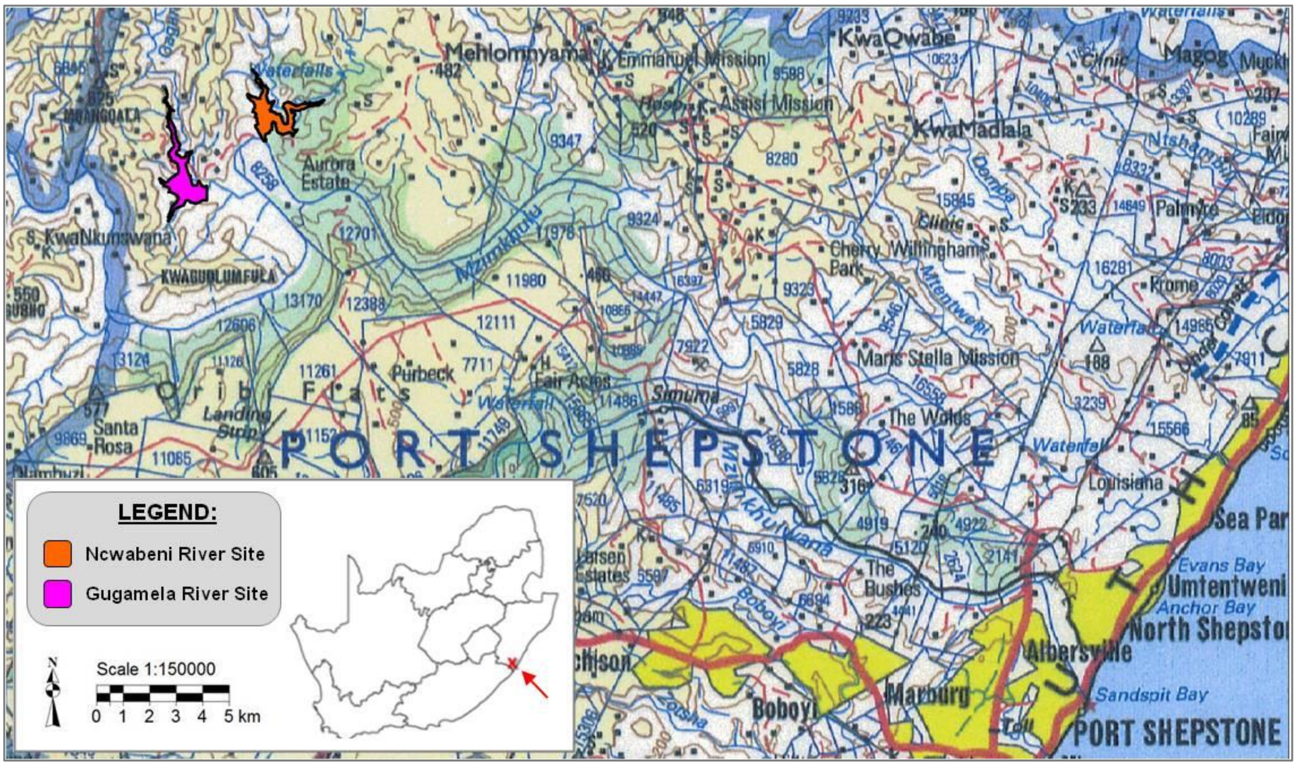
Uhlelo lwesifundazwe saseMzimkhulu lokuphakela amanzi iMzimkhulu Regional Water Supply Scheme oluyingxenye yohlelo iLower South Coast System luhlinzeka ngamanzi kusifunda esigudla uGu kusukela eHiberdeen kufike eMargate, okubandakanya nePortshepstone. Okwamanje amanzi athathwa emfuleni ongalawulwa, iMzimkhulu River. Amanzi amuncwa esizindeni sokumunca amanzi iSt.Helen's Rock emaduzane nePort Shepstone, bese empontshelwa endaweni okuhlanzwa kuyo amanzi. Ukusuka lapho abe esedluliselwa ezizindeni ezahlukahlukene zokwaba.

Ukuze zonke izinhlaka ezisebenzisa amanzi zihlanzekwe ngezidingo zamanzi, uMnyango Wezamanzi (DWA) uhlongoze ukwakhiwa kwedanyana lokulondoloza amanzi (OCS) komunye wemifudlana engenela kumfula uMzimkhulu. Lelidanyana lingagcwaliswa amanzi asuka esizalweni somfula bese kuthayiselwa ngokumpontshwa kwamanzi asuka emfuleni uMzimkhulu ngezikhathi zokugcwala kwawo. Ngezikathi zokwehla komfula, angadedelwa aye emfuleni iMzimkhulu ukuze azomuncwa mazansi nawo esizindeni sokumunca amanzi iSt. Helen's Rock. Leziza zombili ezahlonzelwa idamu leOCS zisemfuleni iNcwabeni(Okungakhethwa kuko 2D) nasemfuleni iGugamela (Okungakhethwa kuko D3A).

## INDAWO EKUYO LEPHROJEKHTHI

Lephrojekhthi imaphakathi neKZN, okungaba u20km ukuya eNyakatho-Ntshonalanga nePort Shepstone. Leziza ezimbili zedamu iOCS ziseduze nomgcele ongaseningizimu kuWard 1 kamasipala wendawo uMzumbe (KZ213) ongaphansi kukamasipala wesifunda Ugu (DC21) (buka isithombe esilandelayo).

Lephrojekhthi isendaweni engaphansi kobukhosi bakwaNyamande emhlabeni ubhaliswe ngaphansi kweNgonyama Trust. Indawo engaphesheya komfula esosebeni iMzimkhulu (Gibraltar 8258) yona iphethwe ngokuzimele kuthi ilinyelwa ukwenza inzuzo.




**Ibalazwe Lendawo**

## INCAZELO NGEPHROJEKHTHI

I-OCS izoba nalokhu okulandelayo:

1. Idamu i-OCS kanye nesakhiwo esizokala ukukhishwa kwamanzi abuyele emfuleni iMzimkhulu;
2. Ukumuncwa kwamanzi emfuleni iMzimkhulu;
3. Ukumuncwa kwamanzi ngendlela etheni isuse udaka;
4. Idawo lapho kupotshiwa amanzi kanye nolayini wepayipi ozothumela amanzi edanyini.

Kucutshugulwa izinhlelo ezimbili zokwakhiwa kwedamu iOCS, okuwuhlelo iNcwabeni nohlelo iGugamela. Imingcele ebalulekile yalamadamu (okufaka phakathi nohlelo lokumuncwa) ifinyezwe kulelithebula elilandelayo.

**Izilinganiso Zemingcele yalamadamu**

| Imingcele | Izakhiwo okungakhethwa kuzo | |
|---|---|---|
| | D2 | D3A |
| Inhlobo (izinhlobo) zedamu | (usimende) | |
| Umfula | Ncwabeni | Gugamela |
| Amaphoyinti omugqa osemaphakathini (izilinganiso) | 30°36'27.1"S 30°14'22.2"S | 30°37'19.2"S 30°13'35.1"S |
| **Umumo wedamu** | | |
| Izinga lomfula (m.a.s.l) | 122.5 | 131.5 |
| Isizalo somfula | 39.8 $km^2$ | 34.6 $km^2$ |
| Izinga lokunikezelwa ngokugcwele - -isaphelele ($10^6 m^3$) | 15.8 | 16.0 |
| Izinga lokunikezelwa ngokugcwele – masekukhona okucuyiwe ($10^6 m^3$) | 13.2 | 13.4 |
| Ubude be-free board (m) | 3.5 | 3.5 |
| Uma umfula ugcwele | 0.95 $km^2$ | 0.98 $km^2$ |
| Izinga lokungachitheki kwamanzi – NOCL (m.a.s.l) | 171.0 | 180.5 |
| Ubude bodonga lwedamu ukusuka ku NOCL ukuya emfuleni | 48 m | 49 m |
| Ubude bodonga lwedamu ukusuka ku NOCL ukuya phansi ekuqaleni kwedamu | 49.5 | 51.0 |
| Amazinga ngokwe - DWA | Izinga III | Izinga III |
| **Isakhiwo esikhipha amanzi ageleza edanyini (iSpillway)** | | |
| Isakhiwo sezikhukhula | 415 | 385 |
| Ukucwaninga ukuphepha kwezikhukhula | 985 | 905 |
| Inhlobo yespillway | Umshini (side channel) onobude obulinganiselwa ku-50m amadamu womabili | |
| Ubude bespillway (m) | 100.0 | 70.0 |
| **Ulayini wepayipi** | | |
| Ubude bepayipi (ukwenyuka nokwehla kwalo) | 600 m | 1 600 m |
| Ukwenyuka nobubanzi | 900 mm | 900 mm |
| Izinga lokugeleza | 1 $m^3$/s | 1 $m^3$/s |

Ukulawulwa nokusebenza kwanoma yiliphi idamu leOCS phakathi kwalawa omabili kuyefana. Amanzi azomuncwa emfuleni iMzimkhulu eSt Helen's Rock ukuze ayohlanzwa bese esatshalaliswa njengoba kwenziwa manje. Amanzi azogcwaliswa edamini leOCS azomuncwa endaweni entsha yokumunca amanzi esemfuleni uMzimkhulu ngesikhathi ugcwele bese ayadedelwa ngesikhathi womile ukuze kuthayiselwe umthamo ongamuncwa eSt Helen's Rock.

## EZINYE IZINDLELA

Kwenziwe izigaba eziningana zokuhlonza, kuqhathaniswe kubuye kukhethwe ezinye izindlela okungahlangatshezwa ngazo ukukhula kwesidingo sokuhlinzekwa ngamanzi uhlelo lokuhlinzekwa kwamanzi lwaseLower South Coast (Lower South Coast Water Supply Scheme). Ukwakhiwa kwedamu leOCS njengohlelo olukhulu lokukhulisa ingqalasizinda ekhona njengamanje ixhunywe nezinye izinhlelo ezikhona itholakale ingcono kakhulu.

Loku okulandelayo kuzobukisiswa ngekathi kwenziwa uhlelo lwe-EIA:

- Iziza zamadamu;
- Uhlobo lodonga lwedamu;
- Indawo okuzoba kuyo izimuncamanzi;
- Izindawo ezizompontshwa;
- Ukunikezelwa kukagesi; no
- Kalubhadwa.

Umbiko we-EIA unikeza incazelo emfushane ngempiloyedamu yalephrojekhthi (ukuthola amandla nobuthakathaka bephrojekhthi, ipulani no kwenziwa, ukwakhiwa, ukusetshenziwa, nokususwa uma lingasadingeki)

## UHLELO LWE-EIA

Leprojekhthi ehlongozwayo ithinta kakhulu eminye imisebenzi esohlwini lweSaziso sikaHulumeni No. R544, R 545 no R546 esidinga ukugunyazwa ngokomthetho wokuhlola umthelela endaweni (EIA) imithetho (2010) eyamiswa ngokwe National Enviromental Management Act, ka 1988 (Isigaba 107 sika 1988) (NEMA)

Ngokwe NEMA, iziphathimandla ezibhekele ukuhlola komthelela endaweni uMnyango kaZwelonke wezeMvelo njengoba abahlongozi bephrojekhthi (DWA) kungumnyango kaZwelonke.

INemai Consulting yaqokwa yiDWA ukuba ibe abahloli bomthelela endaweni (EAP) abazimele ukuze bahlole umthelela wedamu iNcwabeni OCS endaweni.

Umbiko we-EIA ubala izenzo esekufinyelelwe kuzo ngenkathi yeskophu iphinde inikeze incazelo emfushane ngendlela yokwenza i-EIA, ngokwezindingo nezifiso ze-projekhthi, uhlelo lwe-EIA, ukuhlela ngokwecebo lesifundo elaliyingxenye yombiko weskophu, uhlolo lwezindawo okungakhethwa kulo, kanye nokuba umonakalo ongahle ubekhona.

## UBUNJALO BENDAWO OKUZOSETSHENZWA KUYO

Umbiko we - EIA unikeza incazeko jikelele yesimo sendawo lapho iphrojekhthi izokwenziwa khona, iphinde inikeze izingxoxo mayelana nomumo wendawo ekuzuosetshenzwa kuyo ephenywe ezochwepheshe. Lokhu kuqinisekisa ukubhekelelwa kwezindawo ezibuthaka nezingathinteka kabuhlungu ngenxa yephrojekhthi.

Isifundo sendawo sifaka phakathi yonke imithelela yephrojekhthi, lokhu kubandakanya indawo ekuzosetshenziwa kuyo kanye nendawo emaduzane.

## UHLELO LWEZIFUNDO EZENZIWA PHAMBILINI

Ukubaluleka kwezifundo zochwepheshe kuthintwe okutholakele ngekathi kwenziwa uhlelo lweskophu, ezihlose ukwethula izinkinga ezihamba phambili kanye nokulandela imithetho mgomo, zibandakanya:

- Izifundo zezihlahla nezilwane zasezweni;
- Ukuhlola komthelela kwezamagugu;
- Ukuhlola komthelela kwezamanzi nezemifula;
- Uhlolo lomthelela kwezolimo;
- Uhlolo lomthelela ekubukeni;
- Izifundo zezamachweba;
- Izifundo zezenhlalo-mnotho; no
- Hlolo lomthelela kwezenhlalo.

Phezu kwalokho, i-DWA ihlongoze ukwenziwa kwezifundo zomnotho ukucabangisisa isidingo sesakhiwo sephrojekhthi esifundazweni. Lokhu kuzobandakanya ukubhekisisa ezomnotho nemithelela yokukhetha la lingabhadwa khona.

Ulwazi olutholakale ezifundweni zochwepheshe lufakwe kumbiko we-EIA ngalendlela elandelayo:

1. Lolulwazi lusetshenzisiwe ukuqedela incazelo yobunjalo bendawo ngokupheleleyo;
2. Umbiko ofinqinye wochwepheshe ngamunye ngamunye uyatholakala kulombiko, ugcizelela kakhulu;

3. Ochwaningo lochwepheshe olwenziwe ezindaweni zombili ezikhethiwe luyabandakanyeka ekukhetheni indawo engcono yokwakha idamu;
4. Ohlolo lwezemithelela yochwepheshe, kanye nezinyathelo ezizothathwa ekudambiseni imithelela, ziyatholakala kwiphrojekhthi yohlolo lwezemithelela;
5. Ulwazi lochwepheshe lusetshenzisiwe ukuphendula okuphawulwe abanentshisekelo nabathintekayo ngokuthinta ochwepheshe ngamunye ngamunye;
6. Iziphakamiso ezisezingeni eliphezulu ezenziwe ozochwepheshe zifakiwe emaphethelweni naseziphakamisweni ze-EIA yamanqamu.

## UKUHLOLA KOMTHELELA

Lengxenye yombiko we-EIA ibhekisisa ikakhulukazi imithelela engadalwa yilelidamu elihlongoziwe i-OCS endaweni. Imithelela yomumo wendawo ayaxhumana nemisebenzi yephrojekhthi, lokho kubandakanya isimo sedawu uqobo lwayo, uma amanzi agcwele nokusetshenziswa kwedamu. Imithelela itholakale ngalezindlela ezilandelayo:

- Ukubhekisisa incazelo ngephrojekhthi kanye nendawo okuzosetshenzelwa kuyo;
- Imithelela ebandakanya eminye imisebenzi esohlwini lweSaziso sikaHulumeni No. R. 544, R. 545 kanye ne-R 546, ukugunyazwa kwakhona sekubhaliselwe;
- Izinkinga ezikhonjwe abagunyazi bezemvelo;
- Okutholakele ngenkathi yocwaningo lochwepheshe;
- Okuphawulwe wumphakathi.

Imithelela ebandakanya imisebenzi ebaliwe ephakanyiswe abagunyazi bezemvelo iyadingidwa ngokusezingeni eliphezulu. Ukuze kuqondwe umithelela exhumene nephrojekhthi, itholakele imisebenzi nezindawo ezibandakanyeka kwimpiloyedamu yephrojekhthi.

Lemithelelela elandelayo engahle ibekhona iyabhekisiswa kumbiko we-EIA:

1. Isimo sezulu;
2. Amatshe nomhlabathi;
3. Amanzi aphezulu;
4. Izihlahla nezimbali;
5. Izilwane;
6. Izinga lomoya;

7. Umsindo;
8. Ezenhlalo zendawo;
9. Ezemigwaqo yokufinyelela nokuminyana kwezimoto;
10. Isithombe sendawo kanye nezabavakashi.

Imithelela yokukhetha la lingabhadwa khona iyahlolwa. Umbiko we-EIA uphetha ngokuthi ukulandelwa kwezinyathelo zokudambisa imithelela ebaliwe ngesikhathi sempilodamu ye phrojekhthi, kanye nokucabangisisa inzuzo eza nedamu i-OCS (ngaphambi kokugcina isimo ekuso), ukuthetha la lingabhandwa khona kumele kunqabiwe ukuze kufinyelelwe kwinjongo yephrojekhthi.

Ukwanda kwemithelela ephathelene nokulawula amanzi, indawo yezenhlalo-mnotho, umphambo wezokuthutha, izinga lomoya, izilwane nezihlahla ezahlukene kanye nezinga lesithombe sendawo, konke lokhu kuyacatshangisiswa.

## UCWANINGO LWEZINYE IZINDLELA

Umbiko we-EIA unikeza wonke amasu ezemvelo nokwakhiwa ezicatshangiwe ezibandakanya ezinye izindawo, ngokuqhudelanisa ucwanigo ukuze kutholakale indlela ekuyiyona engasetshenziswa ukuvikela ezemvelo – Best Practicable Environmental Option (BPEO).

Ngokweziphakamiso zochwepheshe, imicabango yokwakhiwa kanye nokuqhudelanisa imithelela ebandakanya izindawo zombili ezikhethiwe ukwakha idamu – iOCS, ekuyiyona OCS eyayikhethiwe kwakuyidamu likasimende elinomhlabathi onamatshe endaweni i-D2 emfuleni iNcwabeni (FSL of 167.5 m.a.s.l), enesakhiwo esikhulu esikhipha amanzi ageleza edanyini, indawo ekupotshwa kuyo amanzi, ulayini wepayipi kanye nomgwaqo wokufinyelela.

## UKUBANDAKANYWA KWEMIPHAKATHI

Umbiko we-EIA wethula indlela elandeliwe ekubandakanyeni umphakathi kwidamu elihlongoziwe i-OCS.

**IZIPHETHO NEZIPHAKAMISO ZE-EIA**

Ngokukhethwa kwe-BPEO mayelana nendawo ekuzokwakhiwa kuyoidamu i-OCS, ukuthathwa kwezinyathelo ngokudambisa imithelela kumbiko we-EIA kanye nokuzimisela ekusebenziseni uhlelo lokulawula ezemvelo, kunethemba lokuthi lezindawo ezibalulekile nemithelela enhlangene nephrojekhthi ingakwazi ukudanjiswa. Ngalokho, kungaphethwa ekutheni aziko inzinkinga ezihlangene nephrojekhthi kanti nencwadi egunyazayo ingahle itholakale, ngokutholakele ezifundweni zochwepheshe nohlolo lomthelela, kanye nokulandela imithetho mgomo yokulawula ezemvelo ezibaliwe.

Lombiko we-EIA ubandakanya iziphakamiso ezithize ezisuselwa kwi-EIA ngedamu iNcwabeni OCS, ezingaba nomthelela esimeni sokugunyazwa kwezemvelo (lapho kudingeka khona).

## TITLE AND APPROVAL PAGE

| | |
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| *Project name:* | ***The Ncwabeni Off-Channel Storage Dam*** |
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*Prepared by Nemai Consulting*
*for the Department of Water Affairs*

NEMAI CONSULTING

**Consultants:** *Nemai Consulting*

*Approved for Consultants by:*

........................................................

*N Naidoo*

*Study Leader*

***DEPARTMENT OF WATER AFFAIRS (DWA)***

*Approved for Directorate: Options Analysis by:*

........................................................

*JA Bester*

*Chief Engineer: Options Analysis*

*(East)*

# AMENDMENTS PAGE

| Date | Nature of Amendment | Amendment No. | Signature |
|---|---|---|---|
| November 2012 | Draft for Authorities & Public Review | 0 |  |
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# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF APPENDICES

# LIST OF ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| **ARC** | Agricultural Research Council |
| **BID** | Background Information Document |
| **BPEO** | Best Practicable Environmental Option |
| **CBA** | Critical Biodiversity Area |
| **CFR** | Concrete Faced Rockfill |
| **°C** | Degrees Celsius |
| **DAEA** | Department of Agriculture and Environmental Affairs |
| **DEA** | Department of Environmental Affairs |
| **DEA&DP** | Department of Environmental Affairs and Development Planning |
| **DEAT** | Department of Environmental Affairs and Tourism |
| **DEM** | Digital Elevation Model |
| **DMR** | Department of Mineral Resources |
| **DRH** | Direct Runoff Hydrograph |
| **DWA** | Department of Water Affairs |
| **DWAF** | Department of Water Affairs and Forestry |
| **EAP** | Environmental Assessment Practitioner |
| **EC** | Electrical Conductivity |
| **ECO** | Environmental Control Officer |
| **EIA** | Environmental Impact Assessment |
| **EIS** | Ecological Importance and Sensitivity |
| **EKZNW** | Ezemvelo KZN Wildlife |
| **EMPr** | Environmental Management Programme |
| **EMS** | Environmental Management System |
| **EWR** | Ecological Water Requirements |
| **FSL** | Full Supply Level |
| **GIS** | Geographical Information System |
| **GN** | Government Notice |
| **GWW** | Government Water Works |
| **ha** | Hectare |
| **I&AP** | Interested and Affected Party |
| **IDP** | Integrated Development Plan |
| **IHAS** | Integrated Habitat Assessment System |
| **IHI** | Index of Habitat Integrity |
| **ISP** | Internal Strategic Perspective |
| **km** | Kilometre |
| **KZN** | KwaZulu-Natal |
| **ℓ** | Litres |

| | |
|---|---|
| **l/s** | Litres per second |
| **l/c/d** | Litres per capita per day |
| **m** | Metre |
| **m.a.m.s.l.** | Meters above mean sea level |
| **m/s** | Metres per second |
| **$m^3$** | Cubic metre |
| **MAR** | Mean Annual Runoff |
| **MPRDA** | Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) |
| **Ml** | Mega litre |
| **mm** | Millimetre |
| **$Mm^3$** | Million cubic metres |
| **$Mm^3/a$** | Million cubic metres per annum |
| **NEMA** | National Environmental Management Act (Act No. 107 of 1998) |
| **NEM:WA** | National Environmental Management: Waste Act (Act No. 59 of 2008) |
| **NOCL** | Non-overspill crest level |
| **NWA** | National Water Act (Act No. 36 of 1998) |
| **NWRS** | National Water Resources Strategy |
| **OCS** | Off-Channel Storage |
| **OCSS** | Off-Channel Storage Scheme |
| **OP** | Ortho-Phosphates |
| **PES** | Present Ecological State |
| **PMF** | Potential Maximum Flood |
| **RCC** | Roller Compacted Concrete |
| **RDF** | Recommended Design Flood |
| **RDM** | Resource Directed Measures |
| **REC** | Recommended Ecological Category |
| **RHP** | River Health Programme |
| **RMF** | Regional Maximum Flood |
| **RMP** | Resource Management Plan |
| **RWSS** | Regional Water Supply Scheme |
| **SAHRA** | South African Heritage Resources Agency |
| **SANBI** | South African National Biodiversity Institute |
| **SANCOLD** | South African National Committee on Large Dams |
| **SANS** | South African National Standards |
| **SASS5** | South African Scoring System, version 5 |
| **SDF** | Spatial Development Framework |
| **SEF** | Safety Evaluation Flood |
| **SMME** | Small Medium and Micro Enterprise |
| **SUH** | Synthetic Unit Hydrograph |
| **TDS** | Total Dissolved Solids |
| **ToR** | Terms of Reference |

| | |
|---|---|
| **TP** | Total Phosphates |
| **UDM** | Ugu District Municipality |
| **VAC** | Visual Absorption Capacity |
| **WC/WDM** | Water Conservation / Water Demand Management |
| **WMA** | Water Management Area |
| **WRC** | Water Research Commission |
| **WRYM** | Water Resources Yield Model |
| **WSA** | Water Services Authority |
| **WSDP** | Water Services Development Plan |
| **WTW** | Water Treatment Works |
| **WTP** | Water Treatment Plant |
| **WULA** | Water Use Licence Application |

# DEFINITIONS OF KEY TERMS

| | |
|---|---|
| ***Aggregate*** | *Crushed rock or gravel screened to sizes for use in road surfaces, concrete, or bituminous mixes. A mass or cluster of soil particles, often having a characteristic shape.* |
| ***Catchment*** | *The area of land drained by a watercourse.* |
| ***Dam*** | *A concrete or earthen barrier constructed across a river and designed to control water flow or create a reservoir.* |
| ***Decommissioning*** | *To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned.* |
| ***Discharge*** | *Volume of water released from a dam at a given time.* |
| ***Ecological Water Requirements*** | *The quantity and quality of water of a resource that is required to maintain the said water resource in its assigned ecological category.* |
| ***Embankment*** | *An earth structure the top of which is higher than the adjoining surface. A shaped earth or rockfill dam. Fill material, usually earth or rock, placed with sloping sides and with a length greater than its height.* |
| ***Environment*** | *The surroundings in which humans exist and which comprise:*<br>• *The land, water and atmosphere of the earth.*<br>• *Micro-organisms, plant and animal life.*<br>• *Any part or combination of a) and b) and the interrelationships among and between them.*<br>• *The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that can influence human health and well-being.* |
| ***Environmental Aspect*** | *Those components of the company's activities, products and services that are likely to interact with the environment.* |
| ***Environmental Feature*** | *Elements and attributes of the biophysical, economic and social environment.* |
| ***Environmental Impact*** | *The change to the environment resulting from an environmental aspect, whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.* |
| ***Eutrophication*** | *A process where more organic matter is produced than existing biological oxidization processes can consume. The increase in the nutrient levels of a lake or other body of water; this usually causes an increase in the growth of aquatic animal and plant life.* |
| ***Fish ladder (fishway)*** | *An inclined trough which carries water from above to below a dam so that fish can easily swim upstream.* |
| ***Full Supply Level (FSL)*** | *The maximum normal operating level of a reservoir behind a dam.* |
| ***Gauging station*** | *A particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained* |
| ***Government Waterworks*** | *A waterwork (e.g. water storage dams, water transfer schemes and flood attenuation works) owned or controlled by the Minister of Water and Environmental Affairs and includes the land on which it is situated.* |

| | |
|---|---|
| ***Impervious*** | *Not permeable; not allowing liquid to pass through. Resistant to movement of water.* |
| ***Impoundment*** | *A body of water formed behind a dam.* |
| ***Mean Annual Runoff (MAR)*** | *The long term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition.* |
| ***Purchase Line*** | *The area below which the Department of Water Affairs will aquire property in order to be able to construct the dam and accommodate the dam basin.* |
| ***Reserve*** | *The quantity and quality of water required -*<br>• *to satisfy basic human needs by securing a basic water supply; and*<br>• *to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource.* |
| ***Roller Compacted Concrete (RCC) Dam*** | *A concrete gravity dam constructed by the use of a dry mix concrete transported by conventional construction equipment and compacted by rolling, usually with vibratory rollers* |
| ***Rockfill Dam*** | *An embankment dam in which more than 50 percent of the total volume is comprised of compacted or dumped pervious natural or crushed rock.* |
| ***Spillway*** | *A structure that passes normal and/or flood flows in a manner that protects the structural integrity of the dam. Overflow channel of a dam or impoundment structure. A structure over or through which flow is discharged from a reservoir.* |
| ***Storage*** | *The volume of water in a reservoir at a given time.* |
| ***Watercourse*** | *A geomorphological feature characterized by the presence of a streamflow channel, a floodplain and a transitional upland fringe seasonally or permanently conveying surface water.* |
| ***Weir*** | *An overflow structure built across an open channel to raise the upstream water level and/or to measure the flow of water. A measuring or gaging weir is calibrated for depth of flow over the crest. A weir generally consists of a rectangular, trapezoidal, triangular, or other shaped notch, located in a vertical, thin plate over which water flows.* |

# 1 PURPOSE OF THIS DOCUMENT

This document serves as the Final Environmental Impact Assessment (EIA) Report for the proposed Ncwabeni Off-Channel Storage (OCS) Dam, where the Department of Water Affairs (DWA) is acting as the project proponent. According to Government Notice (GN) No. R. 543 (18 June 2010), an EIA means a systematic process of identifying, assessing and reporting environmental impacts associated with an activity.

The proposed Ncwabeni OCS Dam project will consist of the following components:
1. An OCS dam on either the Ncwabeni River (site D2) or Gugamela River (site D3A);
2. An abstraction / gauging weir on the Mzimkhulu River;
3. An abstraction works with a mechanism to remove silt;
4. A pump station and pipeline to deliver water to the dam; and
5. An outlet infrastructure to make measured releases back to the Mzimkhulu River.

Key milestones that have been reached in the EIA process to date include the following:
- An Application Form for Scoping and EIA was submitted to DEA on 26 September 2011;
- The Final Scoping Report and Plan of Study for the EIA were approved by the Department of Environmental Affairs (DEA) on 26 April 2012; and
- The Draft EIA Report was lodged for public review from 19 November 2012 – 15 January 2013.

The Scoping and EIA Reports served to build on the following environmental investigations that were undertaken as part of the pre-feasibility and feasibility studies:
1. Mzimkhulu River Off-Channel Storage Dam Pre-Feasibility Study: Assessment of environmental issues associated with the proposed development of an off-channel storage dam along the Mzimkhulu River (2007); and
2. Ncwabeni: Off-Channel Storage Dam Feasibility Study: Module 1: Technical Study: Environmental Screening Investigation (2011).

# 2 DOCUMENT ROADMAP

As a minimum, the EIA Report aims to satisfy the requirements stipulated in regulation 31 of GN No. R. 543 (18 June 2010). **Table 1** presents the document's composition in terms of the aforementioned regulatory requirements.

**Table 1: EIA Report Roadmap in relation to GN No. R. 543**

| Chapter | Title | Correlation with GN No. R. 543 | |
|---|---|---|---|
| 1 | Purpose of this Document | – | – |
| 2 | Document Roadmap | – | – |
| 3 | Project Background and Motivation | – | – |
| 4 | Legislation and Guidelines Considered | – | – |
| 5 | EIA Process | – | – |
| 6 | Assumptions and Limitations | R31(2)(m) | A description of any assumptions, uncertainties and gaps in knowledge; |
| 7 | Need and Desirability | R31(2)(f) | A description of the need and desirability of the proposed activity; |
| 8 | Environmental Assessment Practitioner | R31(2)(a)(i-ii) | Details of -<br>(i) the EAP who compiled the report; and<br>(ii) the expertise of the EAP to carry out an environmental impact assessment; |
| 9 | Project Location | R31(2)(c) | A description of the property on which the activity is to be undertaken and the location of the activity on the property. |
| 10 | Project Description | R31(2)(b) | A detailed description of the proposed activity; |
| 11 | Profile of the Receiving Environment | R31(2)(d) | A description of the environment that may be affected by the activity |
| 12 | Summary of Specialist Studies | R31(2)(j) | A summary of the findings and recommendations of any specialist report or report on a specialised process; |
| 13 | Impact Assessment | R31(2)(d) | A description of the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity; |
| | | R31(2)(h) | An indication of the methodology used in determining the significance of potential environmental impacts; |
| | | R31(2)(k) | A description of all environmental issues that were identified during the environmental impact assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures; |
| | | R31(2)(l)(i-vii) | An assessment of each identified potentially significant impact, including— |
| | | | (i) cumulative impacts; |
| | | | (ii) the nature of the impact; |
| | | | (iii) the extent and duration of the impact; |

| Chapter | Title | Correlation with GN No. R. 543 | |
|---|---|---|---|
| | | | (iv) the probability of the impact occurring; |
| | | | (v) the degree to which the impact can be reversed; |
| | | | (vi) the degree to which the impact may cause irreplaceable loss of resources; and |
| | | | (vii) the degree to which the impact can be mitigated; |
| 14 | Analysis of Alternatives | R31(2)(g) | A description of identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment |
| | | R31(2)(i) | A description and comparative assessment of all alternatives identified during the environmental impact assessment process; |
| 15 | Public Participation – EIA Phase | R31(2)(e)(i-iv) | Details of the public participation process conducted in terms of subregulation (1), including: |
| | | | (i) steps undertaken in accordance with the plan of study; |
| | | | (ii) a list of persons, organisations and organs of state that were registered as interested and affected parties; |
| | | | (iii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and |
| | | | (iv) copies of any representations and comments received from registered interested and affected parties; |
| 16 | EIA Conclusions and Recommendations | R31(2)(n) | A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation; |
| | | R31(2)(o)(i-ii) | An environmental impact statement which contains— |
| | | | (i) a summary of the key findings of the environmental impact assessment; and |
| | | | (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives; |
| 17 | References | – | – |
| Appendix F | | R31(2)(p) | Draft environmental management programme containing the aspects contemplated in regulation 33; |
| Appendix E | | R31(2)(q) | Copies of any specialist reports and reports on specialised processes complying with regulation 32; |

# 3 PROJECT BACKGROUND AND MOTIVATION

## 3.1 Overview of the Umzimkhulu Water Supply System

The Umzimkhulu Regional Water Supply Scheme (RWSS), which forms part of the KwaZulu Natal (KZN) Lower South Coast System, supplies water to all urban coastal towns from Hibberdene to Ramsgate, as well as to many rural inland settlements such as Fairview, Kwa-Madlala, Louisiana, Bhoboyi, Murchison, KwaNdwalane, Izontsha, Kwa Mavundla, Gamalakhe, etc., with a total estimated present rural population size of about 152 450.

A significant growth in the water requirements for the system has been predicted through various previous studies, and a substantial portion of that growth can be associated with the increase of the level of service for the rural population as well as the planned extension of the system to cover additional rural areas, which are not presently supplied with water from the scheme.

**Figure 1: Rural setting in Lower South Coast System (Google Earth image)**

The water for the Umzimkhulu RWSS is presently sourced from non-regulated river flows in the Mzimkhulu River. The water is abstracted at the St. Helen's Rock abstraction works which is situated just downstream of the confluence of the Mzimkhulu and the Mzimkhulwana Rivers, near Port Shepstone (see **Figure 2**).

From the St. Helen's Rock abstraction works water is pumped by a low-lift pump station to settlement ponds, from where it is further pumped by a high-lift pump station to the

Mzimkhulu Water Treatment Works (WTW). The water is then distributed to the various user nodes.

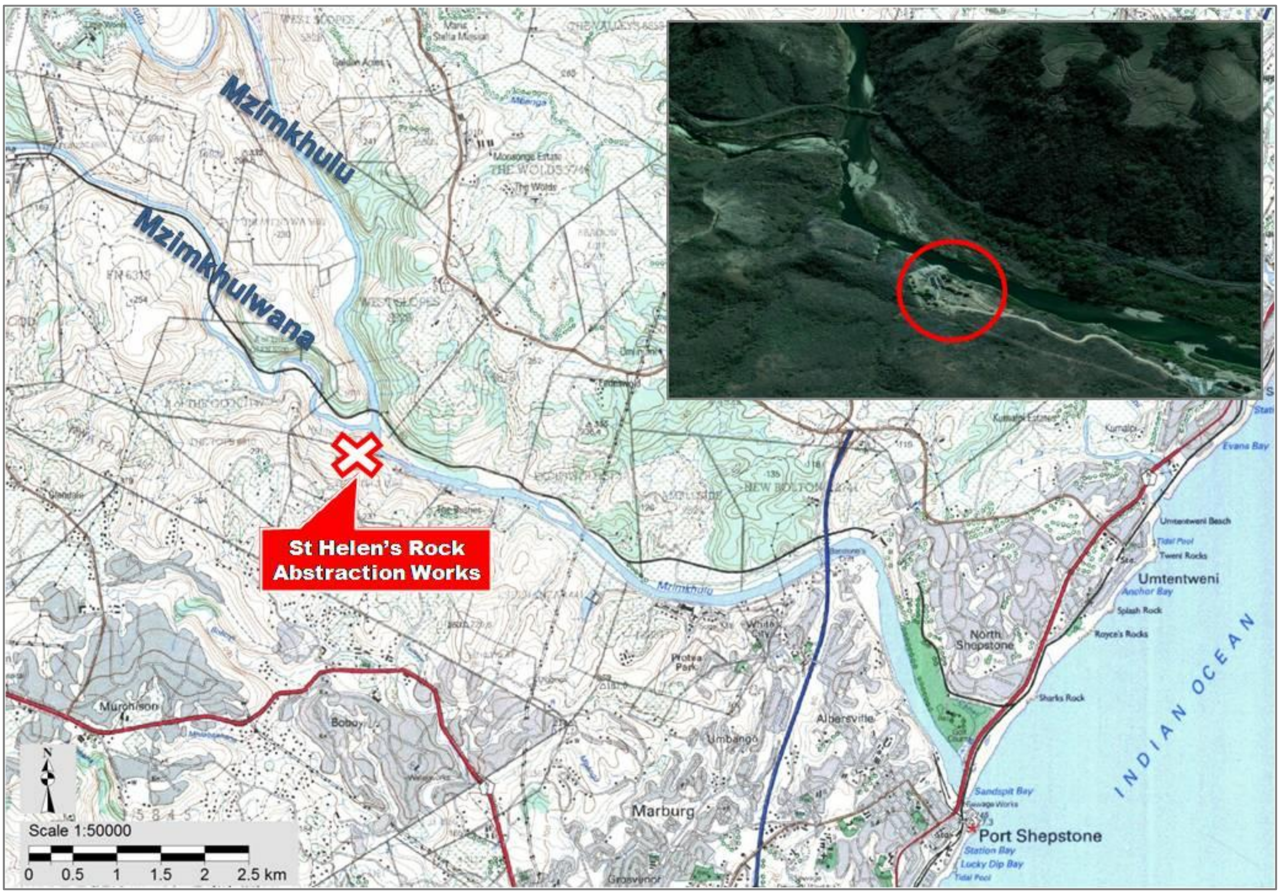



**Figure 2: Location of St Helen's Rock Abstraction Works**

## 3.2 Water Requirement Projections

The *Southern KwaZulu-Natal Water Resources Pre-feasibility Study Phase 1*, completed in 2002, concluded that during dry periods, the river flow is insufficient to meet the water requirements, even without provision for the release of the ecological Reserve. The study recommended that, in order to provide for the water requirements for all user

| Box 1: | Why off-channel storage? |
|---|---|

An on-channel dam is sited on a main-stem of a river or stream, and is filled directly by flow from the upstream catchment. An off-channel dam is sited outside the main river valley on a minor tributary or completely off stream, and it has a small natural drainage basin above the dam. The water to fill the off-channel dam is primarily diverted by gravity or pumping from a larger adjacent basin.

Benefits of an off-channel dam include:

- Off-channel storage has advantages in a system such as the Mzimkhulu River which has heavy silt loads;
- The dam positioned off the main channel on a tributary has little impact on both the water flow and silt régime of the river;
- The dam does not fill up with silt as would a dam on the main channel, which increases the dam's life span; and
- Abstractions are made during high flow months and stored for release during the low flow months.

sectors, including the Reserve, the construction of an off-channel storage (OCS) dam in one of the tributaries to the Mzimkhulu River, should be considered. The reservoir can be filled from its incremental catchment, supplemented by pumping from the Mzimkhulu River during times of high river flows. During times of low flows water can be released back into the Mzimkhulu River for abstraction downstream at the existing St. Helen's Rock abstraction works.

The *Southern KwaZulu-Natal Water Resources Pre-feasibility Study Phase 2*, which was completed in February 2005, investigated numerous options with regard to the position of the potential OCS dams. Four competitive sites which are located about 20km north-west of Port Shepstone were selected as the most feasible potential OCS dam sites. Two of the sites (D2 and D2A) were located on the Ncwabeni River while the other two (D3 and D3A) were on the Gugamela River. Conceptual designs for dams at these sites were undertaken as part of the afore-mentioned study.

Following on the above, the Reconnaissance Phase of the *Mzimkhulu River Off-Channel Storage Pre-feasibility Study*, completed in October 2007, re-assessed all four OCS dam options on the basis of more detailed hydrological modelling and updated information regarding water requirements, topographical surveys, geotechnical and flood hydrology data, which became available after completion of the *SKZNFS PH2*. It was established that the D3 site on the Gugamela River and the D2A site on the Ncwabeni River were distinctly less favourable than the other two sites and were therefore not investigated further.

For the Feasibility Study the water supply area has been expanded beyond the existing Mzimkhulu RWSS to also include the some of the Umzumbe rural areas closer to the Dam (see **Figure 3**). Umgeni Water is currently implementing the Mhlabatshane Scheme which will supply water to the Umzumbe area south of the Umzumbe River. The Mhlabatshane scheme will not have sufficient water, however, to supply the full planned supply area with the desired level of service (60 l/c/d).

As such, through discussions with the Ugu DM, it is proposed that the water supply to the Umzumbe area is augmented by the proposed OCS dam, so that the full desired level of service of 60 ℓ/c/d can be achieved. The lower lying areas furthest from the Mhlabatshane Dam could be supplied by the proposed OCS dam, leaving the higher lying areas closer to the Mlhabatshane Dam to be supplied by the Mhlabatshane WSS. The suggested split in supply as presented in **Figure 3**.

In addition to the Mhlabatshane supply area, the Assisi supply scheme water requirements has been added to the Umzimkhulu RWSS as the Assisi scheme cannot deliver sufficient water to meet the full demand, and the water of the Umzumbe River currently being used to supply the Assisi scheme can be better utilised north of the Umzumbe River where there is a water resources shortage.

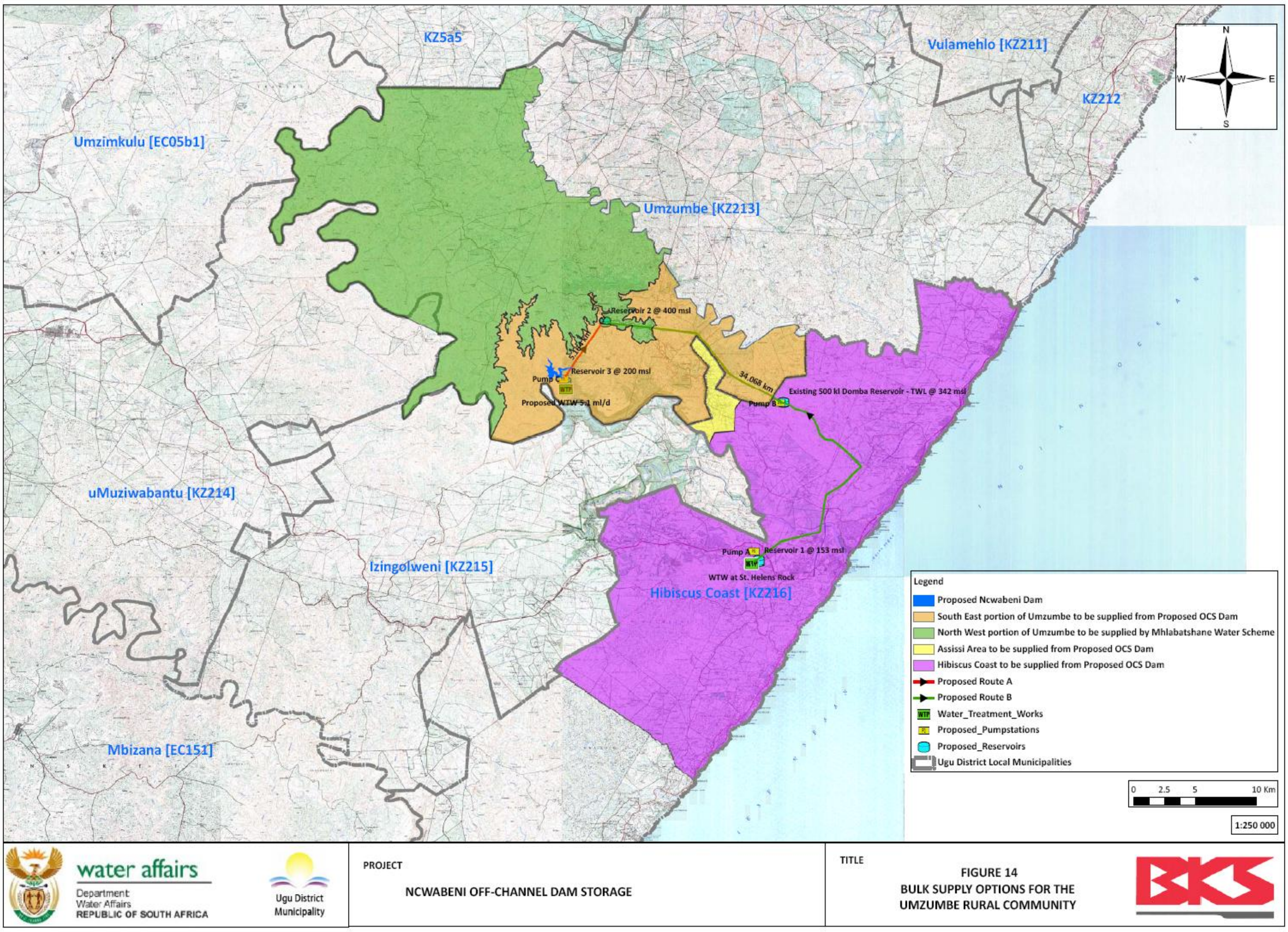



**Figure 3: Ncwabeni OCS Dam Supply Area – Mzimkhulu RWSS and Umzumbe**

**Figure 4** displays the historical growth in water supply/requirements for the past 15 Years, as well as the current availability of about 18.5 million m3/a. The demand for water is expected to exceed the water availability from the river by 2012 before even leaving water in the river for the ecology (implementation of the Reserve). As such the water resource needs urgent augmentation. As a significant infrastructure solution such as the proposed off-channel storage dam can only be implemented by 2017 at the earliest, the short term solution of reducing water losses in the system through water conservation and water demand management measures (WC/WDM) is anticipated. The implementation of WC/WDM is shown in **Figure 4** as the flattening of the water requirement projections between 2010 and 2015. The total water requirement projections for the existing Mzimkhulu RWSS (dotted line), and the additional Umzumbe area included (red solid line) are projected up until 2040. The addition of the Umzumbe area to the Mzimkhulu supply area adds an additional 1 to 2 million $m^3$/a demand to the system. The total demand for water that needs to be augmented by the proposed off-channel storage dam is about 30 million $m^3$/a by 2040. The off-channel storage dam has been sized accordingly.

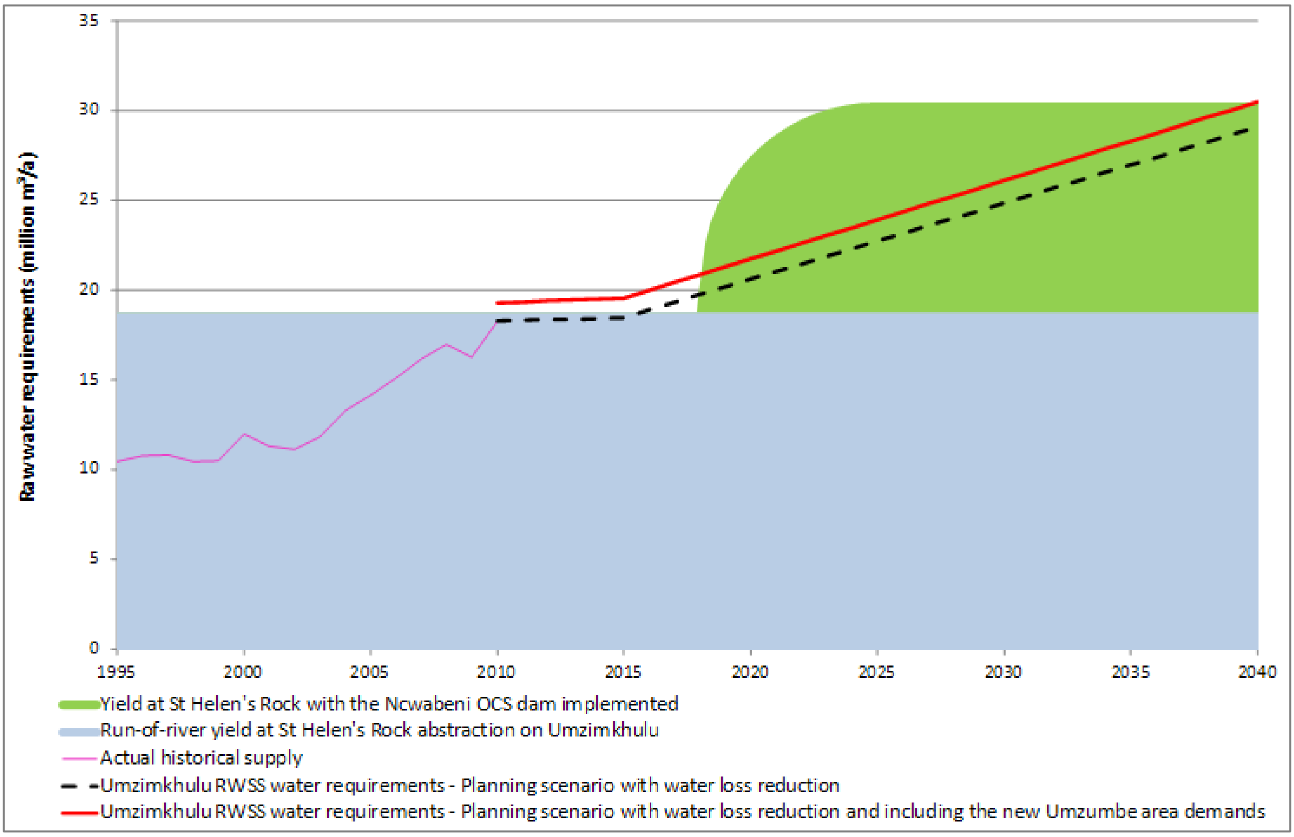



**Figure 4: Water Requirement projections for the Mzimkhulu RWSS including the additional Umzumbe supply area**

## 3.3 Background to Project Title

Although it would have been preferable for the name of this study to have been the “Mzimkhulu River off-channel storage Dam”, it was changed to avoid confusion with a different existing off-channel storage balancing dam that is as part of the Mzimkhulu Region supply scheme. The existing off-channel storage balancing dam was already called the “Mzimkhulu off-channel storage Dam” and provides short term water storage for the operation of the regional water supply scheme.

As such, the name of the proposed off-channel storage dam and associated study was changed to avoid confusion during the feasibility phase. Ultimately the dam, if constructed, would most likely receive a new name according the DWA’s dam naming protocol.

# 4 NEED AND DESIRABILITY

In terms of Regulation 28(1)(i) of GN No. R. 543 (18 June 2010), this section discusses the need and desirability of the project. The format contained in the Guideline on Need and Desirability (DEA&DP, 2009) has been used in **Table 2**.

**Table 2: Need and Desirability of the Project**

| No. | Question | Response |
|---|---|---|
| | | **NEED ('timing')** |
| 1. | Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP). | The Ugu District Municipality is the Water Services Authority for all the local municipalities within its area of jurisdiction. Hence, Umzumbe Local Municipality is dependent on Ugu District Municipality for water supply.<br><br>According to the UDM IDP, key objectives for Basic Water Services Delivery include:<br>• To fast-track and improve the delivery and the quality of potable water (within government targets);<br>• To ensure access to rudimentary water services for communities below RDP Standards and<br>• To ensure sustainable infrastructure development.<br><br>The proposed Ncwabeni OCSS will greatly aid the UDM in meeting these objectives. |
| 2. | Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time? | The Southern KwaZulu-Natal Water Resources Pre-Feasibility Study (DWAF, 2004b) was conducted to determine water requirements and water availability of the area under investigation. During Phase 1 of the project it was determined that if the Ecological Reserve is implemented there is a shortfall in water available for current abstraction from the Mzimkhulu River throughout the year. Should the Reserve not be accounted for, there will still be a shortfall between July and October each year.<br><br>Several options to augment the supply of the required water were investigated during Phase 2 of the abovementioned study. The construction of an OCS dam as part of a larger scheme of upgrading the current infrastructure and linking it to other existing systems was identified as the preferred alternative (BKS, 2011). |
| 3. | Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate). | The Water Services Development Plan for Ugu District Municipality has prioritised the provision of potable water in rural areas, which is informed by more than 50% backlog of water supply in areas of Umzumbe (Umzumbe Local Municipality, 2009).<br><br>Localised impacts associated with the project (e.g. resettlement of households) are assessed in **Section 12**. |
| 4. | Are the necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development? | Realignment of existing access road required to allow for continued use by local community. |

| No. | Question | Response |
|---|---|---|
| 5. | Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services)? | The UDM will possibly operate the OCS dam, once completed. The district is in the process of initiating an EIA for the upgrading of the existing abstraction works at St Helen's Rock. Amongst others, this will improve the management, control and economic use of raw water to be released from the proposed Ncwabeni OCS Dam.<br><br>The Ncwabeni OCS Dam was identified in the UDM IDP as a key intervention required in terms of service delivery in water infrastructure development in the district. |
| 6. | Is this project part of a national programme to address an issue of national concern or importance? | According to the Internal Strategic Perspective (ISP) for the Mvoti to Mzimkhulu Water Management Area (WMA) (DWAF, 2004a), the natural river flow in the Mzimkhulu during dry periods may not be sufficient to meet the requirements of the Reserve, because of large numbers of people being dependent on run-of-river abstractions for their basic needs, together with the relatively high requirements for the ecological component of the Reserve. The Ncwabeni OCS dam intends to address this deficit by meeting the water demands of the Umzimkhulu RWSS, which forms part of the KZN Lower South Coast System. |
| **DESIRABILITY ('placing')** | | |
| 7. | Is the development the best practicable environmental option (BPEO) for this land/site? | A number of factors were considered in selecting the sites for the proposed OCS Dam, such as streamflow hydrology, geological conditions, topography, availability of construction material, seismic hazard, sediment yields, etc. The BPEO was determined following a comparative analysis of the feasible alternatives – see **Section 13**. |
| 8. | Would the approval of this application compromise the integrity of the existing approved municipal IDP and SDF as agreed to by the relevant authorities? | It is not anticipated that the proposed OCS Dam will contradict or be in conflict with the municipal IDPs and SDFs. Resolution on the project was also reached at a Councillor Meeting held at the Ugu District Municipality.<br><br>According to the Umzumbe Local Municipality SDF, the dam sites are located in an area that has particular value in terms of tourism. This aspect will need special consideration as part of the Resource Management Plan for the Ncwabeni OCS Dam, where the vision for the area will need to be supported through the provisions in this Plan. |
| 9. | Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations? | Compatibility of project with C-plan and other environmental management and planning tools were considered during the EIA phase.<br><br>According to the Umzumbe Local Municipality SDF, the dam sites are located in an area that has particular value in terms of tourism. This aspect will need special consideration as part of the Resource Management Plan for the Ncwabeni OCS Dam, where the vision for the area will need to be supported through the provisions in this Plan. |
| 10. | Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context). | As part of the technical analysis, a number of factors were considered in selecting the sites for the proposed OCS Dam, such as streamflow hydrology, geological conditions, topography, availability of construction material, seismic hazard, sediment yields, etc. The specialist studies, as part of the EIA phase, further investigated the locations based on sensitive environmental features and receptors. |

| No. | Question | Response |
|---|---|---|
| 11. | How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)? | • Refer to impact assessment contained in **Section 12**.<br>• Potential impacts during construction phase to be managed through EMPrs for the project's main components. |
| 12. | How will the development impact on people's health and wellbeing (e.g. i.t.o. noise, odours, visual character and sense of place, etc)? | |
| 13 | Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs? | Opportunity costs, which are associated with the net benefits forgone for the development alternative, were considered as part of the Socio-economic Study. |
| 14 | Will the proposed land use result in unacceptable cumulative impacts? | Refer to impact assessment contained in **Section 12**.<br><br>It is believed that the cumulative impacts can be mitigated to a satisfactory level. |

# 5 PROJECT LOCATION

The project area is situated in the central part of KZN, approximately 20km north-west of Port Shepstone (**Figure 5**). The two OCS Dam sites are located close to the southern boundary of Ward 1 of the Umzumbe Local Municipality (KZ213), which falls within the Ugu District Municipality (DC21) (see **Figure 6**).

The Umzumbe Local Municipality covers a vast, largely rural area of some 1260 $km^2$ with approximately 1% being built up / semi-urban area. The municipality incorporates 17 traditional authority areas comprising 19 municipal wards.

The project area falls under the Cele K Tribal Authority, on land which is registered under the Ngonyama Trust. The property description is as follows: Alexander Native Location No. 6, Farm Number 16462 (see **Figure 7**).

The area is characterised by traditional homestead settlements and rural subsistence agriculture, situated on communal land. The land on the opposite bank of the Mzimkhulu River (Gibraltar 8258) is privately owned and commercially farmed, and the farm is known as Camro Estates.

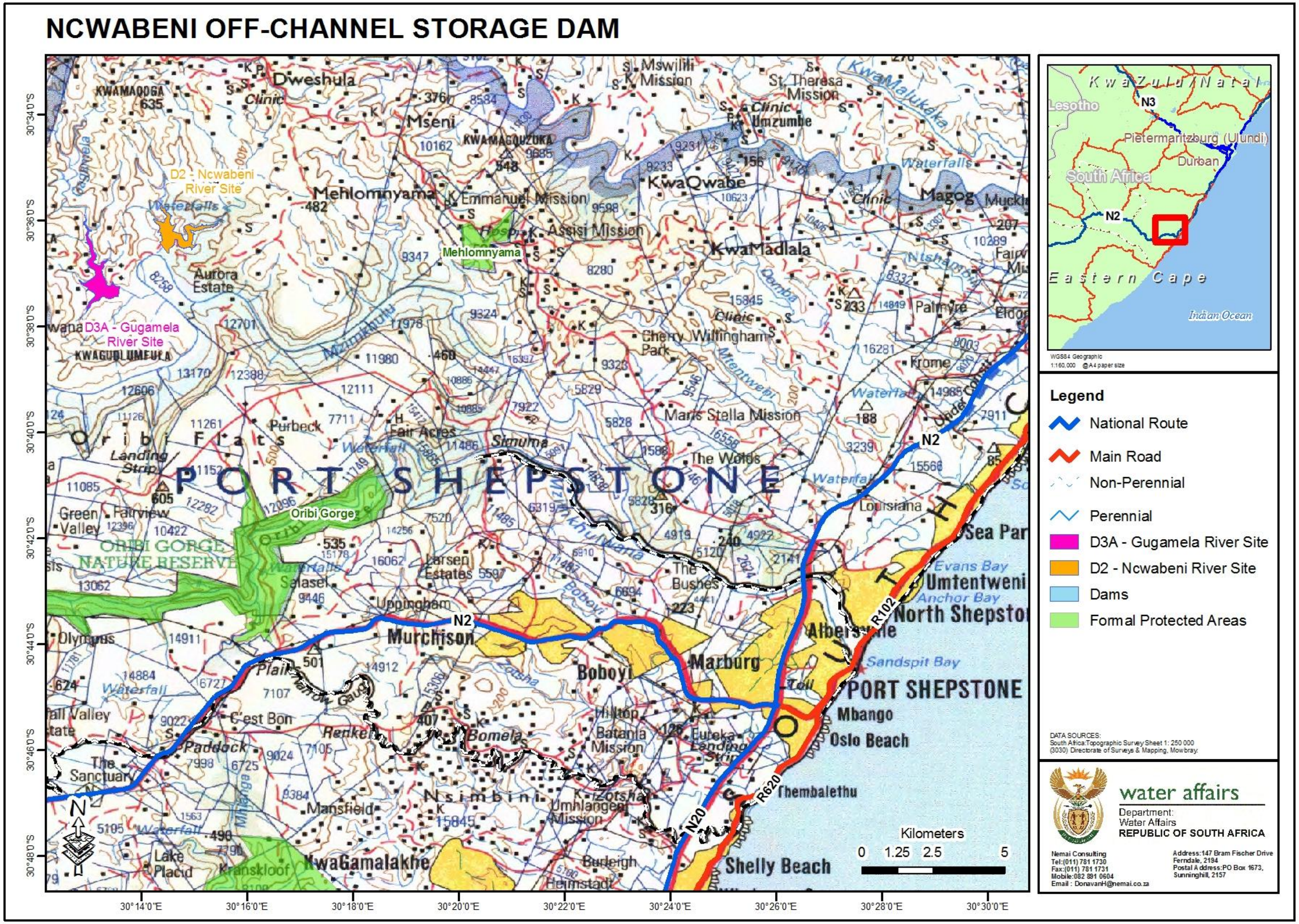



**Figure 5: Regional Locality Map**

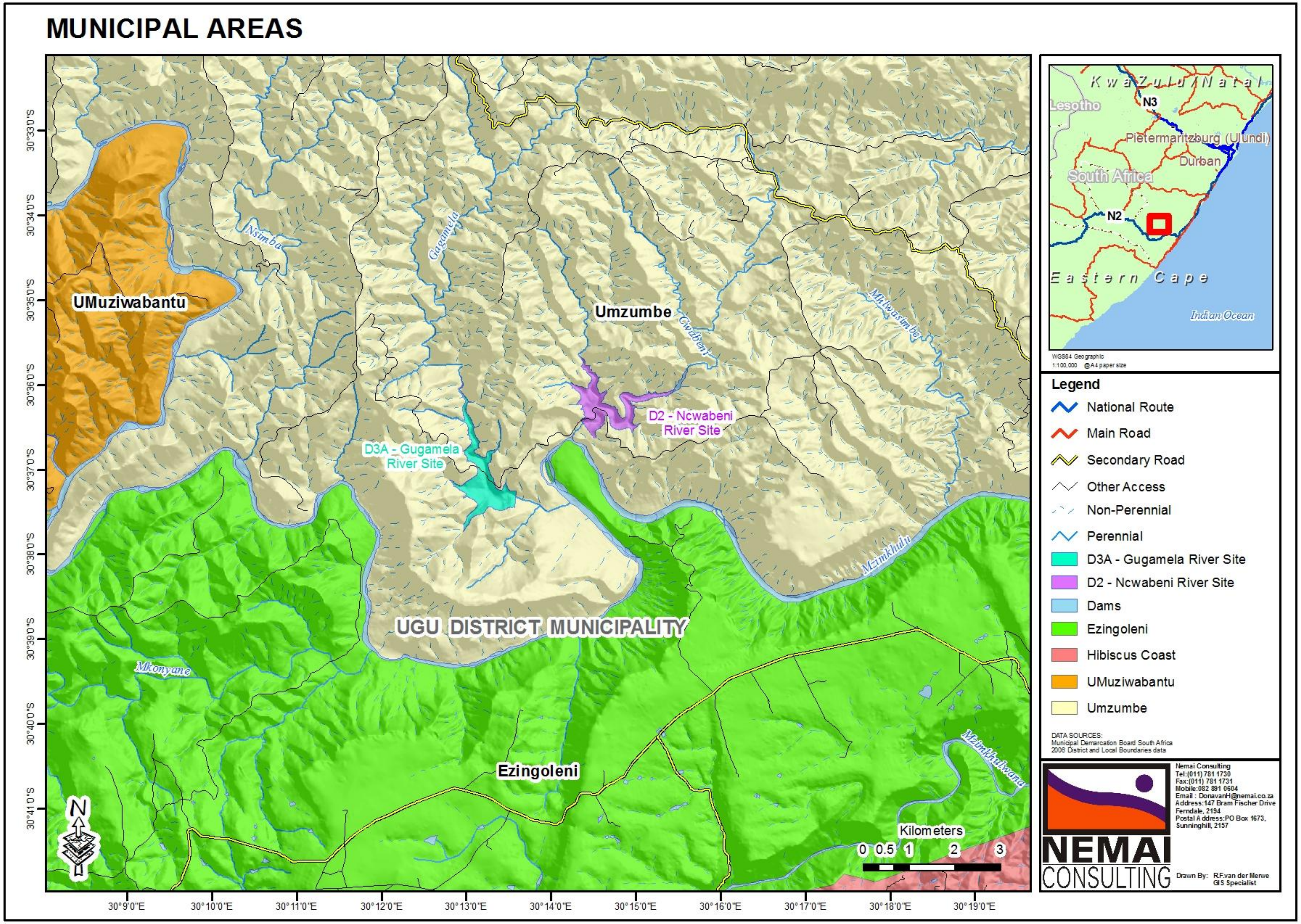



**Figure 6: Municipal Map**

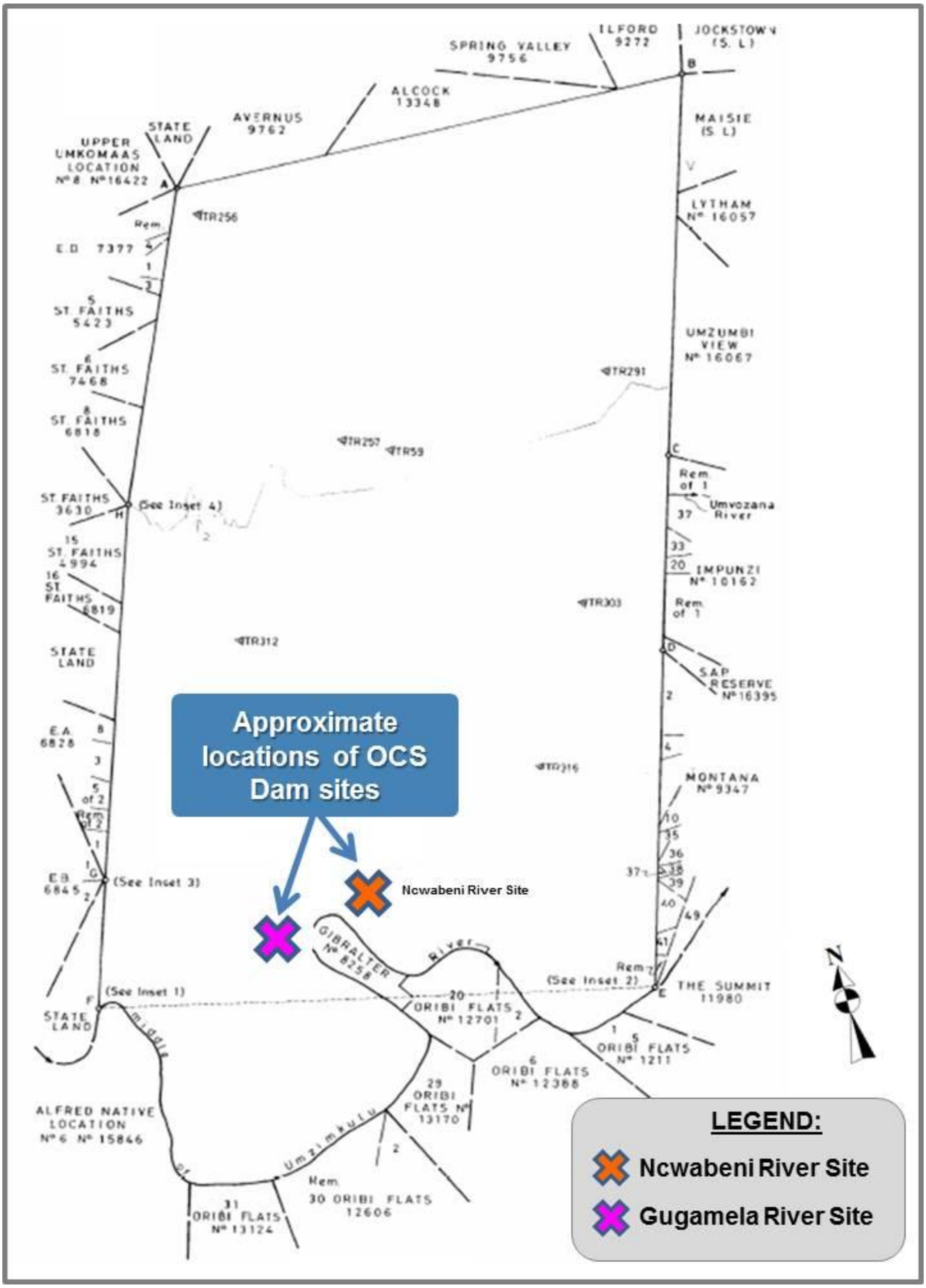



**Figure 7:** Title deed map of *Alexander Native Location No. 6*, Farm Number 16462 (DWAF, 2007c)

# 6 PROJECT DESCRIPTION

## 6.1 Screened Alternatives

### *6.1.1 Southern KwaZulu-Natal Water Resources Pre-feasibility Study*

The Southern KwaZulu-Natal Water Resources Pre-feasibility Study (DWAF, 2002) was split into two phases. Phase 1 of the study concentrated on data acquisition to establish the base condition and on identifying possible water conservation measures to reconcile resource availability with demand. When Phase 1 of the study revealed the need to develop new water resources, Phase 2 of the study was activated. In this Phase 2 the various development options were screened and evaluated from engineering, social, economic and environmental perspectives.

Phase 1 of the pre-feasibility study was completed in July 2002. It revealed that the current levels of water requirements and reductions in streamflow resulted, or shortly will result, in water supply problems, particularly for the residential and commercial sectors situated along the coast and the irrigation in the upper Mzimkhulu River. Phase 1 of the study demonstrated that, although there are adequate water resources, these need to be developed by provision of storage and improving the efficiency of river abstraction.

As part of the Southern KwaZulu-Natal Water Resources Pre-feasibility Study, a phased development approach was anticipated by differentiating between short, medium and long-term infrastructure requirements. The short term was regarded as between 0 and 5 years, medium term as between 5 and 10 years and long term as more than 10 years. To facilitate the combination of development options, the anticipated timing for implementation was indicative of the interpretation of potential raw water supply short falls. Refer to the potential development options contained in **Table 3**, where emphasis has been placed on those interventions for the Mzimkhulu River.

**Table 3: Identification of potential development options for the Lower South Coast Water Supply System (DWAF, 2002)**

| Anticipated Implementation Period | Scheme description | River |
|---|---|---|
| **Short term** | 1) Improve abstraction efficiency at existing works | Mzimkhulu |
| **Medium term** | 2) Linking the Mzinto system with the Mzimkhulu system | Mzimkhulu |
| | 3) Develop off-channel storage dams on the Mzimkhulu: | |
| | • Proposed dam site D1 | Sinyazi |
| | • Proposed dam site D2 and D2a | Ncwabeni |
| | • Proposed dam site D3 and D3a | Gugamela |
| | 4) Raising of Gilbert Eyles dam | Mzimkhulwana |
| | 5) Desiltation of Gilbert Eyles dam | Mzimkhulwana |
| **Long term** | Regional storage schemes: | |
| | 6) Link to Mkomazi system – Temple or Ngwadini dams | Mkomazi |
| | 7) Umgeni Water Scheme – Upper part of Mzimkhulu river | Mzimkhulu |

The above listed potential bulk water supply schemes represented a very wide spectrum of solutions to the end users in the study area. The following 8 pragmatic principles were applied to select the most promising development options for further investigation:

- The sustainable spare capacity in the existing WTP infrastructure must be utilized optimally;
- The capacity of the existing storage and distribution infrastructure must be utilized optimally on a regional basis;
- The development scheme should facilitate more flexibility in the management of regional water supply;
- The development scheme should facilitate a fully integrated and phased development process;
- The development scheme should minimize the cost implications to customers where there are not sufficient economies of scale to justify large capital expenditure;
- The development scheme should facilitate the improvement of water quality;
- The development scheme should be technically feasible and facilitate the management of technical risks; and
- The development scheme should be environmentally sustainable and facilitate the management of risks in this regard.

Applying the above principles to the identified development options the most promising combination of options, as reflected in **Table 4**, were selected.

**Table 4: Development Options for the Lower South Coast Water Supply System (DWAF, 2002)**

| Development Sequence | Development Scheme | Option L1 | Option L2 | Option L3 |
|---|---|---|---|---|
| Phase 1 | Construct weir at St. Helens Rock Abstraction works | √ | √ | √ |
| Phase 2 | Linking the Mzimkhulu system with the Mzinto system | √ | √ | √ |
| Phase 3 | Construct OCS dam in Ncwabeni River. Site D2 | √ | | |
| Phase 3 | Construct OCS dam in Gugamela River. Site D3 | | √ | |
| Phase 3 | Raise Gilbert Eyles dam. | | | √ |
| Phase 4 | Link to Mkomazi system<br>Ngwadini dam or similar scheme | √ | √ | √ |

The following conclusions were drawn in the Southern KwaZulu-Natal Water Resources Pre-feasibility Study (DWAF, 2002), with specific reference to the Mzimkhulu River:

- The Mzimkhulu WTP has spare capacity that can be more optimally used to supplement neighbouring water supply systems if combined with flow regulation in the Mzimkhulu River;
- The Mzimkhulu River with a relatively large catchment, is less sensitive to increased future water abstractions even if accompanied with the implementation of the Reserve;
- The flow in the Mzimkhulu River has been affected by the run of river abstraction operations for a period of more than 30 years. Neither the river nor the estuary are in a pristine condition;
- Off channel pump storage is the preferred approach to efficient sedimentation management in the river with relatively high silt loads;
- The solid granite river bedrock conditions in the Ncwabeni River (Site D2), which is a tributary of the Mzimkhulu River, offers the best founding conditions of all the off-channel pump storage schemes investigated;
- The Ncwabeni River catchment is relatively undeveloped, thus offering better quality water. The plant species diversity and scarcity need to be confirmed;

- The concrete gravity dam options for the OCS dams are more economical than the earthfill options due to founding and spillway requirements. The RCC option is more economical than the conventional mass concrete option;
- The development of a 9.5million $m^3$ RCC off-channel pump storage dam in the Ncwabeni River (Site D2) is the preferred Mzimkhulu River regulating option;
- The option to develop the Mzimkhulu River system appears to be economically more viable compared to the option to purchase treated water from Umgeni Water from the Mgeni River. This comparison is however based on the assumption that the Reserve is not implemented in the Mtwalume River; and
- In the event that the off-channel pump storage option is accepted, the weir at the abstraction works on the Mzimkhulu River needs to be developed immediately.

Note that some of these conclusions have been updated through subsequent studies.

### *6.1.2 Mzimkhulu River Off-Channel Storage Pre-feasibility Study*

The scope of the Mzimkhulu River Off-Channel Storage Pre-feasibility Study (DWAF, 2007a) was to select the best OCS scheme (consisting of an abstraction weir, a pumping station, a rising main, and an OCS dam), based on engineering feasibility, economic viability and environmental acceptability.

During the Reconnaissance Phase of the Mzimkhulu River Off-Channel Storage Pre-feasibility Study the development of OCS dams at four possible sites, D2 and D2A on the Ncwabeni River and D3 and D3A on the Gugamela River, was investigated. The yields for each of these dams were determined for two options, namely – yield generated from the local catchment upstream of the dam and yield from local catchment, but supplemented by pumping from the Mzimkhulu River. The following conclusions were drawn:

- If no pumping from the Mzimkhulu River is considered and the Ecological Reserve is released, none of the dams considered can meet the projected 2025 water requirements of 22 million $m^3/a$ at St. Helen’s Rock based on the yield generated from their own catchments; and

- If pumping from the Mzimkhulu River is considered, the yields from the dams increase considerably. The planning scenario water requirements in 2025 can be met by all individual dams, except for D3.

Initially, all four development options were sized for a range of dam wall heights. The relevant construction quantities for each dam and height were determined and the corresponding costs were estimated using models developed for each dam type. On the basis of that, the cost-yield relationships for each dam site, based on the yield generated from the dam catchment alone, were established. The optimal maximum dam height for each dam was then selected from the cost-yield curves. Based on the cost estimates and considering other factors affecting the developments, all options were evaluated in broad terms. It was concluded that dam sites D3 and D2A are substantially less favourable than sites D2 and D3A, and could therefore be excluded from further consideration.

#### *6.1.3 Multi-Purpose Dam*

Various upstream multi-purpose dams were considered at a reconnaissance level by other water resources studies. As part of the Feasibility Study a yield analysis was conducted to evaluate the merits of a multi-purpose dam and to determine the size of the on-channel dam that would be required to solve the Umzimkhulu RWSS's water shortfalls.

An upstream multi-purpose dam would need to be linked to afforestation as a mitigation dam, as the most likely other potential user of water in the catchment. Most large afforestation development potential is in the Bisi River, a major tributary of the Umzimkhulu. To effectively mitigate the impacts of afforestation on the river flow regime, the dam would need to be close to the afforestation developments (see **Figure 8**). Trying to operate a dam higher up in the system and accurately release water for the abstraction in the Lower Umzimkhulu for Port Shepstone would be difficult. The dam would also require approximately 45 million $m^3$ storage capacity (17 million $m^3$ for sediment), which is significantly more storage than is needed for the OCS dam

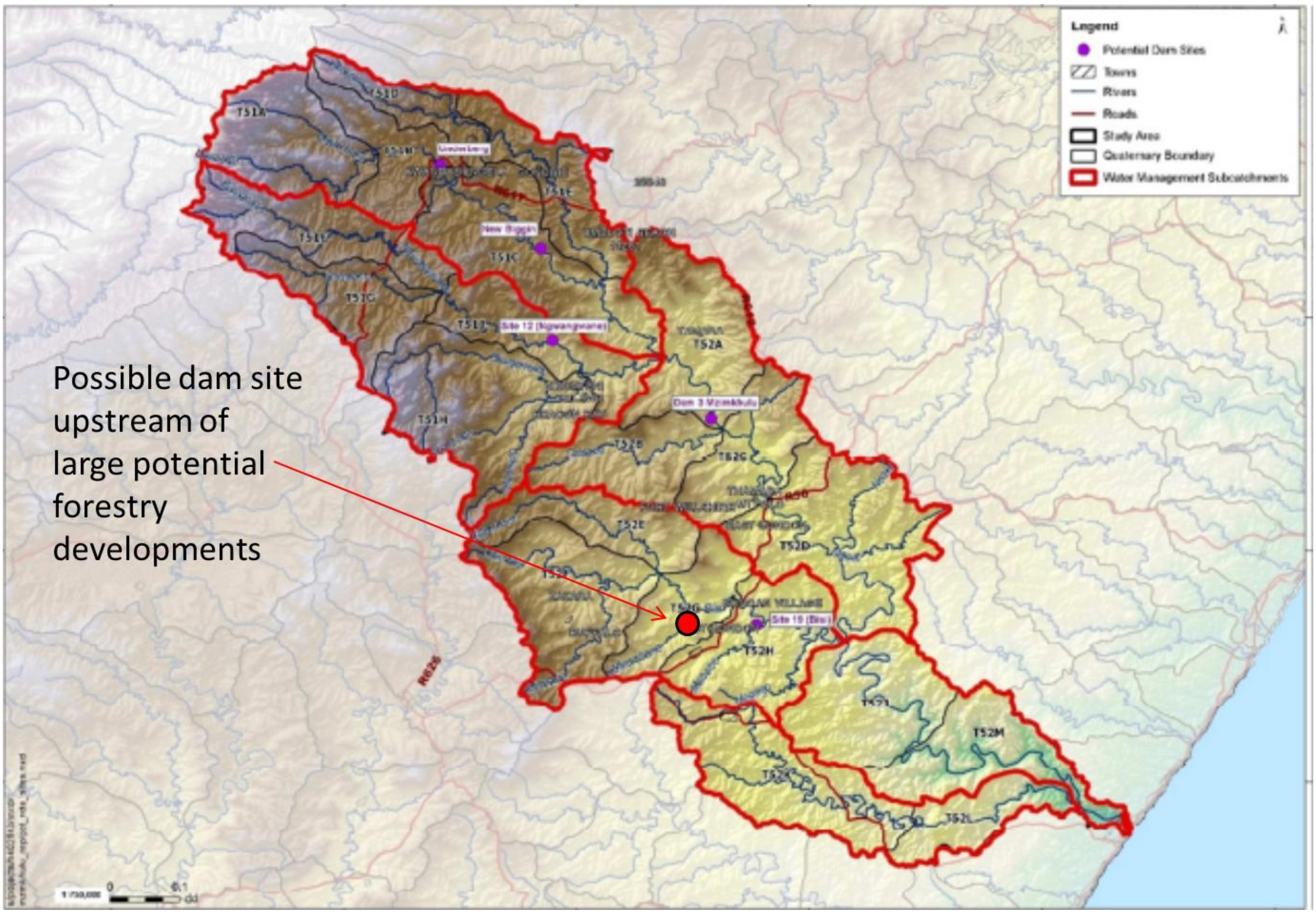



**Figure 8: Possible location of multi-purpose dam (upstream of potential large forestry developments)**

The actual size of the dam needed for mitigation due to afforestation is fairly small and as such the portion of afforestation contributing towards a multi-purpose dam is small and the scheme loses its "multi-purpose" attractiveness and benefits. Afforestation developments would probably be better off building a few "large-farm dams" to solve their specific problem.

Larger multi-purpose dams upstream have not been studied in any detail and are only at a conceptual level. To further study and implement one of these dams would take much longer than implementing the proposed OCS dam. This would delay the augmentation of the water resource, which is critical to address water demands of the Umzimkhulu RWSS.

## 6.2 Project Components

The proposed project consists of an OCS scheme on either the Ncwabeni River (site D2) or Gugamela River (site D3A) - refer to the aerial map (**Figure 9**) and elevated views of the sites (**Figures 10 – 11**). The catchment areas for the two OCS dams are shown in **Figure 12**.

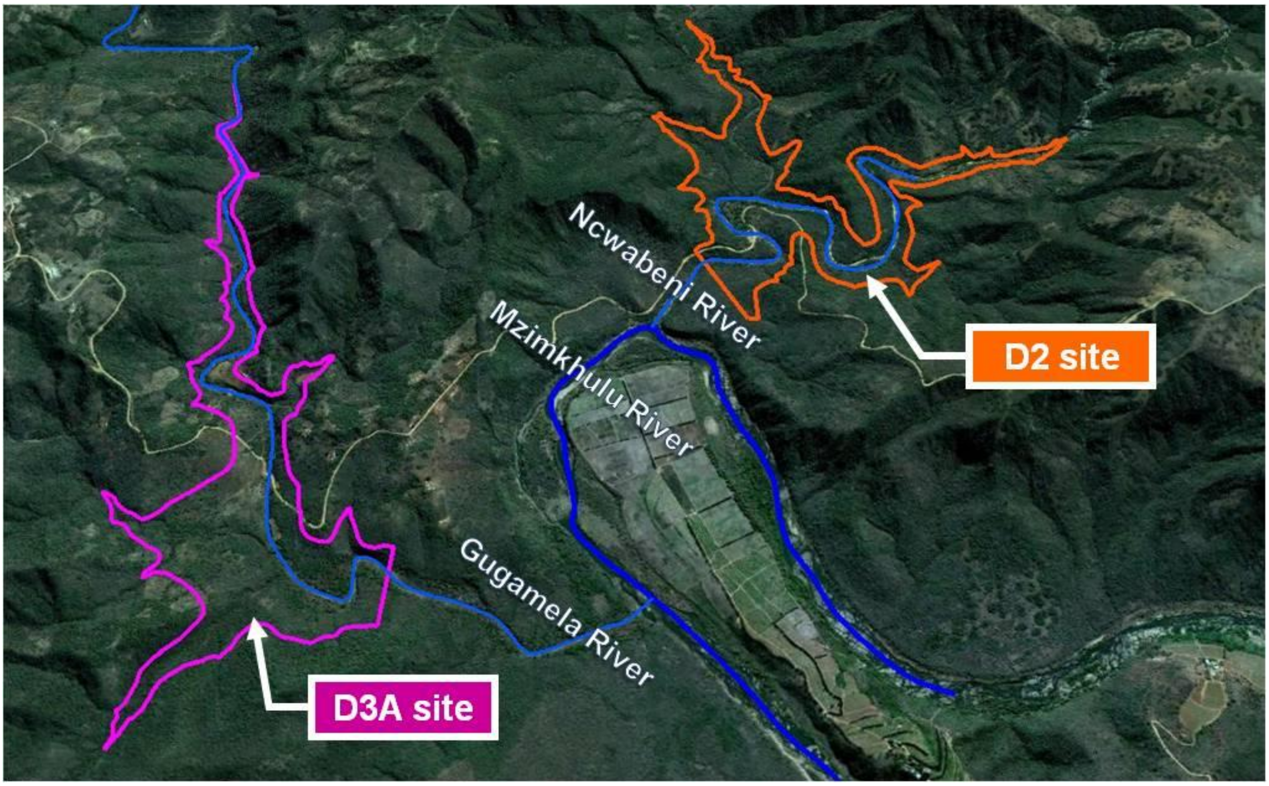



**Figure 9: Aerial view of OCS Dam Sites**

The alternative layouts for the two schemes are contained in **Appendix B1**. The OCS scheme will consist of the following components:

5. An OCS dam and outlet infrastructure to make measured releases back to the Mzimkhulu River;
6. An abstraction / gauging weir on the Mzimkhulu River;
7. An abstraction works with a mechanism to remove silt; and
8. A pump station and pipeline to deliver water to the dam.

**Figure 10:** **Elevated view of Site D3A**

**Figure 11:** **Elevated view of Site D2**

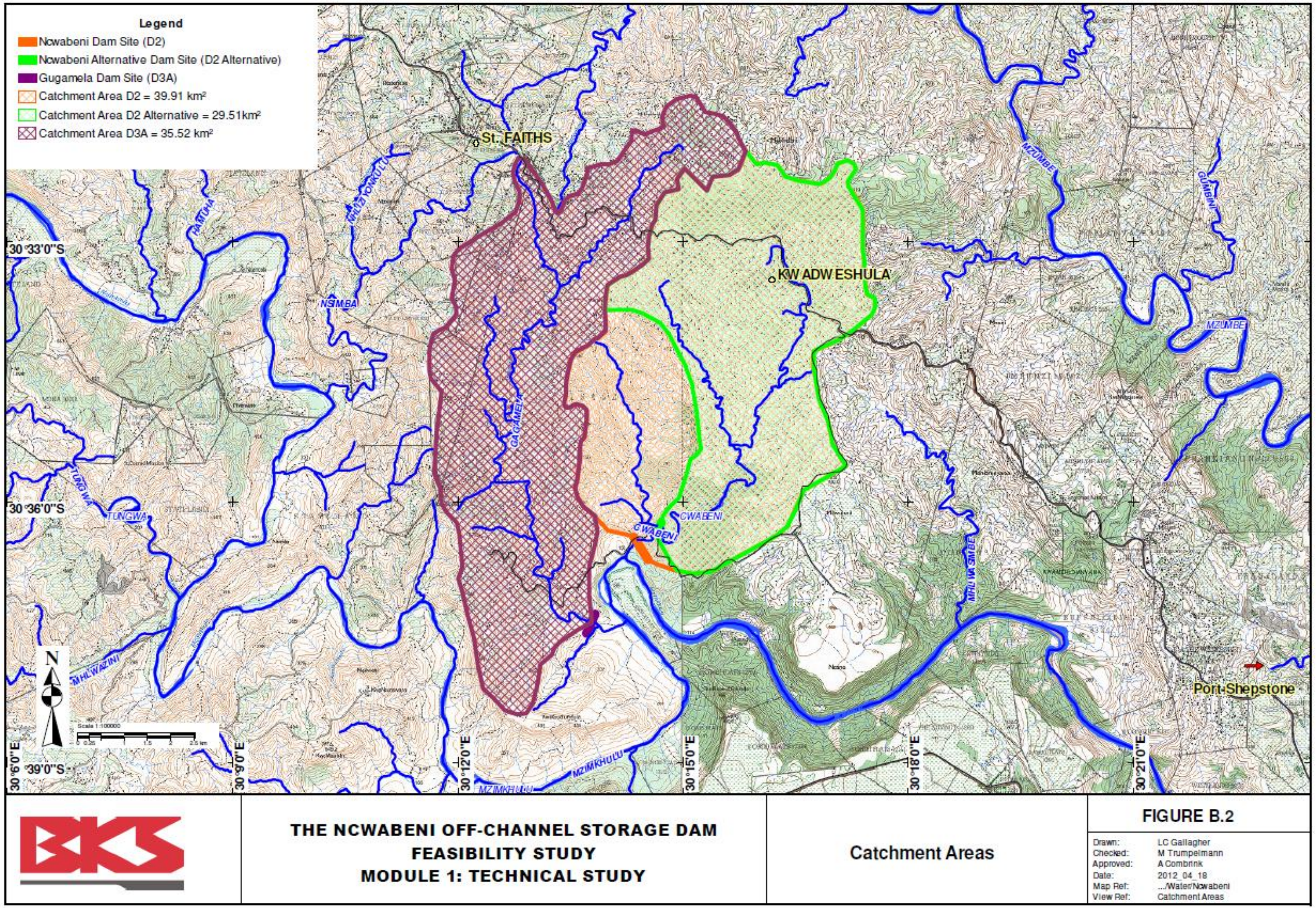



**Figure 12:** **Catchment areas for sites D2 and D3A (BKS, 2012c)** ***(Note: disregard 'D2 alternative')***

The salient parameters for the two dam options are summarised in the table to follow.

**Table 5: Approximate Parameters of dam options**

| Parameter | Development Option | |
|---|---|---|
| | D2 | D3A |
| Dam type(s) | Composite (concrete gravity/earthfill) | |
| River | Ncwabeni | Gugamela |
| Coordinates of centreline (approximate) | 30°36'27.1"S; 30°14'22.2"E | 30°37'19.2"S; 30°13'35.1"E |
| **Dam Characteristics** | | |
| River bed level (m.a.s.l.) | 122.5 | 131.5 |
| Inundation area ($km^2$) | 0.95 | 0.98 |
| Full supply capacity – Gross ($10^6$ $m^3$) | 15.8 | 16.0 |
| Full supply capacity – Net ($10^6$ $m^3$) | 13.2 | 13.4 |
| Catchment area ($km^2$) | 39.8 | 34.6 |
| Free board height (m) | 3.5 | 3.5 |
| Non-overspill crest level - NOCL (m.a.s.l.) | 171.0 | 180.5 |
| Dam wall height from NOCL to river bed (m) | 48.5 | 49.0 |
| Dam wall height from NOCL to foundation (m) | 49.5 | 51.0 |
| DWA classification | Category III | Category III |
| **Spillway** | | |
| Design flood | 415 | 385 |
| Safety evaluation flood (SEF) | 985 | 905 |
| Spillway type | Side channel with a length of 50m for both dam sites | |
| Spillway length (m) | 100.0 | 70.0 |
| **Pipeline** | | |
| Total length of pipeline (rising plus gravity main) | 600 m | 1 600 m |
| Rising main nominal diameter | 900 mm | 900 mm |
| Flow rate | 1 $m^3$/s | 1 $m^3$/s |

Each of the components of the OCS dam is discussed in greater details in the sub-sections to follow. The majority of this information was sourced from the Ncwabeni: Off-Channel Storage Dam Feasibility Study: Module 1: Technical Study: Supporting Report 3: Design and Cost Estimates (BKS, 2012c).

### *6.2.1 OCS Dam*

The OCS dam will consist of the following:

- OCS dam embankment;
- Spillway, chute and stilling basin; and
- Outlet works.

#### 6.2.1.1 OCS Dam Embankment

The two main dam types that were considered included:

- A rockfill dam with either a concrete face, asphalt core or a bentonite/sand core; and
- A Roller Compacted Concrete (RCC) dam.

Further investigations into the dam type during the Feasibility Study focused on the following three alternatives on the Ncwabeni River to carry through to the feasibility design stage:

1. RCC gravity dam;
2. Zoned earthfill embankment dam; and
3. Concrete Faced Rockfill (CFR) dam.

The cost estimates for these options after the third phase of geotechnical investigations (drilling, sampling of cores and testing) are listed in the table to follow.

**Table 6: Summary of Cost Estimates for Various Dam Types (BKS, 2012c)**

| Dam Type | Comparable Cost (R million)* |
|---|---:|
| RCC Dam | 861.1 |
| Earthfill Dam | 337.1 |
| CFR Dam | 412.3 |
| Earth Core Rockfill Dam | 364.3 |
| Asphalt Core Rockfill Dam | 1,009.9 |
| Bentonite Core Rockfill Dam | 362.3 |

* Costs include Preliminary and General, Preliminary works, Contingencies, Planning, Design, Supervision and VAT

The cost for an RCC dam was much higher than for the earthfill and CFR dams, and the RCC option was thus discarded. Sufficient earthfill materials and sandy materials for the Bentonite Core or Earth Core Rockfill dams were not found during the material investigation. However, a rockfill and concrete material quarry was identified and tested inside the dam reservoir and was deemed to be good to use. The CFR Dam was thus selected as the preferred option for the feasibility design.

A typical cross-section for a CFR Dam is provided in **Appendix B2**. The layout of the main embankment at site D2 is provided in **Appendix B3**.

#### 6.2.1.2 Spillway, Chute and Stilling Basin

Flood frequency analyses were conducted as part of the Mzimkhulu River Off-Channel Storage Pre-Feasibility Study (2007) and were used for the sizing of the spillway, chute and stilling basin.

In line with the Guidelines on Safety in Relation to Floods (SANCOLD), the spillway for a Category III dam (large size and high hazard rating) should be capable of discharging the attenuated Recommended Design Flood (RDF) equal to the 200-year flood with adequate dry freeboard for wind, wave and surge effects, without damaging the dam. In addition, the spillway should accommodate the attenuated Safety Evaluation Flood (SEF) with zero dry freeboard, accepting damage to the dam, but not catastrophic failure (BKS, 2012c).

For site D2, the rockfill dam type will have a spillway, weir and chute that are routed directly to the Mzimkhulu River from the left flank of the dam. In the case of site D3A, the spillway of an embankment dam would be a side channel spillway delivering water back into the Gugamela River instead of directly into the Mzimkhulu River. For the RCC dam a central spillway will be required.

The energy dissipating structure at the outlet of the chute is designed for the routed RDF. In the event of an SEF, damage would occur at the stilling basin but the safety of the dam would not be jeopardised. This is in line with SANCOLD’s requirements. At this stage, a flip bucket is proposed as the preferred option for energy dissipation.

Refer to **Appendix B4** for the layouts and details of the spillway, chute and flip bucket pertaining to site D2.

#### 6.2.1.3 Outlet Works

The outlet works is designed to:

- Fulfil environmental requirements (EWR) in terms of the Ecological Reserve;

- Enable releases for domestic use; and
- Empty the dam during emergency drawdown conditions.

The outlet works consists of a twin or dual system comprising multi-level intakes with butterfly valves to enable the selection of the level at which water will be drawn off, and sleeve valves at the downstream end for controlling the releases. The outlet pipes will each have a diameter of 600 mm. An emergency gate is required for closure for maintenance purposes at the bellmouth entrances. The intakes are protected with precast concrete trash racks and fine screens to prevent blockage by floating debris. Access to the outlet works will be obtained via the access bridge and from downstream along the conduit for inspection purposes.

### *6.2.2 Abstraction Weir, Abstraction Works, Pipeline and Access Road*

The layout and sections of the diversion weir and abstraction works is provided in **Appendix B5**.

#### 6.2.2.1 Abstraction Weir

The main purposes of the abstraction weir, which is situated on the Mzimkhulu River at the abstraction works, include the following:

- Divert water from the Mzimkhulu River to fill the planned OCS dam for supply to Port Shepstone;
- Regulate the required releases for the Ecological Water Requirements (EWR);
- Ensure accurate flow measurement in the River.

The weir must provide sufficient head for flushing the gravel and sand traps and to ensure sufficient suction head for the pumps during low flow conditions. The weir was designed with a low notch (average 2,3 m high) of 25 m long adjacent to the abstraction works to direct water towards the inlet weir of the abstraction works' gravel trap. The level of the low notch was designed to accommodate the hydraulic gradient of flowing water through the abstraction works towards the downstream area of the river. The remaining section of the weir towards the right bank is on a level 300 mm higher than the low notch and will be approximately 67 m long.

The weir will also serve as a flow measurement structure and a crump weir was thus selected as the diversion weir. The low notch will measure lower flows accurately and is instrumental in directing river flows at higher power in front of the intake of the gravel trap canal to the abstraction works. The power of the water for this layout will draw the sediment over the low notch of the diversion weir.

The abstraction weir will make provision for a fishway to allow for the migration of aquatic biota (fish and invertebrates).

#### 6.2.2.2 Abstraction Works

The main purpose of the abstraction works is to remove sediment from the Mzimkhulu River. Water can only be pumped to the Ncwabeni OCS Dam once the sediment is removed.

The abstraction works consists of the following components:

- An inlet weir to the gravel trap with a radial control gate (3.1 m wide by 2 m high) at the downstream end to wash out the deposited gravel material;
- A sand trap, adjacent to and hydraulically connected to the gravel trap, with a radial control gate (3.1 m wide by 2 m high) at the downstream end to wash out the deposited sand material;
- A hopper/silt trap chamber adjacent to and hydraulically connected to the sand trap with a jet pump to remove silt; and
- A pump station with submersible pumps on the side of the silt trap.

Various configurations for the inlet weir and sediment traps were investigated and considered. Fine sediment can be removed either by gravitation or by jet pump. The jet pump will be operated by the submersible duty pumps in the pump station. The design of the abstraction works is based on a low maintenance design with a high assurance of supply. The following design criteria were used for the layout of the abstraction works:

- Level of the inlet weir 300 mm below the low notch of the diversion weir to discharge water into the abstraction works;

- The gravel trap is designed to accommodate 2 $m^3/s$ (two times the design size of the hopper), and has a 1V:15H slope to scour deposited gravel material (cobbles and boulders). Under normal flow conditions, the gravel trap will be submerged;
- An inlet to the sand trap chamber has trash racks to remove debris and gravel. These trash racks are aligned to the river flow (in plan) to enhance the development of secondary flow currents against the structure to ensure local scouring and keep intakes clear. Coarse sediment will thus be transported away from the intakes during a flood. The soffit level of the trash racks is on the Minimum Operating Level to ensure that no floating debris will collect in front of the trash racks during floods;
- The sand trap is downstream of the trash racks and upstream of the hopper and can accommodate a flow of 2 $m^3/s$. The main purpose of this arrangement is to reduce sand transfer into the hopper;
- The hopper (silt trap chamber) is designed to accommodate 1 $m^3/s$ (based on a combined peak duty pump discharge of four duty pumps with a total maximum pumping rate of 0,9 $m^3/s$ operating at 20 hours per day). The hopper (silt trap chamber) is protected by sidewalls and a cover slab at the 1:100 year flood level of the Mzimkhulu River. The hopper will be formed in rock and protected by a concrete slab anchored to the rock;
- A fishway will be required to comply with the requirements for the migration of fish. The upstream entrance to the fishway will be controlled by a rectangular orifice, which will be under water during floods to limit possible debris entrainment. The downstream end is located between the gravel and the sand trap radial gates; and
- Hydraulically operated radial control gates at the downstream ends of the gravel and sand traps are provided to flush the deposited material when, for example, a small to medium flood occurs. Sidewalls also protect the radial gate from the 1:100 year floods of the Mzimkhulu River.

#### 6.2.2.3 Pump Station and Pipeline

The pump station will be located on the left-hand bank (northern bank) of the abstraction weir. Water will be pumped from the abstraction works to the dam via a rising main pipeline. The pump station will deliver up to 1 $m^3$/s of water.

The layout of the pump station is based on the following:

- A wet well arrangement was deemed the most economical arrangement. In the past five to eight years, the DWA constructed a number of river abstraction systems with varying levels of success, but those with submersible pumps have always performed well;
- A pumping rate of 0.75 $m^3$/s was selected based on the abstraction/yield curve that was developed for the most likely demand for Ncwabeni Dam, which is less than the 0.9 $m^3$/s that the hopper is designed for;
- The size of the pipeline is selected to accommodate a flow velocity smaller than 1 m/s, and a pump rate of 0.75 $m^3$/s; and
- A minimum of 25% standby capacity is required.

The two duty pump system was selected for the following reasons:

- The pumps have the best efficiency characteristic;
- The standby pump will have a large capacity; and
- Less maintenance is required.

The pipeline will be routed alongside the slipway chute of the dam to reduce impacts on the surrounding landscape. The pipeline will spill the water into the basin at a suitable upstream point to avoid interfering with the dam wall.

#### 6.2.2.4 Access Road

The D859 will need to be re-aligned where a section of the existing road will become inundated (see **Section 6.7.4**). A new access road will also need to be built to allow for access to the abstraction works. The new access road will be 6 m wide and will include a stormwater drain.

## 6.3 Operation of the System

The operation of the OCS scheme may be transferred to the Ugu District Municipality or Umgeni Water.

The operation of either OCS dam option as part of the greater supply system will be essentially the same. Water will be abstracted from the Mzimkhulu River at St Helen's Rock for treatment and supply as is currently done. The OCS dam, to be orientated approximately 26 to 28km upstream, will be filled by water abstracted from a new abstraction weir on the Mzimkhulu River during the high flow months. Water will then be released during the low flow months to augment the volume that can be abstracted at St Helens Rock.

Water will only be released from the OCS dam for abstraction at St Helen's Rock. Although no direct releases will be made for the downstream EWR and the estuary of the Mzimkhulu River, they will benefit indirectly from the scheme, and have been taken into account. By supplying water for abstraction at St Helen's Rock, the OCS dam will reduce the reliance on, and abstraction of, run-of-river flows, particularly during the low flow months.  River flows can then firstly be available for the reserve, and the OCS dam will then augment the volume of water to be abstracted at St Helen's Rock if the balance of the flow in the river is insufficient.

During the earlier years after construction of the scheme, the volume that the OCS dam needs to release to augment the abstraction at St Helen's Rock will be lower. At this point much of the yield of the dam can be generated by the incremental catchment of the tributary upstream of the OCS dam, with limited pumping from the Mzimkhulu River during the summer months. As the water requirements grow and greater abstractions are needed at St Helen's Rock, more water will need to be released from the OCS dam and greater pumping will be needed to fill the OCS dam during the summer months. **Figure 13** shows the abstraction and pumping needed during the various months of the year once the full demand of the 25 year planning horizon is realised.

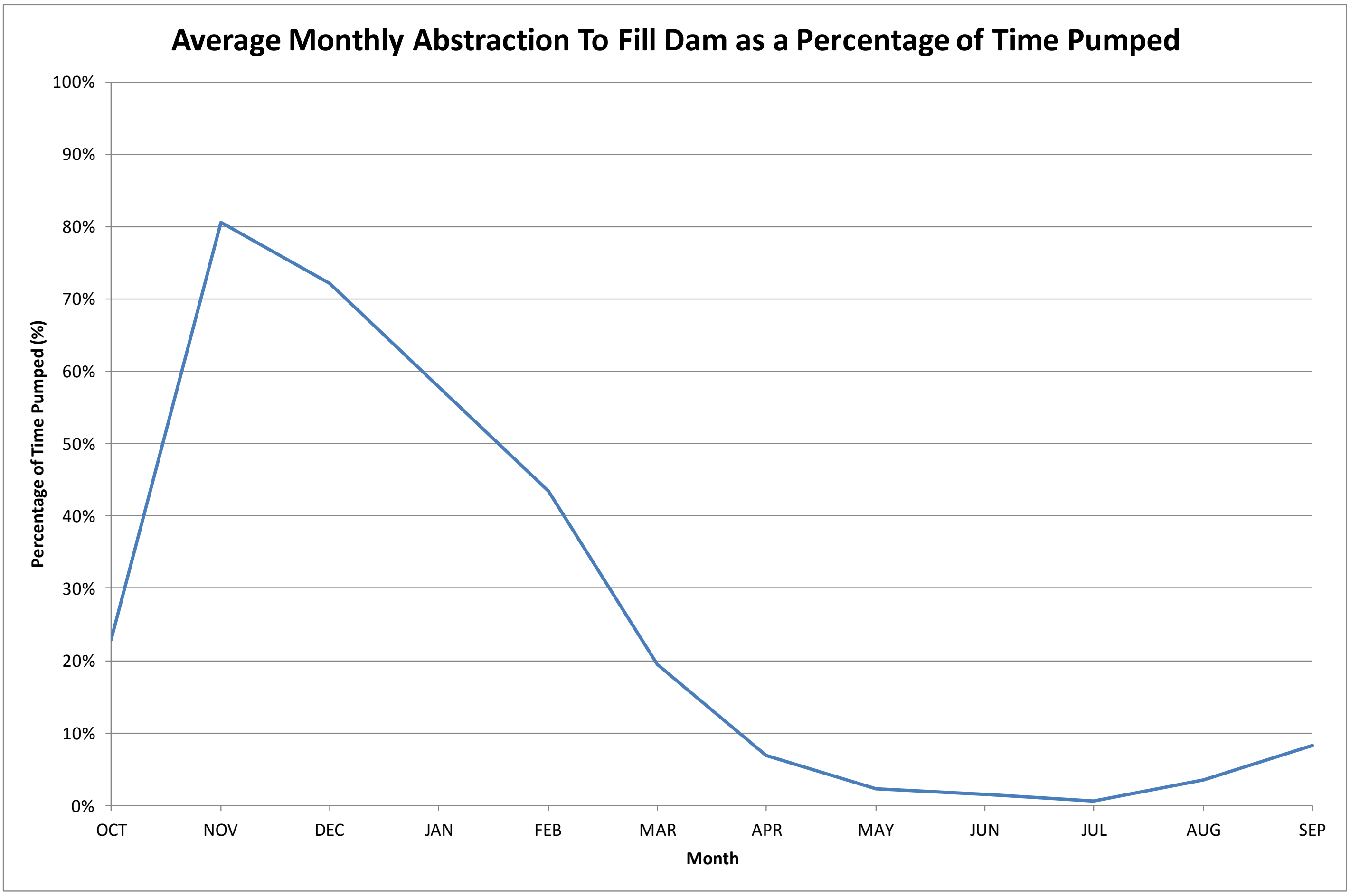



**Figure 13: Monthly average abstraction and pumping requirements to refill the OCS dam**

**Figure 13** shows that the majority of the abstraction and pumping requirements from the Mzimkhulu River to refill the OCS dam will occur in the summer months, and in particular the first few months of the wet season. Note that is figure shows average monthly abstraction as a percentage of the time that pumping is needed, based on a simulated 80 year period. Actual abstraction and pumping will vary from year to year and greater abstractions from the Mzimkhulu River will be needed to refill the OCS dam during dry years, and only a few months of pumping needed during wet years.

The average monthly volumes of water to be released from the OCS dam to augment the full planning horizon projected water requirements are shown in **Figure 14**. Releases occur in the winter months when river flows are low. This is primarily from June/July to October.

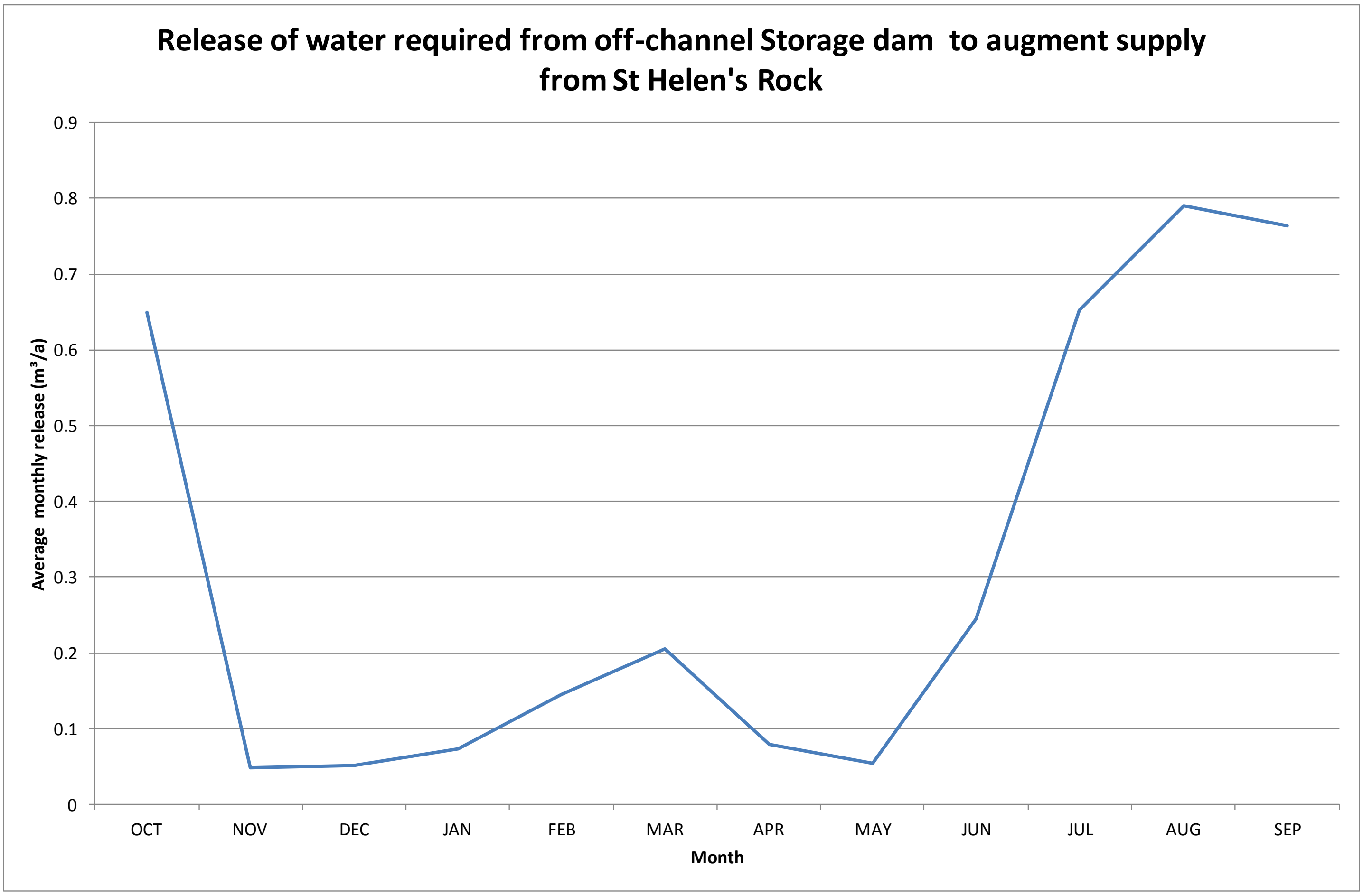



**Figure 14:** **Required releases from the OCS dam to augment supply from St Helen's Rock**

## 6.4 Implementation Timelines

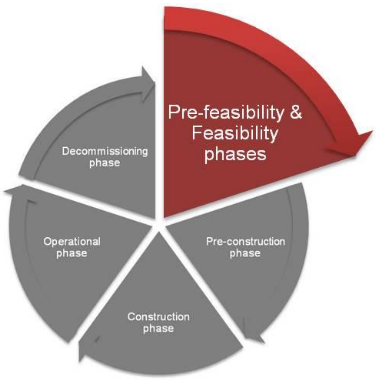
The following implementation timeline is anticipated for the proposed Ncwabeni OCS Dam:

- Construction to begin 2014;
- Construction to end 2018; and
- First filling of dam in 2017.

## 6.5 Project Life-Cycle

To adequately consider the impacts associated with the development of the OCS Dam (see **Section 12**), the major activities during each phase of the project life-cycle are listed in the sub-sections to follow.

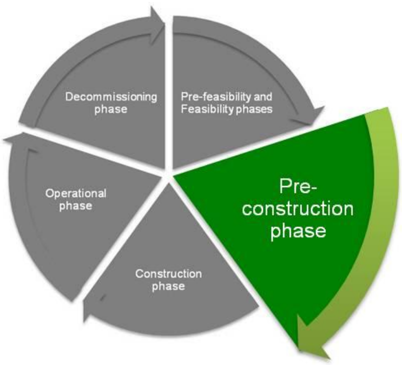
### *6.5.1 Pre-feasibility and Feasibility Phases*




Major activities during the Pre-feasibility and Feasibility Phases of the project include the following:

- Streamflow modelling;
- Assessment of base conditions (including geology, construction material investigation, assessing the seismic hazard, topographical survey, height-area-capacity relationships for each proposed dam basin, analysing sediment yields);
- Technical, economic and environmental screening of alternatives to the OCSS;
- Sizing and costing of dam and infrastructure; and
- Geotechnical investigations to confirm borrow areas and quarries.

### *6.5.2 Pre-construction Phase*




Major activities during the Pre-construction Phase of the project include the following:

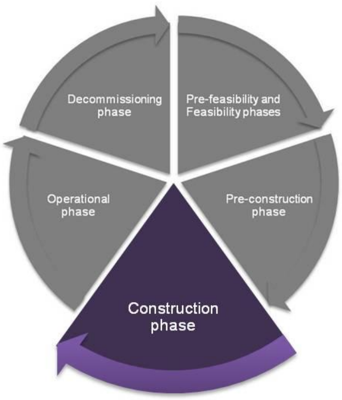
- Negotiations and agreements with the landowners (Cele K Tribal Authority and Camro Estates);
- Detailed engineering design;
- Detailed geotechnical investigations;
- Geophysical investigations;
- Fencing off of construction domain;
- Survey and map topography for determination of post-construction landscape, rehabilitation and shaping (where necessary);
- Procurement process for Contractors;
- Selective improvements of access road D859, to facilitate the delivery of construction plant and materials;
- Arrangements for accommodation of construction workers;
- The building of a site office and ablution facilities;
- Barricading of sensitive environmental features (e.g. graves);
- Development of resettlement plans;
- The harvesting of timber that will be inundated;

- Plan for search, rescue and relocation of red data, protected and endangered species, medicinal plants, heritage resources and graves;
- Permits to be obtained if protected trees are to be cut, disturbed, damaged, destroyed or removed; and
- Permits to be obtained if heritage resources are to be impacted on and for the relocation of graves.

The impacts associated with the above activities are addressed through mitigation measures contained in the Pre-construction Environmental Management Programme (EMPr).

### *6.5.3 Construction Phase*

#### 6.5.3.1 Major Activities




High-level activities as part of the construction phase include:

- Site establishment and clearance;
- Relocation of infrastructure;
- Temporary and permanent access roads and haul routes.
- Temporary low-level river crossing(s);
- Establish construction camps;
- Bulk fuel storage;
- Storage and handling of material;
- Construction employment;
- Construction of dam wall and abstraction weir -
  - River diversions;
  - Coffer dams to maintain a dry works area;
  - Site clearing and blasting – expose rock foundation;
  - Source material from borrow areas;
- Excavation;
- Blasting;
- Establishment of and operations at crusher;
- Establishment of and operations at batching plant;
- Establishment of and operations at materials testing laboratory;

- Create quarry and borrow areas;
- Construction of embankment;
- Concrete Works;
- Steel works;
- Mechanical and Electrical Works;
- Construction of pump station and sediment exclusion works;
- Electrical supply;
- Construction of rising main –
  - Clearing of construction servitude;
  - Trenching;
  - Excavate pipe trench;
  - Install and compact pipe bedding;
  - Install pipe sections;
  - Repair field joints and backfill and compact pipe trench in layers;
  - Construct access chambers and pipeline markers (concrete posts);
  - Construct Break Pressure Tank;
- Relocation of D859 –
  - Temporary accommodation of traffic;
  - Clearing of new road reserve;
  - Source and transport material from borrow area;
  - Install culvert at watercourse crossing;
- Cut and cover activities;
- Stockpiling (sand, crushed stone, aggregate, etc.);
- Establish waste transition area;
- Wastewater management;
- Disposal of unsuitable and excess material within the dam basin;
- Relocation of dwellings, graves, protected species; and
- Reinstatement and rehabilitation of construction domain (outside of inundation area, as necessary).

The impacts associated with the above activities are addressed through mitigation measures contained in the various Construction EMPrs.

#### 6.5.3.2 Construction Facilities

The location of the construction and labour camps, as well as the material stockpiles, crushing area and batching plant, for site D2 are shown in **Figure 15**. Sensitive environmental features associated with the major construction facilities for site D2, which are addressed within the EIA report, include the following

- A drainage line traverses the sites earmarked for the construction camp, crushing area and batching plant;
- Steep slopes are encountered in certain areas associated with the river valley, which require stormwater protection;
- The construction camp is situated within dense vegetation;
- Sections of the D859 are affected by the material stockpiles, and the road re-alignment would need to accommodate existing road users;
- Graves occur to the north-west of the labour camp, which would need to be adequately safeguarded; and
- The labour camp is situated outside of the dam basin. Although it is anticipated that the permanent offices will eventually be located on this site, the portions of the disturbed land that will not be used for operational purposes would require suitable reinstatement and rehabilitation following construction.

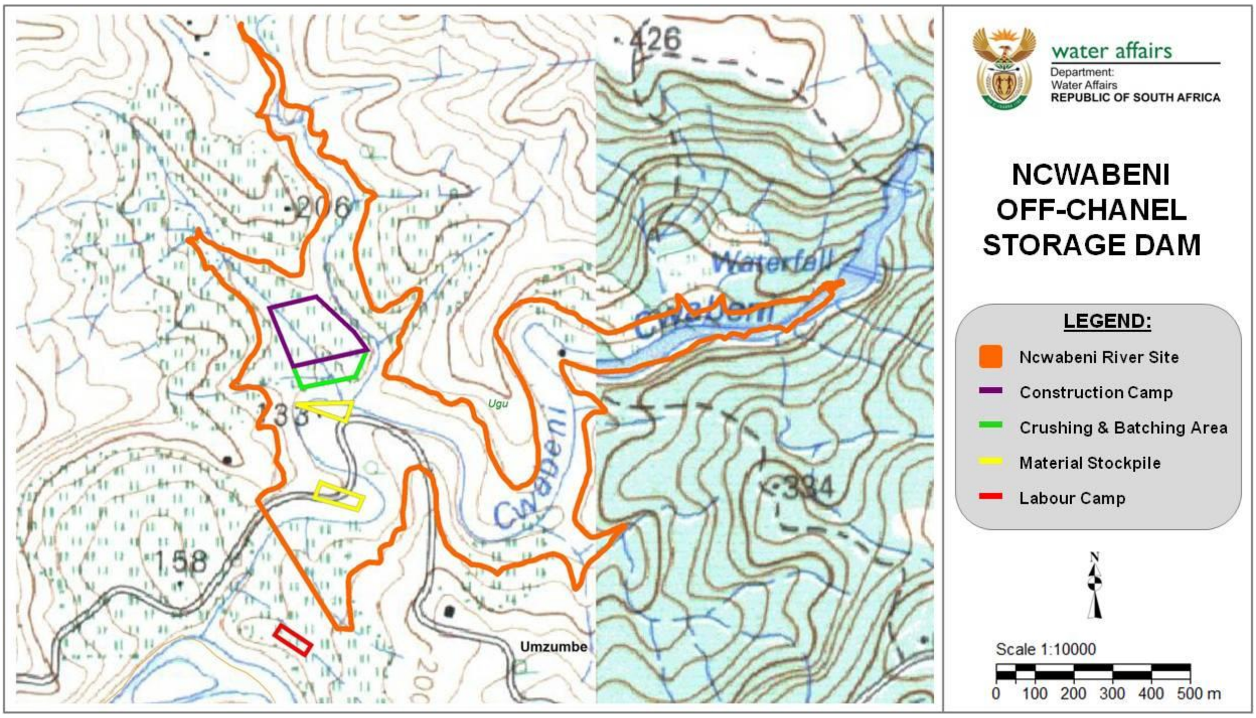



**Figure 15: Construction and Labour Camps (and other major construction facilities) – site D2**

The location of the construction and labour camps for site D3A are shown in **Figure 16**. Sensitive environmental features associated with these areas which need to be managed include the following

- Drainage lines run to the south and west of the construction camp and labour camp, respectively;
- Steep slopes are encountered in certain areas associated with the river valley, which require stormwater protection;
- The labour camp is situated within dense vegetation;
- An abandoned homestead and graves occur within the footprint of the construction camp; and
- The labour camp is situated outside of the dam basin. Although it is anticipated that the permanent offices will eventually be located on this site, the portions of the disturbed land that will not be used for operational purposes would require suitable reinstatement and rehabilitation following construction.

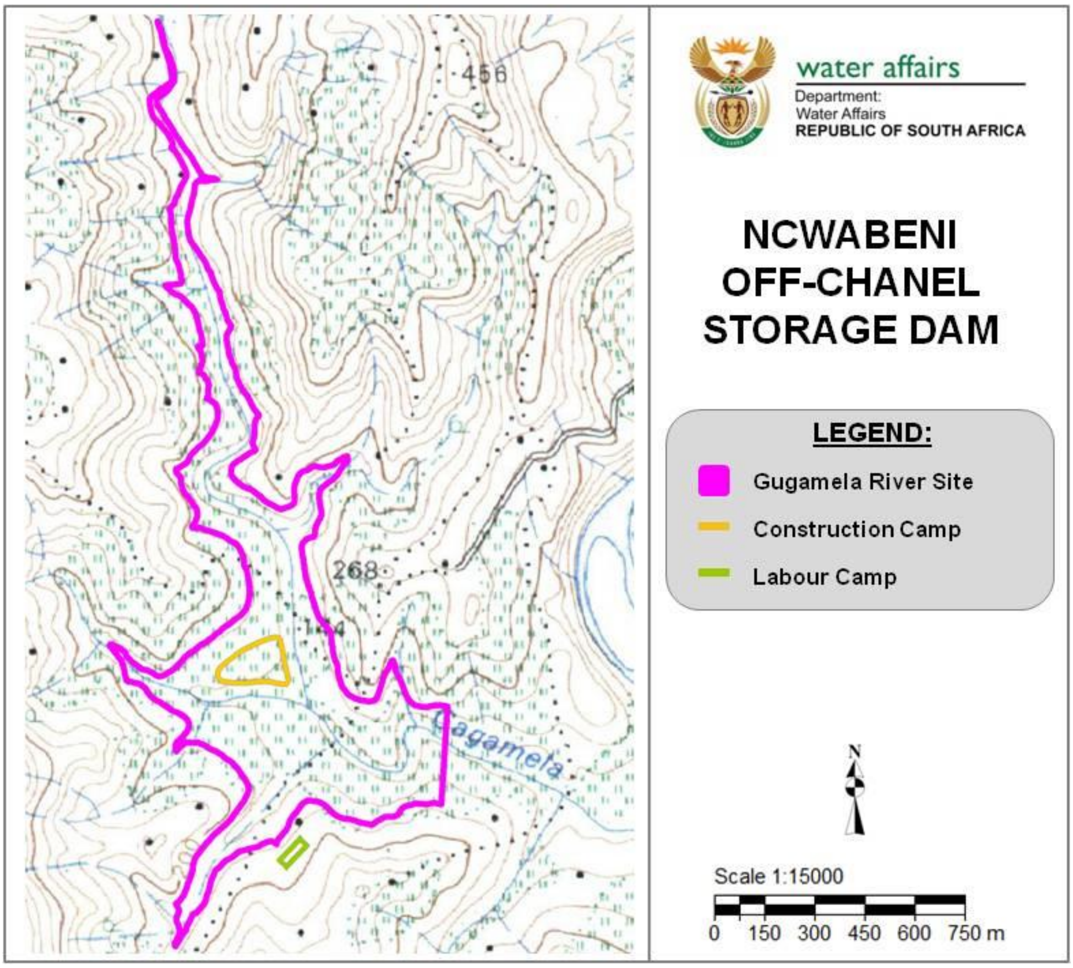
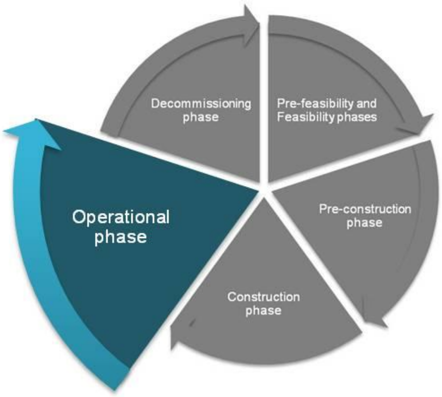



**Figure 16: Construction and Labour Camps – site D3A**

### *6.5.4 Operational Phase*




Major activities during the Operation Phase of the project include the following:

- Operation facilities (offices and accommodation);
- Maintenance of infrastructure;
- Operation of dam;
- On-going consultation with directly affected parties; and
- Develop Resource Management Plan (RMP).

The impacts associated with the above activities are to be addressed through mitigation measures contained in the Operational EMPr (to be developed in the future).

### *6.5.5 Decommissioning Phase*


Under suitable maintenance the lifespan of the dam is estimated to be more than 50 years. Depending on water supply demands, the dam could possibly be upgraded or at least maintained to cater for projected needs. Decommissioning is thus not considered applicable to the scheme. However, should decommissioning be required the activity will need to comply with the appropriate environmental legislation and best practices at that time.

## 6.6 River Diversions

The following river diversions are required during the construction phase:

- River diversion for building of dam wall;
- River diversion for sourcing rock from quarries; and
- River diversion for construction of abstraction weir.

The Contractor will prepare detailed method statements on how the river diversions will be undertaken.

### *6.6.1 River Diversion for Building of Dam Wall*

The river diversion for the construction of the dam will occur in three stages, as discussed below.

Stage 1 of the river diversion comprises water passing in the river. The bottom level of the intake tower is higher than the 20-year flood level and the natural slope of the left bank next to the river serves as the cofferdam. During this stage, the main embankment on the left abutment and the conduit will be constructed. The river section of the embankment will be constructed during the Stage 2 river diversion.

The Stage 2 river diversion comprises a cofferdam upstream of the embankment directing the water through the outlet conduit, and a cofferdam at the outlet of the conduit. The upstream cofferdam must be capable of accommodating the 20-year flood (± 126 m.a.s.l.) and must result in sufficient upstream water height (±130 m.a.s.l.), whichever is highest. The downstream cofferdams can be constructed as part of the rockfill embankment, and can be placed in the downstream toe of the embankment. Once construction is finished, a pipe for seepage and a seepage measurement weir are installed. A pipe will run from the shell zones across the seepage barrier into the measuring weir. The outlet conduit was sized with a bottom width of 6 m, vertical side walls of 2.5 m high and with part of a 3.5 m radius circle as the roof. The total area of the conduit is about 21 m$^2$.

Stage 3 river diversion - once the construction of the embankment is completed up to 150 m.a.s.l., the outlet conduit, serving as the diversion tunnel, may be closed with a gate immediately upstream of the intake to the conduit. A 4 m long concrete plug will be constructed downstream behind the gate. Impoundment may commence once Stage 3 river diversion is completed.

### *6.6.2 River Diversion for Sourcing Rock from Quarries*

In order to source rock material from the Ncwabeni dam basin, a river diversion will be required, as shown in **Figure 17**.

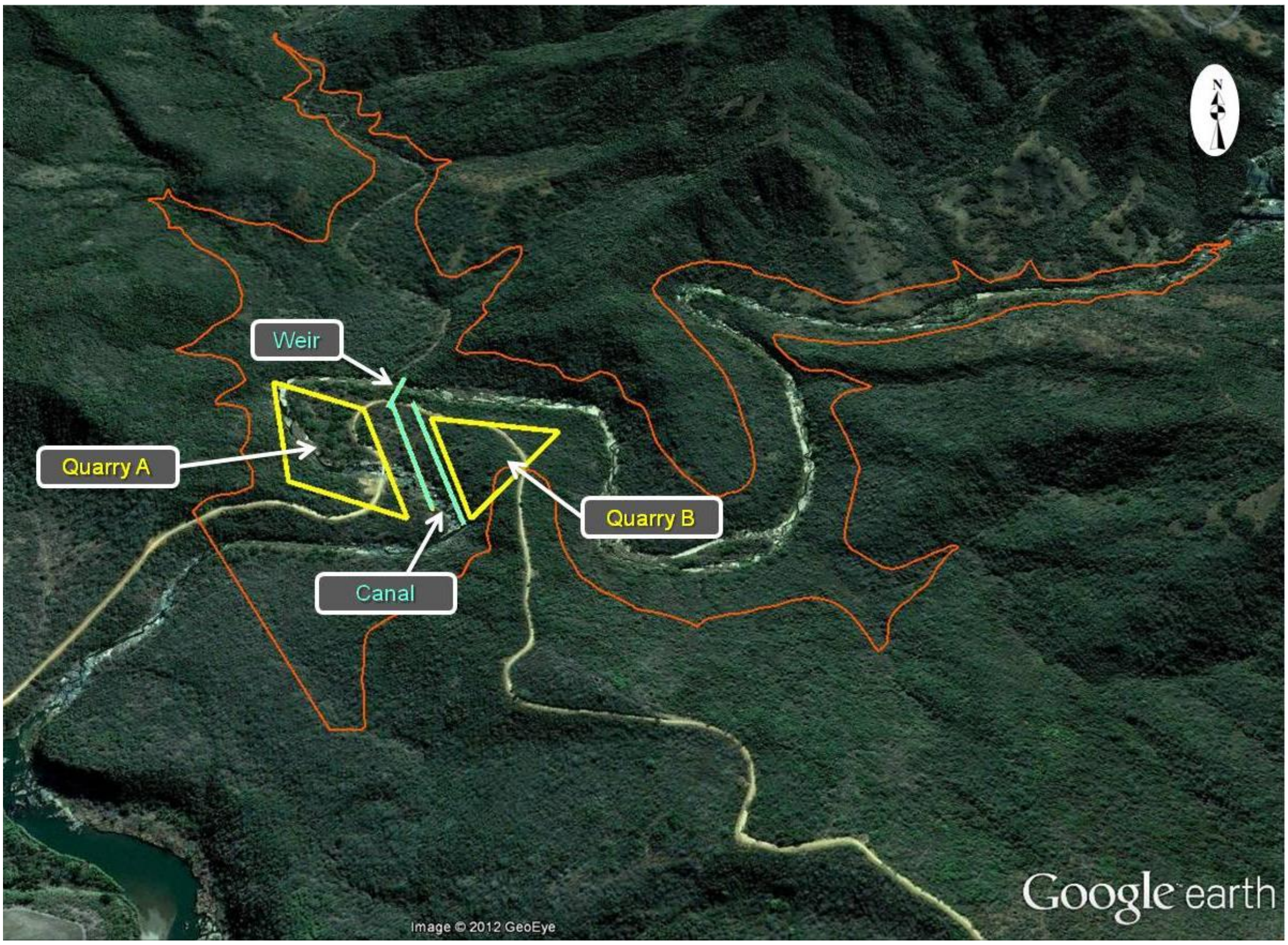



**Figure 17: Quarry Areas and River Diversion (Google Earth image)**

### *6.6.3 River Diversion for Construction of Abstraction Weir*

The river diversion for the abstraction weir will be constructed in two stages, namely:

- The first stage will be a coffer wall to construct the abstraction works and low notch of the diversion weir; and
- The other stage will be a coffer wall to construct the higher notch section of the diversion weir.

A cofferdam will be temporarily built upstream of the constructed portion of the abstraction weir. This earth cofferdam will direct the river flow towards the river diversion and prevent river flow to the weir construction area in the riverbed. An example of a coffer dam during the construction of a weir structure is provided in **Figure 18**.

Cofferdam construction would proceed using a “tip and push” methodology. Trucks would drop the earth material at the end of the cofferdam and a bulldozer will push the earth material into the river, along the centre line of the cofferdam. Cofferdam removal would proceed in a similar manner, with a tracked excavator ripping up the dam and the spoil being removed via trucks that have been reversed onto the cofferdam up to its edge.

It is expected that the contractor will use the batching plant that has been established for the OCS Dam, for the construction of the weir. This implies that concrete will be trucked in from this batching plant.


**Figure 18: Example of a cofferdam used to create a dry works area**

## 6.7 Resources Required for Construction and Operation

This section briefly outlines the resources that will be required to execute the project.

### *6.7.1 Materials*

The construction of the OCS Dam and associated works will require the sourcing of construction materials including aggregate (i.e. crushed rock or gravel screened to particular sizes).

The Material and Geotechnical Investigations used a phased approach to investigate the materials required for construction and for the dam foundations, diversion weir and abstraction works structures. In each phase, dam-type-selection and cost-estimation studies were undertaken to direct the next phases of the investigations. Geophysical Investigations such as seismic refraction studies, trenching investigations and drilling, coring, sampling and testing were undertaken. Using this approach, various types of dams and the availability of construction materials were considered and had the most impact on identifying the dam with the lowest cost.

Initially, the following borrow areas were identified for the two dam options:

- Ncwabeni scheme: Three borrow areas, namely one inside the proposed dam basin (quarry) to provide 800 000$m^3$ of rock material for a rockfill embankment as well as aggregate and sand for concrete, and a second outside of the dam basin to provide sandy material. The third possible borrow area is in the Gugamela basin but initial indications are that the required material is not available in sufficient quantity for the particular dam type. It is however being kept in until the geotechnical and materials investigation concludes.
- Gugamela scheme: Three borrow areas, namely one inside the proposed dam basin to provide semi-permeable and impermeable material and two outside of the basin to provide 800 000$m^3$ of rock material for a rock-fill embankment as well as aggregate and sand for concrete, and a second outside of the dam basin to provide sandy material.

Following more detailed Material and Geotechnical Investigations, the two quarries at site D2 (refer to layout in **Appendix B6**) were identified as a source for rockfill, aggregates and sand. The material quantities required to the CFR dam equate to 723,680$m^3$ of coarse rockfill, which will be sourced from the aforementioned quarries.

Temporary haul roads will be created to access the borrow areas. A batch plant will be established on site. Stockpiling of aggregate will take place in proximity to the batch plant.

### *6.7.2 Water*

During the construction stage, water will be required for various purposes, such as concrete batching, washing of plant and equipment in dedicated areas, dust suppression, potable use by construction workers, etc. Water for construction purposes will be sourced directly from watercourses on site, such as the Mzimkhulu River and its tributaries, and groundwater (boreholes) will also be utilised. Water tankers will also supply water to the site.

### *6.7.3 Sanitation*

Sanitation facilities will be provided for construction workers in the form of chemical toilets. Septic tanks will also be created at the site offices and labour camp. All sanitation facilities will be serviced at regular intervals.

### *6.7.4 Roads*

From Port Shepstone, the project area is accessed by travelling north-westwards on the P68-2 Main Road (St Faiths Road) and then turning southwards on a district gravel road (i.e. D859), which leads to the sites.

A re-alignment of the D859 is required to compensate for the section of the road that traverses the dam basin, which will become inundated. The re-alignment is also needed to facilitate access to the diversion weir and abstraction works. The Relocation of D859 will include the following:

- Temporary accommodation of traffic;
- Clearing of new road reserve;
- Source and transport material from borrow area; and
- Install culvert at watercourse crossing.

As shown in the layout contained in **Appendix B1**, D3A require a much longer relocation of the D859 (approximately 5 000 m) as opposed to D2 (approximately 1 000 m).

For D2, a new access road will also need to be built to gain access to the abstraction works. Haul roads will be created to transport material from the borrow areas. Within the construction domain, roads will also be created to allow for access to the various facilities and work areas.

#### *6.7.5 Waste*

Solid waste generated during the construction phase will be temporarily stored at a waste transition area and will be removed at regular intervals and disposed of at the local permitted waste disposal site. According to Govender (pers comm, 2011), the nearest permitted waste disposal site to the project area is Oatlands Regional Refuse Site near Margate. All the waste disposed of will be recorded.

Wastewater, which refers to any water adversely affected in quality through construction-related activities and human influence, will include the following:

- Sewage;
- Water used for washing purposes (e.g. plant, equipment, staff); and
- Drainage over contaminated areas (e.g. cement batching / mixing areas, workshop, equipment storage areas).

Suitable measures will be implemented to manage all wastewater generated during the construction period. For example, wastewater from the workshop area and vehicles maintenance area will be captured in an oil / water separator and the quality of the discharge will be monitored against the relevant standards.

#### *6.7.6 Electricity*

Electricity will be obtained from diesel generators or temporary electricity connections during the construction phase.

For operational purposes of the OCS Dam, a new high voltage power line will supply electricity to the site, for which a separate EIA will be conducted. Eskom's network to the north of the project site is currently overloaded and at the time when this report was compiled investigations were underway by Eskom to identify possible options and routes to convey power to the project site. The most likely route entails bringing power from the south from the Bhobhoyi area near the lime/cement factory.

An alternative option of utilising hydropower that is already being generated at the Camro Estates farm for pumping purposes has been identified and the feasibility of this option will be evaluated further.

#### *6.7.7 Manufactured Items*

Manufactured items for construction, such as reinforcing steel, pre-cast components, stormwater pipes, etc. will also be required and will be sourced from local commercial suppliers as far as possible. These items will be transported to site and will be stored in dedicated areas.

#### *6.7.8 Construction Workers*

Both skilled and un-skilled labour will be used during the construction phase. Labour procurement for unskilled workforce will be facilitated through a Labour Desk and preference will be given to the local community.

### 6.8 Resource Management Plan for Ncwabeni OCS Dam

A Government Waterwork refers to a waterwork (e.g. water storage dams, water transfer schemes and flood attenuation works) owned or controlled by the Minister of Water and Environmental Affairs and includes the land on which it is situated. The future use of the Ncwabeni OCS Dam, as a Government Waterwork, will be detailed in a Resource Management Plan (RMP) which will be compiled by DWA. This plan will take into consideration aspects highlighted to date in the EIA process, such as the access to and utilisation of the OCS Dam by the surrounding rural community (e.g. stock watering) and the possible use of the impoundment for recreational purposes.

According to the Guidelines for the Compilation of Resource Management Plans (RMPs) (DWAF, 2006), the main aim of an RMP is to *"…compile workable, functional sustainable access and utilisation plans for water resources and in particular State Dams through a* *process based on the attainment of harmony within the natural and cultural environment while addressing the needs and expectations of both the community, users and visitors ….*". Broadly, an RMP comprises an Integrated Environmental Management Plan (including a zonation plan), a proposal for institutionalising the implementation of the plan and a Business Plan that informs decision-makers of the required actions and resources associated with the RMP. The RMP development approach is presented in the figure to follow.

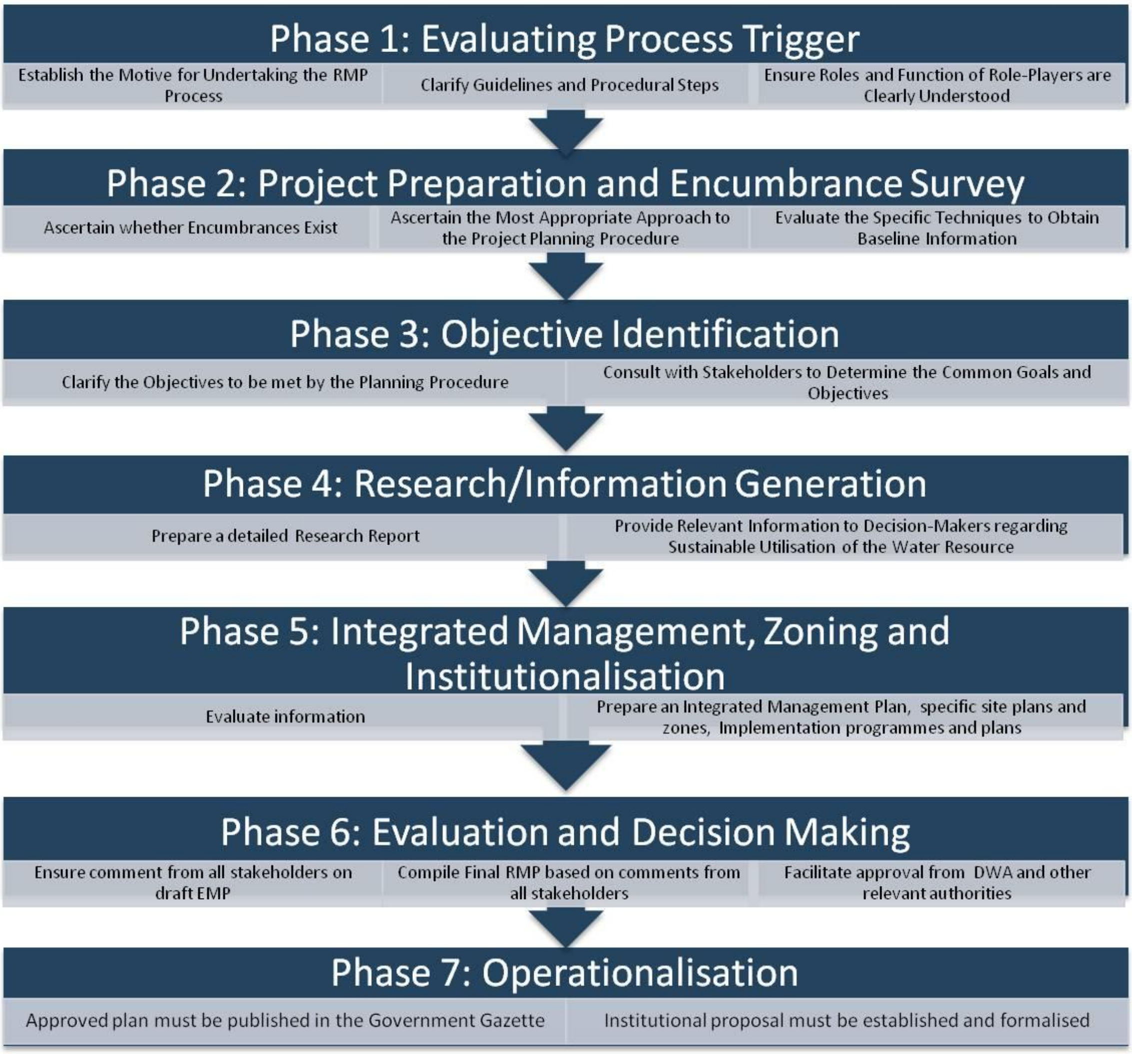



**Figure 19: RMP Development Process**

## 6.9 Land Acquisition

DWA determines the land to be acquired for state-owned dams, known as the Purchase Line, based on the following factors:

- The Full Supply Level (FSL);
- The natural 1:100 year floodline for the portion of the river to be inundated;
- The expected volume of silt to be deposited over a 50 year period in the dam, as well as the profile thereof;
- The 1:100 year backwater profile (1:100 year high flood level) for the proposed dam, taking the 50 year sediment into account;
- The point of no influence of the proposed dam; and
- The buffer strip / line, which is the strip of land between the 1:100 year backwater line and the Purchase Line. The buffer line is a line of safety above the 1:100 year flood line for the dam. It is at least 1.5 m above the 1:100 year flood line. The 1:100 year flood is a rare, and very large, flood that will only occur 10 times in 1 000 years, or in one percent of the time. The 1:100 year flood line is not a horizontal line but one curved upwards in the upstream direction in accordance with the backwater curve created by the dam. The buffer lines for the two dam sites are shown in **Figure 20**.

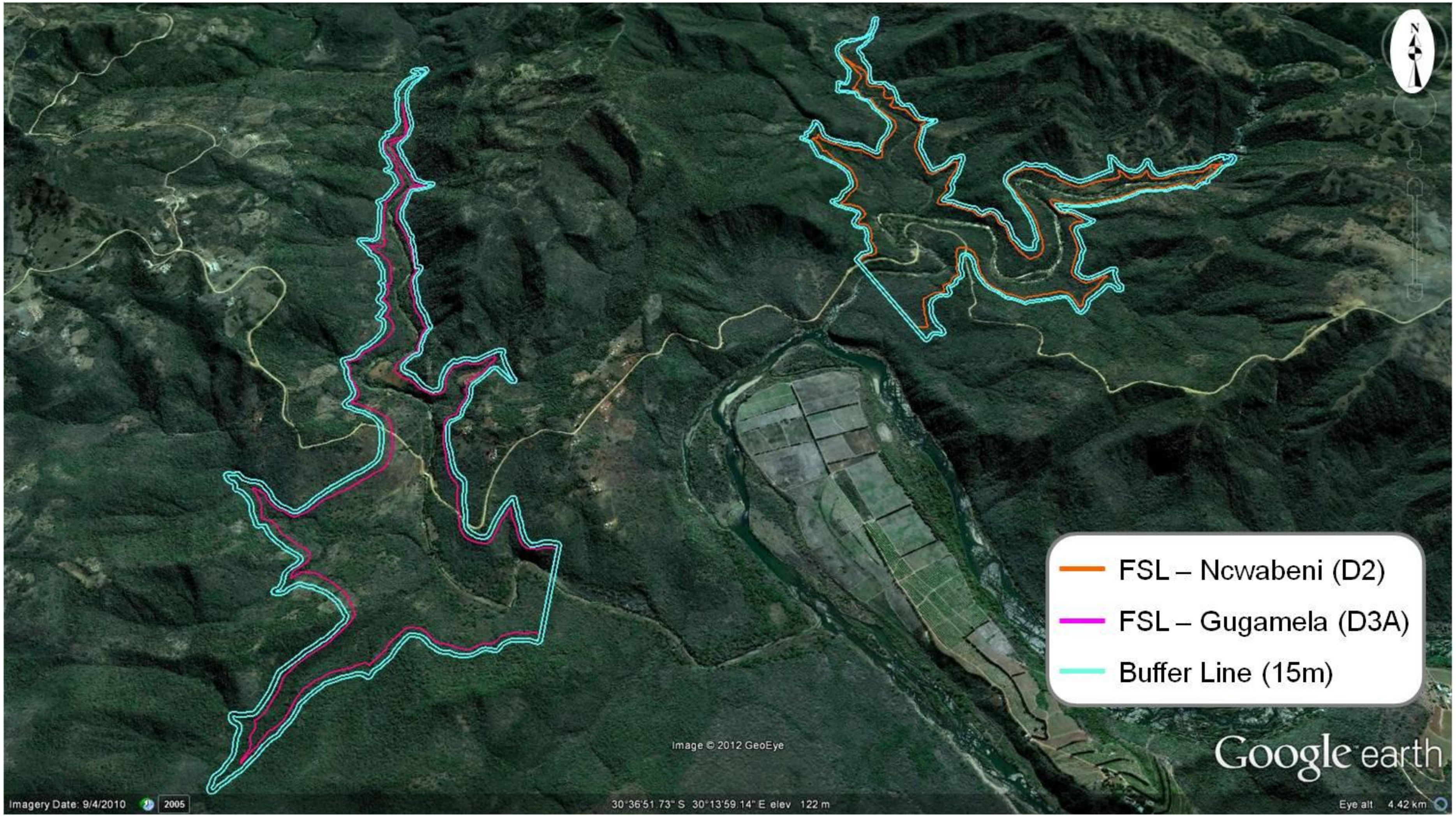



**Figure 20: FSL and Buffer Lines for D2 and D3A (Google Earth image)**

Apart from the Purchase Line, the following additional areas may also need to be acquired:

1. Construction site -
    - Area required for the dam wall and appurtenant works;
    - Area for offices, stores, laboratories, labour camp, etc;
    - Construction plant and materials stockpiling;
2. Properties acquired for environmental reasons -
    - Areas to ensure ecological sustainability (based on mitigation measures);
    - Access roads to dam.

In terms of section 64 of the NWA, the Minister may expropriate any property for any purpose contemplated in this Act, if that purpose is a public purpose or is in the public interest. The expropriation process is executed in terms of the Expropriation Act (Act No. 63 of 1975), which is aligned to section 25 of the Constitution of the Republic of South Africa (No. 108 of 1996). Negotiations around the management of impacts and compensation for tribal and state-held land are carried out by the relevant tribal authorities (Cele K Tribe), in conjunction with the relevant district municipality, Provincial and National Government Departments.

The land acquisition process does not form part of the EIA, and this will be undertaken separately by DWA in negotiation with the affected landowner.

# 7 LEGISLATION AND GUIDELINES CONSIDERED

## 7.1 Legislation

### *7.1.1 Environmental Statutory Framework*

The legislation that has possible bearing on the proposed Ncwabeni OCS Dam project from an environmental perspective is captured in **Table 7** below. **Note:** this list does not attempt to provide an exhaustive explanation, but rather an identification of the most appropriate sections from pertinent pieces of legislation.

**Table 7: Environmental Statutory Framework**

| Legislation | Relevance |
|---|---|
| Constitution of the Republic of South Africa, (No. 108 of 1996) | • Chapter 2 – Bill of Rights.<br>• Section 24 – environmental rights. |
| National Environmental Management Act (No. 107 of 1998) | • Section 24 – Environmental Authorisation (control of activities which may have a detrimental effect on the environment).<br>• Section 28 – Duty of care and remediation of environmental damage.<br>• Environmental management principles.<br>• Authorities – Department of Environmental Affairs (DEA) (national) and KZN Department of Agriculture and Environmental Affairs (provincial). |
| GN No. R. 543 of 18 June 2010 | • Process for undertaking Scoping and the EIA. |
| GN No. R. 544 of 18 June 2010 | 9. The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water -<br>(i) with an internal diameter of 0,36 metres or more; or<br>(ii) with a peak throughput of 120 litres per second or more,<br>excluding where:<br>a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or<br>b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse. |
| | 10. The construction of facilities or infrastructure for the transmission and distribution of electricity -<br>(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or<br>(ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more. |
| | 11. The construction of:<br>(i) canals;<br>(ii) channels;<br>(iii) bridges;<br>(iv) dams;<br>(v) weirs;<br>(vi) bulk storm water outlet structures;<br>(vii) marinas;<br>(viii) jetties exceeding 50 square metres in size;<br>(ix) slipways exceeding 50 square metres in size;<br>(x) buildings exceeding 50 square metres in size; or<br>(xi) infrastructure or structures covering 50 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. |
| | 12. The construction of facilities or infrastructure for the off-stream storage of water, including dams |

| Legislation | Relevance |
|---|---|
| | and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010. |
| | 13. The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres; |
| | 18. The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from<br>(i) a watercourse;<br>(ii) the sea;<br>(iii) the seashore;<br>(iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater-<br>but excluding where such infilling, depositing, dredging, excavation, removal or moving<br>(i) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or<br>(ii) occurs behind the development setback line. |
| | 19. Any activity which requires a prospecting right or renewal thereof in terms of section 16 and 18 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002). |
| | 20. Any activity requiring a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) or renewal thereof. |
| | 22. The construction of a road, outside urban areas,<br>(i) with a reserve wider than 13,5 meters or,<br>(ii) where no reserve exists where the road is wider than 8 metres, or<br>(iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010. |
| | 23. The transformation of undeveloped, vacant or derelict land to –<br>(i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or<br>(ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; -<br>except where such transformation takes place for linear activities. |
| | 24. The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule such land was zoned open space, conservation or had an equivalent zoning. |
| | 26. Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). |
| | 39. The expansion of<br>(i) canals;<br>(ii) channels;<br>(iii) bridges;<br>(iv) weirs;<br>(v) bulk storm water outlet structures;<br>(vi) marinas;<br>within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind the development setback line. |
| | 47. The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre -<br>(i) where the existing reserve is wider than 13,5 meters; or<br>(ii) where no reserve exists, where the existing road is wider than 8 metres –<br>excluding widening or lengthening occurring inside urban areas. |
| GN No. R. 545 of 18 June 2010 | 3. The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres. |
| | 10. The construction of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following:<br>(i) water catchments,<br>(ii) water treatment works; or<br>(iii) impoundments,<br>excluding treatment works where water is to be treated for drinking purposes. |
| | 15. Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; |

| Legislation | Relevance |
|---|---|
| | except where such physical alteration takes place for:<br>(i) linear development activities; or<br>(ii) agriculture or afforestation where activity 16 in this Schedule will apply. |
| | 18. The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built for which routes have been determined before 03 July 2006 and which have not been authorised by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 or 2009, made under section 24(5) of the Act and published in Government Notice R385 of 2006 [if] –<br>(i) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998);<br>(ii) it is a road administered by a provincial authority;<br>(iii) the road reserve is wider than 30 metres; or<br>(iv) the road will cater for more than one lane of traffic in both directions. |
| | 19. The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more. |
| | 20. Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum /resources Development Act, 2002 (Act 28 of 2002). |
| | 21. Any activity which requires an exploration right or renewal thereof as contemplated in sections 79 and 81 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002). |
| | 23. Any activity which requires a reconnaissance permit as contemplated in section 74 of the Mineral Petroleum Resources Development Act, 2002 (Act 28 of 2002), excluding where such reconnaissance is conducted by means of a flyover. |
| GN No. R. 546 of 18 June 2010 | 2. The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres outside urban areas, in -<br>(i) National Protected Area Expansion Strategy Focus areas;<br>(ii) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;<br>(iii) Sites or areas identified in terms of an International Convention;<br>(iv) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;<br>(v) Core areas in biosphere reserves;<br>(vi) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve;<br>(vii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined. |
| | 4. The construction of a road wider than 4 metres with a reserve less than 13,5 metres. |
| | 10. The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. |
| | 12. The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. |
| | 13. The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:<br>(1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list.<br>(2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No 544 of 2010. |
| | 14. The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:<br>(1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes;<br>(2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list;<br>(3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. |
| | 16. The construction of:<br>(i) jetties exceeding 10 square metres in size;<br>(ii) slipways exceeding 10 square metres in size; |

| Legislation | Relevance |
|---|---|
| | (iii) buildings with a footprint exceeding 10 square metres in size; or<br>(iv) infrastructure covering 10 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. |
| | 19. The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. |
| | 24. The expansion of<br>(a) jetties where the jetty will be expanded by 10 square metres in size or more;<br>(b) slipways where the slipway will be expanded by 10 square metres or more;<br>(c) buildings where the buildings will be expanded by 10 square metres or more in size; or<br>(d) infrastructure where the infrastructure will be expanded by 10 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. |
| National Water Act (Act No. 36 of 1998) | • Chapter 3 – Protection of water resources.<br>• Section 19 – Prevention and remedying effects of pollution.<br>• Section 20 – Control of emergency incidents.<br>• Chapter 4 – Water use.<br>• Chapter 12 – Safety of Dams.<br>• Authority – DWA. |
| Environment Conservation Act (Act No. 73 of 1989): | • Environmental protection and conservation.<br>• Section 25 – Noise regulation.<br>• Authority – DEA |
| National Environmental Management Air Quality Act (Act No. 39 of 2004) | • Air quality management<br>• Section 32 – dust control.<br>• Section 34 – noise control.<br>• Authority – DEA. |
| National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) | • Management and conservation of the country's biodiversity.<br>• Protection of species and ecosystems.<br>• Authority – DEA. |
| National Environmental Management: Protected Areas Act (Act No. 57 of 2003) | • Protection and conservation of ecologically viable areas representative of South Africa's biological diversity and natural landscapes. |
| National Environmental Management: Waste Act (Act No. 59 of 2008) | • Chapter 5 – licensing requirements for listed waste activities (Schedule 1).<br>• Authority – DEA. |
| National Forests Act (No. 84 of 1998) | • Section 15 – authorisation required for impacts to protected trees.<br>• Authority – Department of Agriculture, Forestry and Fisheries (DAFF) |
| Minerals and Petroleum Resources Development Act (Act No. 28 of 2002) | • Permit required for borrow pits – certain exemptions afforded to DWA.<br>• Authority – Department of Mineral Resources (DMR). |
| Occupational Health & Safety Act (Act No. 85 of 1993) | • Provisions for Occupational Health & Safety<br>• Major Hazard Installation Regulations (GN No. R. 692, July 2001)<br>• Authority – Department of Labour. |
| National Heritage Resources Act (Act No. 25 of 1999) | • Section 34 – protection of structure older than 60 years.<br>• Section 35 – protection of heritage resources.<br>• Section 36 – protection of graves and burial grounds.<br>• Section 38 – Heritage Impact Assessment for linear development exceeding 300m in length; development exceeding 5 000$m^2$ in extent.<br>• Authority – Amafa aKwaZulu-Natali. |
| KZN Heritage Act (Act No. 04 of 2008) | • Conservation, protection and administration of both the physical and the living or tangible heritage resources of KZN.<br>• Authority – Amafa aKwaZulu-Natali. |
| Conservation of Agricultural Resources | • Control measures for erosion.<br>• Control measures for alien and invasive plant species. |

| Legislation | Relevance |
|---|---|
| Act (Act No. 43 of 1983) | • Authority – Department of Agriculture. |
| Kwazulu-Natal Planning and Development Act (Act No. 06 of 2008) | • Directs and regulates planning and development in KZN.<br>• An application may be required before land may be used or developed for a particular purpose.<br>• All developments need to be in accordance with the municipality's planning scheme.<br>• Authority - Municipality |
| KwaZulu-Natal Nature Conservation Management Act (Act No. 09 of 1997). | • Institutional bodies for nature conservation in KZN.<br>• Establish control and monitoring bodies and mechanisms.<br>• Ezemvelo KZN Wildlife. |
| Natal Nature Conservation Ordinance (15 of 1974) | • Permit for the removal and transportation of endangered fauna and flora species<br>• Ezemvelo KZN Wildlife |
| Integrated Coastal Management Act (Act No. 24 of 2008) | • Management of Mzimkhulu Estuary.<br>• Authority – DEA. |
| National Road Traffic Act (Act No. 93 of 1996) | • Authority – Department of Transport. |
| Tourism Act of 1993 | • Authority – South African Tourism Board. |

The relationship between the project and key pieces of environmental legislation is discussed in the subsections to follow.

### *7.1.2 National Environmental Management Act (Act No. 107 of 1998)*

According to Section 2(3) of NEMA, "*development must be socially, environmentally and economically sustainable*", which means the integration of these three factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.

The proposed Ncwabeni OCS Dam requires authorisation in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998), and the EIA will be undertaken in accordance the EIA Regulations (2010) that consist of the following:

- EIA procedures – GN No. R. 543;
- Listing Notice 1 – GN No. R. 544;
- Listing Notice 2 – GN No. R. 545; and
- Listing Notice 3 – GN No. R. 546.

The project triggers activities under Listing Notices 1, 2 and 3, and thus needs to be subjected to a Scoping and EIA process. The Application Form made provision for all the activities associated with the OCS Dam and the following associated works:

1. All the construction sites (including the construction housing);

2. Storage facilities;
3. Storage of hazardous materials;
4. Plants, e.g. concrete mixing, crushers, etc.;
5. Relocation of infrastructure, e.g. roads, power lines, telephone lines, etc.;
6. Access roads for construction purposes;
7. Power supply for construction and operational purposes;
8. Borrow areas for sourcing construction material; and
9. River flow gauging.

Note that a separate EIA will be conducted by Eskom to seek approval for a new high voltage power line to supply electricity to the site for operational purposes.

The activities triggered in terms of GN No. R. 544, R. 545 and R. 546 were confirmed based on the following:

- Project description;
- Available technical information;
- Feedback received from the Technical Module team;
- Feedback received from DEA and KZN DAEA;
- Information contained in the Mzimkhulu River Off-Channel Storage Pre-Feasibility Study (2007); and
- Activities identified in the Ncwabeni: Off-Channel Storage Dam Feasibility Study: Module 1: Technical Study: Environmental Screening Investigation (2011).

The listed activities are explained in the context of the project in the table to follow. Note that some of the dimensions in the following table differ from what was included in the Application Form (although all values were originally indicated as approximates), due to the dynamic nature of the planning and design process.

**Table 8: Explanation of the relevant activities listed in the EIA Regulations (2010)**

| GN | Activity No. | Description of Listed Activity |
| --- | --- | --- |
| 544, 18 June 2010 | 9 | Rising main and gravity main to be built as part of conveyance system. The parameters for the conveyance system are as follows:<br>• Total length of pipeline (rising plus gravity main) - D2 = ± 600m; D3A = ± 1 600m;<br>• Rising main nominal diameter - D2 = ± 900mm; D3A = ± 900mm; and<br>• Velocity in rising main - D2 = ± 1.78 m/s; D3A = ± 1.78 m/s. |

| GN | Activity No. | Description of Listed Activity |
|---|---|---|
| | 10 | Infrastructure to supply electricity to the new pump station |
| | 11 | Construction of off-channel storage dam, diversion weir (as part of abstraction works) and approach channel within watercourse. |
| | 12 | Construction of off-channel storage dam with the following gross storage:<br>• D2 = ± 14.3 million $m^3$; and<br>• D3A = ± 14.2 million $m^3$. |
| | 13 | Temporary storage of dangerous goods (e.g. fuel) during the construction phase. |
| | 18 | Construction activities (including bulk earthworks) to be undertaken within a watercourse to construct off-channel storage dam and relevant components of abstraction works (e.g. diversion weir). |
| | 19 | Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment). |
| | 20 | |
| | 22 | Access roads to the dam wall and the weir as well as relocation of roads that will be inundated. |
| | 23 | • The approximate inundation areas for the two alternative sites are as follows:<br>○ D2 = ± 0.95 $km^2$; and<br>○ D3A = ± 0.98 $km^2$.<br>• Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed.<br>• Operator housing / offices and fencing to be built. |
| | 24 | The approximate inundation areas for the two alternative sites are as follows:<br>• D2 = ± 0.95 $km^2$; and<br>• D3A = ± 0.98 $km^2$. |
| | 26 | Possible occurrence of sensitive biodiversity features at the dam sites. |
| | 39 | Possible upgrading of existing road bridge or other infrastructure within 32m of a watercourse. |
| | 47 | Widening or lengthening of existing roads to create access roads to the dam wall and the weir, and for the relocation of roads that will be inundated. |
| 545, 18 June 2010 | 3 | Temporary storage of dangerous goods (e.g. fuel) during the construction phase. |
| | 10 | Water to be pumped from the Mzimkhulu River to the off-channel storage dam. |
| | 15 | The approximate inundation areas for the two alternative sites are as follows:<br>• D2 = ± 0.95 $km^2$; and<br>• D3A = ± 0.98 $km^2$.. |
| | 18 | Relocation of existing road D859, which is administered by the Kwazulu-Natal Department of Transport. |
| | 19 | Dam wall height from Non-overspill Crest Level (NOCL) to river bed:<br>• D2 = ± 48 m; and<br>• D3A = ± 47 m. |
| | 20 | Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed. |
| | 21 | Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed. |
| | 23 | Borrow areas to be created to obtain construction material (concrete aggregates and earth embankment) - sizes to be confirmed. |
| 546, 18 June 2010 | 2 | The construction of a reservoir for bulk water supply with a capacity of more than 250 cubic metres within a sensitive area. |
| | 4 | Access roads to the dam wall and the weir and relocation of roads that will be inundated. Possible occurrence of sensitive biodiversity features at affected areas. |
| | 10 | Temporary storage of dangerous goods (e.g. fuel) during the construction phase. Possible occurrence of sensitive biodiversity features at the dam sites. |
| | 12 | Road and dam construction activities will involve extensive clearance of vegetation (300 square metres or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas. |
| | 13 | Road and dam construction activities will involve extensive clearance of vegetation (1 hectare or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas. |
| | 14 | Road and dam construction activities will involve extensive clearance of vegetation (5 hectares or more, where 75% or more of the vegetative cover constitutes indigenous vegetation). Possible occurrence of sensitive biodiversity features at affected areas. |
| | 16 | Construction of off-channel storage dam, diversion weir (as part of abstraction works) and approach channel within watercourse. Possible occurrence of sensitive biodiversity features at affected areas. |
| | 19 | Access roads to the dam wall and the weir as well as relocation of roads that will be inundated. Possible occurrence of sensitive biodiversity features at affected areas. |
| | 24 | Construction of off-channel storage dam, diversion weir (as part of abstraction works) and approach channel within watercourse. Possible occurrence of sensitive biodiversity features at affected areas. |

### 7.1.3 *Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)*

Sections 16, 22 and 27 of the Mineral and Petroleum Resources Development Act (MPRDA) (Act No. 28 of 2002) set out the requirements with which applicants for prospecting rights, mining rights and mining permits must comply, while section 20 provides that the holder of a prospecting right may only perform "bulk sampling" of minerals under such prospecting right if that holder has the consent of the Minister to do so.

Borrow areas have been identified to source construction material for the building of the proposed off-channel storage infrastructure. Under section 106(1) of the MPRDA, DWA is exempt from the provisions of sections 16, 20, 22 and 27 "*in respect of any activity to remove any mineral for road construction, building of dams or other purpose which may be identified in such notice*".

In terms of Section 106(3) of the MPRDA, DWA does not have to prepare an Environmental Management Plan for borrow areas that are located on Government Waterworks. Although exempted, DWA must still submit Environmental Management Plans for all borrow areas situated outside of the GWW for approval by the Department of Mineral Resources (DMR), in terms of Section 106(2) of the MPRDA.

Based on the current FSL of the OCS dam at site D2, the borrow areas (quarries) fall within the dam basin, and no Environmental Management Plan is thus required for this dam option. For site D3A suitable material for the CFR dam is possibly not available within the basin, and the quarries at site D2 will need to be created to source material. Environmental Management Plans for these quarries will need to be submitted to DMR if site D3A is pursued.

### 7.1.4 *National Environmental Management: Waste Act (Act No. 59 of 2008)*

No authorisation will be required in terms of the National Environmental Management: Waste Act (NEM:WA) (Act No. 59 of 2008), as the project will not include any listed waste management activities.

The following should be noted with regards to waste management during the construction phase:

- Excess material would be spoilt within the dam basin;
- Temporary waste storage facilities will remain below the threshold levels contained in the listed activities under Schedule 1 of NEM:WA; and
- The Environmental Management Programmes (EMPr) for the various phases of the project's life-cycle will make suitable provisions for waste management, including the storage, handling and disposal of waste (general and hazardous waste).

#### *7.1.5 <u>National Water Act (Act No. 36 of 1998)</u>*

Depending on who will act as the developer (DWA, Umgeni Water or the Ugu District Municipality) of the dam and its associated components, an application will need to be made to the DWA KZN Regional Office for a water use licence in terms of Section 21 of the National Water Act (NWA) (Act No. 36 of 1998);

The NWA specifies a series of measures which together are intended to ensure the comprehensive protection of all water resources. This includes setting the Reserve, which is the only right to water in terms of this Act and constitutes the water necessary to provide for basic human needs and to protect water ecosystems. As part of the Mzimkhulu River Catchment Water Resource Study, the Riverine Ecological Water Requirements (EWR) (DWA, 2011b) were determined for various sites in the Mzimkhulu Catchment. The EWR feeds into the Reserve determination process, by representing the quantity and quality of water required to maintain the water resource in its assigned ecological category. The EWR were taken into account in both the yield analysis and technical design of the Ncwabeni OCS Dam.

Chapter 12 of the NWA contains measures aimed at improving the safety of new and existing dams with a safety risk so as to reduce the potential for harm to the public, damage to property or to resource quality. The Dam Safety Office at DWA was established to implement and administer the Dam Safety Regulations (GN R.1560 of 25 July 1986), published in terms of the NWA. Only dams with a safety risk (i.e. dams with a maximum wall height that exceeds 5 m and with a storage capacity of more than 50 000 $m^3$, or any other dam declared as a dam with a safety risk) are subject to these regulations. Both the D2 and D3A dams will be classified as Category III dams with significant hazard potential, and the layouts were prepared in accordance with the guidelines of the South African National Committee on Large Dams (SANCOLD) and world standards.

## 7.2 Guidelines

The following guidelines were considered during the compilation of the EIA Report:

- Guideline on Alternatives: NEMA Environmental Impact Assessment Regulations (prepared by the Western Cape Department of Environmental Affairs and Development Planning, 2006);
- Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005. Integrated Environmental Management Guideline Series (DEAT, 2005a);
- Guideline 4: Public Participation, in support of the EIA Regulations. Integrated Environmental Management Guideline Series (DEAT, 2005);
- Guideline on Need and Desirability, NEMA EIA Regulations (DEA&DP, 2009); and
- Guideline for Environmental Management Plans (Lochner, P. 2005).

## 7.3 Regional Plans

### *7.3.1 Umgeni Water Infrastructure Master Plan*

Umgeni Water's Infrastructure Master Plan describes infrastructure plans for the financial period 2010/2011 – 2040/2041. It is a comprehensive technical report that provides detailed information on the organisation's current infrastructure and on its future infrastructure development plans.

The plan acknowledges that the lower Mzimkhulu system requires additional augmentation in the medium- to long-term and that in order to provide for the water requirements for all user sectors, including the Reserve, the construction of an off-channel storage dam in one of the tributaries to the Mzimkhulu River should be considered.

### *7.3.2 UDM Water Services Policy*

The Water Services Policy of the UDM sets out and provides an overview of the principles and guidelines that the municipality will follow in exercising its role and function as a Water Services Authority (WSA), and it is intended to complement the Water Services Development Plan (WSDP).

The policy states the aspirations of the municipality to provide water services to all persons who reside, work or visit its area of jurisdiction in a manner that is economically and financially sustainable. One of the options that the municipality will pursue in satisfying this endeavour is accessing bulk water through its own resources (such as the Mzimkhulu River).

### *7.3.3 UDM IDP & SDF*

**Table 9** provides an extract from the 2007 – 2012 Integrated Development Plan (IDP) for UDM, focusing on the salient objectives, strategies and key deliverables for Basic Service Delivery from a water services perspective.

**Table 9: Extract from UDM IDP – Basic Water Services Delivery**

| Objectives | Strategies | Key Deliverables |
|---|---|---|
| • To fast-track and improve the delivery and the quality of potable water (within government targets).<br>• To ensure access to rudimentary water services for communities below RDP Standards.<br>• To ensure sustainable infrastructure development. | Expansion of water network in a sustainable manner. | • Upgrade water supply.<br>• Enhance the municipal relationship with the strategic partners such as Umgeni Water. |

The Ncwabeni OCS Dam was identified in the IDP as a key intervention required in terms of service delivery in water infrastructure development in the district.

#### *7.3.4 Umzumbe Local Municipality IDP & SDF*

A key goal of the Umzumbe IDP is to provide an efficient and effective spatial framework that enables the optimal use of resources and delivery of services (Umzumbe Local Municipality, 2009).

According to the Umzumbe Local Municipality SDF, the dam sites are located in an area that has particular value in terms of tourism. This aspect will need special consideration as part of the Resource Management Plan (RMP) for the Ncwabeni OCS Dam, where the vision for the area will need to be supported through the provisions in this Plan.

## 7.4 Protocols

The following strategic priorities and corresponding policy principles as part of the World Commission on Dams, published in November 2000, need to be adhered to:

- Gaining public acceptance;
- Comprehensive options assessment;
- Addressing existing dams;
- Sustaining rivers and livelihoods;
- Recognising entitlements and sharing benefits;
- Ensuring compliance, and
- Sharing rivers for peace, development and security.

# 8 EIA PROCESS

## 8.1 Environmental Assessment Triggers

The proposed Ncwabeni OCSS entails certain activities that require authorisation in terms of NEMA. Refer to **Section 7** for further discussion in the project's legal framework.

The process for seeking authorisation is undertaken in accordance with the Environmental Impact Assessment (EIA) Regulations (GN No. R. 543, R. 544, R. 545 and R. 546 of 18 June 2010), promulgated in terms of Chapter 5 of NEMA. From the date of effect of these amended EIA Regulations, which was 02 August 2010, they replaced the previous EIA Regulations that had been promulgated on 21 April 2006.

Based on the types of activities involved, which include activities listed in GN No. R. 544, R. 545 and R. 546 (see **Table 8**) the requisite environmental assessment for the project is a Scoping and EIA process.

## 8.2 Environmental Assessment Authorities

In terms of NEMA, the lead decision-making authority for the environmental assessment is the National Department of Environmental Affairs (DEA), as the project proponent (DWA) is a national government department. However, due to the geographic location of the project the KZN Department of Agriculture and Environmental Affairs (DAEA) is regarded as a key commentary authority during the execution of the EIA, and all documentation will thus be copied to this Department.

## 8.3 Environmental Assessment Practitioner

Nemai Consulting was appointed by DWA as the independent Environmental Assessment Practitioner (EAP) to undertake the environmental assessment for the proposed Ncwabeni OCS Dam.

In accordance with Regulation 28(1)(a) of GN No. R. 543 (18 June 2010), this section provides an overview of Nemai Consulting and the company's experience with EIAs, as well as the details and experience of the EAPs that form part of the Scoping and EIA team.

Nemai Consulting is an independent, specialist environmental, social development and Occupational Health and Safety (OHS) consultancy, which was founded in December 1999. The company is directed by a team of experienced and capable environmental engineers, scientists, ecologists, sociologists, economists and analysts. The company has offices in Randburg (Gauteng), Durban (KZN) and Rustenburg (North West Province).

The core members of Nemai Consulting that are involved with the Scoping and EIA process for the Ncwabeni OCS Dam are captured in **Table 10** below, and their respective Curricula Vitae are contained in to **Appendix C**.

**Table 10: Scoping and EIA Core Team Members**

| Name | Qualifications | Experience | Duties |
|---|---|---|---|
| Ms D. Naidoo | B.Sc Eng (Chem) | 17 years | • Project Manager<br>• Quality Control |
| Mr D. Henning | • B.Sc (Hons) Aquatic Health<br>• M.Sc River Ecology | 11 years | • EIA Process<br>• Scoping & EIA Reports<br>• EMPrs |
| Mr C. Chidley | • B.Sc Eng (Civil);<br>• BA (Economics, Philosophy)<br>• MBA | 20 years | • Quality Reviewer<br>• Technical Input<br>• EMPrs |
| Ms R. Le Roux | MSc (Env Management) | 6 years | Public Participation Coordinator |

## 8.4 The Environmental Assessment to Date

The following milestones have been reached as part of the environmental assessment to date:

1. A Pre-Application Consultation Meeting was convened with DEA on 22 August 2011.
2. Landowner notification was undertaken. The Cele K Tribal Authority was notified via the Ugu District municipality on 02 August 2011 (acknowledgement of receipt received

on 10 August 2011. A landowner notification letter was submitted to Camro Estates on 08 August 2011 and acknowledgement was received on 09 August 2011.

3. An Environmental Authorities Meeting was held on 15 September 2011 at the Ugu District Municipality offices in Port Shepstone. The meeting was attended by representatives from DEA, KZN DAEA, Ezemvelo KZN Wildlife, Amafa aKwaZulu-Natali, DMR, WESSA – SKZN, Ugu District Municipality, Umzumbe Local Municipality and DWA.
4. An Application Form for Scoping and EIA, in terms of Regulation 26 of GN R. 543 (18 June 2010), was submitted to DEA on 26 September 2011. DEA assigned the following reference number to the project: **NEAS Reference: DEA/EIA/0000586/2011**; **DEA Reference: 12/12/20/2468**. A copy of the Application Form was submitted to KZN DAEA.
5. Separate meetings were held with representatives from Camro Estates and with the Cele K Tribal Authority on 16 November 2011.
6. A Draft Scoping Report, which conformed to regulation 28 of GN No. R. 543 (18 June 2010), was compiled. This document included the following salient information (amongst others):
   a. A Scoping-level impact assessment to identify potentially significant environmental issues for detailed assessment during the EIA phase;
   b. Screening and investigation of feasible alternatives to the project for further appraisal during the EIA phase; and
   c. A Plan of Study, which explains the approach to be adopted to conduct the EIA for the proposed Ncwabeni OCS Dam. This included *inter alia* the Terms of Reference for the identified specialist studies.
7. Project announcement and notification of review of the Draft Scoping Report was undertaken as a combined exercise in January 2012. The Draft Scoping Report was lodged for review from 25 January 2012 - 07 March 2012.
8. A public meeting was held on 08 February 2012 at the Ugu District Municipality Offices. Another meeting was held on the same day with the Cele K Tribal Authority.
9. A Comments and Response Report was compiled (which was updated during the execution of the Scoping process), which summarised the issues raised by I&APs and the project team’s response to these matters.
10. The Final Scoping Report was submitted to DEA on 24 January 2012.

11. DEA issued approval for the Scoping Report on 26 April 2012 (refer to **Appendix A**), which allowed the commencement of the EIA phase. Notification of I&APs of the approval of the Scoping Report and the review of the Draft EIA Report was undertaken as a combined exercise in September 2012.
12. A Draft EIA Report, which conformed to regulation 31(2) of GN No. R. 543 (18 June 2010), was lodged for public review from 19 November 2012 – 15 January 2013.

## 8.5 EIA Methodology

### *8.5.1 Formal Process*

An outline of the Scoping and EIA process for the proposed Ncwabeni OCSS is provided in **Figure 21**.

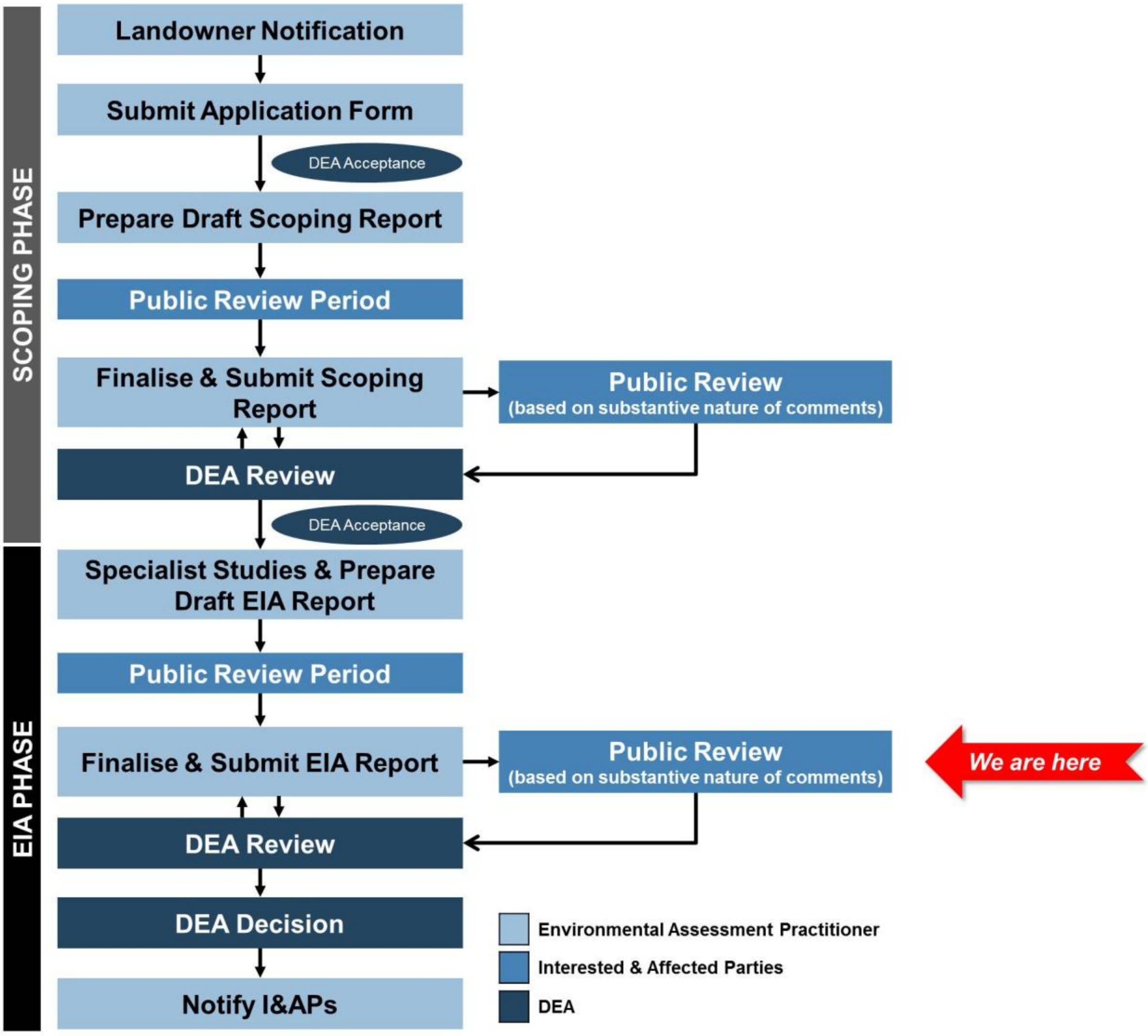



**Figure 21: Outline of Scoping and EIA process**

### 8.5.2 *Objectives of the EIA Phase*

Key objectives of the EIA phase include the following:

- Carry out relevant specialist studies;
- Conduct public participation;
- Assess receiving environment;
- Undertake quantitative assessment of significant environmental impacts and identify concomitant mitigation measures;
- Evaluate project alternative through a comparative analysis; and
- Compile EIA Report in accordance with the requirements stipulated in regulation 31 of GN No. R. 543 (18 June 2010) for review by I&APs. Refer to **Section 2** for the document's composition, in terms of the regulatory requirements.

### 8.5.3 *Amendment of Application Form*

The following activity that was included in the initial Application Form submitted to DEA on 26 September 2011 is no longer relevant to this particular application, as a separate EIA will be conducted for this component of the project:

- GN No. R. 545 – activity no. 8: The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area or industrial complex.

The following activities, which were not included in the original Application Form, are considered to be relevant to the project:

- GN No. R. 544 – activity no. 19: Any activity which requires a prospecting right or renewal thereof in terms of section 16 and 18 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- GN No. R. 544 – activity no. 39: The expansion of -
    - canals;
    - channels;
    - bridges;
    - weirs;
    - bulk storm water outlet structures;
    - marinas;

within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind the development setback line.

- GN No. R. 546 – activity no. 2: The construction of reservoirs for bulk water supply with a capacity of more than 250 cubic metres outside urban areas, in
  - National Protected Area Expansion Strategy Focus areas;
  - Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.

An Amended Application Form, which takes into consideration the abovementioned changes, is included in **Appendix A**.

In the letter issued by DEA (dated 26 April 2012), which approved the Scoping Report and Plan of Study for EIA (refer to **Appendix A**), it was requested that the Application Form be amended "…*as all the listed activities included in the application form are not specific to the proposed development*…". This referred in particular to the activities associated with GN No. R 546. In response to this request, it is noted that the activities that were applied for under GN No. R. 546 were identified in consultation with KZN DEA (refer to **Appendix D**). This was in accordance with what was agreed upon during the Environmental Authorities meeting that was held on 15 September 2012.

#### *8.5.4 Alignment with the Plan of Study*

The Plan of Study, which was contained in the Scoping Report and was approved by DEA, explained the approach to be adopted to conduct the EIA for the proposed Ncwabeni OCSS. The manner in which the EIA Report addresses the requirements of the Plan of Study is shown in **Table 11**.

**Table 11: Alignment of EIA Report with Plan of Study**

| Plan of Study Requirement | EIA Report Reference |
| --- | --- |
| Assess pertinent environmental issues identified during Scoping through:<br>1. Applying an appropriate impact assessment methodology;<br>2. Conducting specialist studies;<br>3. Obtaining technical input; and | • **Sections 11;** and<br>• **Section 12** |

| Plan of Study Requirement | EIA Report Reference |
|---|---|
| 4. Identifying suitable mitigation measures. | |
| Specialist studies to be completed in accordance with Terms of Reference. | • **Section 11; and**<br>• **Appendix E** |
| Public participation to include the following:<br>• Update the I&AP Database;<br>• Notification – Approval of Scoping Report;<br>• Convene public meeting and landowners' meetings;<br>• Compile and maintain a Comments and Response Report;<br>• Allow for the review of the Draft EIA Report; and<br>• Notification of DEA Decision. | **Section 14** |
| EIA Report to satisfy the minimum requirements stipulated in regulation 31 of GN No. R. 543 (18 June 2010). | **Section 2** |
| Authority Consultation. | **Section 14** |

The EIA included the following deviations from the Plan of Study:

- The following specialists replaced the individuals initially listed in the Plan of Study -
  - Estuarine Study - Dr. Barry Clark;
  - Heritage Impact Assessment - Jean Beater;
  - Agricultural Potential Study - John Phipson;
- Although not included in the Plan of Study, DWA commissioned an Economic Study to consider the strategic need for the project on a regional scale, which included the economic rationale and implications of a no-go option; and
- Due to the dynamic nature of the EIA process, the timeframes indicated in the Plan of Study were altered as the subsequent tasks of the process were conducted.

### *8.5.5 Screening of Alternatives*

As part of the Southern KwaZulu-Natal Water Resources Pre-Feasibility Study Phase 2 (2005) and Mzimkhulu River Off-Channel Storage Pre-Feasibility Study (2007), various options to meeting the project's objectives were considered from an engineering, social, economic and environmental perspective. Refer to further discussion on screened alternatives under **Section 6.1**.

The Scoping exercise considered feasible alternatives in terms of the type of dam, the siting of the dam and the positioning of appurtenant works. The "no go" option was also evaluated.

The locations of the OCSS and appurtenance works are taken forward in the impact prediction, where the potential adverse effects to the environmental features and attributes are examined further in **Section 12**.

A comparative analysis of the alternatives (**Section 13**) was also conducted from environmental (including specialist input) and technical perspectives, which included a systematic comparison of the implications of the project options to enable the selection of a Best Practicable Environmental Option (BPEO).

#### *8.5.6 Impact Prediction*

Refer to **Section 12** for the impact assessment of the Ncwabeni OCSS.

The potential environmental impacts associated with the project were identified through an appraisal of the following:

- Proposed locations and footprint of the project infrastructure and components, which included site investigations and a desktop evaluation with a Geographical Information System (GIS) and aerial photography;
- Project infrastructure and design considerations;
- Activities associated with the project life-cycle (i.e. pre-construction, construction, operation and decommissioning);
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes;
- Input received during public participation from I&APs;
- Findings of specialist studies;
- Legal and policy context; and
- Cumulative impacts.

The Scoping exercise aimed to identify significant environmental impacts for further consideration and prioritisation during the EIA stage. Note that “significant impacts” relate to whether the effect (i.e. change to the environmental feature / attribute) is of sufficient importance that it ought to be considered and have an influence on decision-making. During Scoping the impact prediction was executed on a qualitative level, where the main impacts where distilled by considering factors such as the nature, extent, magnitude, duration, probability and significance of the impacts.

During the EIA stage a detailed assessment is conducted to identify all impacts, which are evaluated via contributions from I&APs, the project team and requisite specialist studies, and through the application of the impact assessment methodology contained in **Section 12.1.6**. Suitable mitigation measures are proposed to manage (i.e. prevent, reduce, rehabilitate and/or compensate) the environmental impacts, and are included in the EMPrs (see **Appendix F**).

# 9 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations accompany the EIA process:

- As the design of the project components is still in feasibility stage, and due to the dynamic nature of the planning environment, the dimensions and layout of the infrastructure may change as the technical study advances.
- A separate EIA will be conducted for the new high voltage power line that will bring electrical power to the site.
- The Social Impact Assessment listed the following limitations (Dr Neville Bews & Associates, 2012):
    - The data currently available from Statistics South Africa carries with it certain limitations that will be reflected in this study. Although updated demographic data is available from Stats SA in the form of the Community Survey 2007 and the Mid-year population estimates, this data does not reach down to the ward level and at that level the only data available from Stats SA was that gathered during Census 2001. This being the most recent Census undertaken in South Africa;
    - Every attempt was made to gather data from a wide range of sources, however, much of the data in this report was made available through the EIA, and relies on the accuracy of this data. The results of this study cannot be generalised and applied to the entire population across the whole area and, as is in the nature of social research, is restricted to the specific study area.
- Limitations related to the Terrestrial Ecology Assessment include the following (Nemai Consulting, 2012b):
    - The majority of threatened plant species are seasonal and only flower during specific periods of the year. Time constraints did not allow for repeated sampling over different seasons and so existing data was used to provide additional information;
    - The majority of threatened faunal species are secretive and difficult to observe, even during intensive field surveys conducted over several seasons. For this reason supplementary data from Ezemvelo KZN Wildlife records have been included in this report;
    - Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage and the specialist can thus not

accept responsibility for conclusions and mitigation measures made in good faith based information gathered or databases consulted at the time of the investigation.

- Limitations noted in the Invertebrate Survey include the following (van der Merwe, 2012):
  - It is usually not feasible to sample invertebrate diversity adequately over a relatively short period of time or during the drier, colder (winter) months. Summer surveys are recommended to firmly establish the absence of *Doratogonus infragili* and *Doratogonus montanus* from the two sites.
- The Heritage Impact Assessment noted the following limitations (Beater, 2012):
  - The dense Valley Bushveld vegetation made access to sites very difficult at times. Access to sections of both dam sites was obtained by using existing paths and roads which was made possible due to the knowledge of the area by community members who accompanied the team to site.

***<u>Note:</u>*** *With regards to the limitations of the Terrestrial Ecology Assessment, Invertebrate Survey and Heritage Impact Assessment, a recommendation that emanated from the EIA phase (see* ***Section 15.3****) is that a Search, Rescue and Relocation Management Plan needs to be developed that takes into consideration red data, protected and endangered species, medicinal plants, heritage resources and graves.*

- The Visual Impact Assessment noted the following limitations (Axis Landscape Architecture, 2012):
  - The assessment was undertaken during the conceptual stage of the project and is based on information available at the time.
- The assumptions and limitations associated with the Socio-Economic Study include the following (Nemai Consulting, 2012a):
  - Data used for the demographic profile was data from Statistics South Africa 2001. This is eleven years old but is the only comprehensive data set available thus results may be skewed;

  - The study area is defined as Sunduza, Ncane and Nyamande. A more comprehensive spatial data would have allowed this study to reflect the demographics more accurately.
- The estuarine specialist (Anchor Environmental, 2012) noted that this description of the Mzimkhulu Estuary is drawn largely from the estuarine Ecological Water Requirements study that was completed as part of the Mzimkhulu River Catchment Water Resource Study (DWA, 2011c). The overall confidence regarding the hydrodynamics of the estuary and hence the overall study was low, owing to the lack of historical water level data for the system, lack of good data on the state of the mouth, and the lack of a flow record just upstream of the estuary. This does not necessarily affect the accuracy of the information on the status of the system but may affect the accuracy of prediction made in the study.
- Regardless of the analytical and predictive method employed to determine the potential impacts associated with the project, the impacts are only predicted on a probability basis. The accuracy of the predictions is largely dependent on the availability of environmental data and the degree of understanding of the environmental features and their related attributes.
- A relatively unknown impact associated with project is the potential contributions to greenhouse gas emissions caused by to decomposition of inundated vegetation within the dam basin. This impact was evaluated on a desktop level through literature research on the topic. Mitigation measures and recommendation are included in the EIA Report to address this matter further.

# 10 PROFILE OF THE RECEIVING ENVIRONMENT

This section provides a general description of the status quo of the receiving environment in the project area. This serves to provide the context within which the EIA was conducted. The study area includes the entire footprint of all the project components, which includes the construction domain and surrounding receiving environment.

Where necessary, the regional context of the environmental features is also explained, with an ensuing focus on the local surrounding environment. The reader is referred to **Section 11** for more elaborate explanations of the specialist studies and their findings for specific environmental features.

This section allows for an appreciation of sensitive environmental features and possible receptors of the effects of the proposed project. The potential impacts to the receiving environment are discussed further in **Section 12**. It should be noted that the impacts of an off-channel dam are less than those associated with an on-channel impoundment, particularly with regard to the influence to the water flow and silt regime.

## 10.1 Land Use

According to DEAT (2001), about 26% of the Mzimkhulu catchment is under agriculture, mostly commercial forestry and subsistence farming. Some temporary commercial irrigated agriculture, sugar cane, temporary commercial dryland agriculture, and improved grassland is also present. Approximately 9% of the catchment land-cover is degraded grassland and bushland with roughly 64% being natural; this consists mainly of grassland, bushland, and forest. About 1% of the land-cover comprises of urban development, mainly residential development and smallholdings. Major towns in the Mzimkhulu catchment include Port Shepstone near the coast and Umzimkulu further inland.

The largest water users in the catchment are domestic (rural) use and stock-watering. This relatively large rural use and extensive afforestation (584 km$^2$), has a significant impact on the low flow in the catchment (DWAF, 2004a).

The proposed dam sites are situated in rural areas, in predominantly natural environments (see **Figure 22**). Surrounding land uses include small-scale and subsistence farming on the tribal land and a privately owned commercial farm on the southern side of the Mzimkhulu River. Site D2 is more pristine, with rural dwellings and subsistence farming occurring in parts of site D3A.

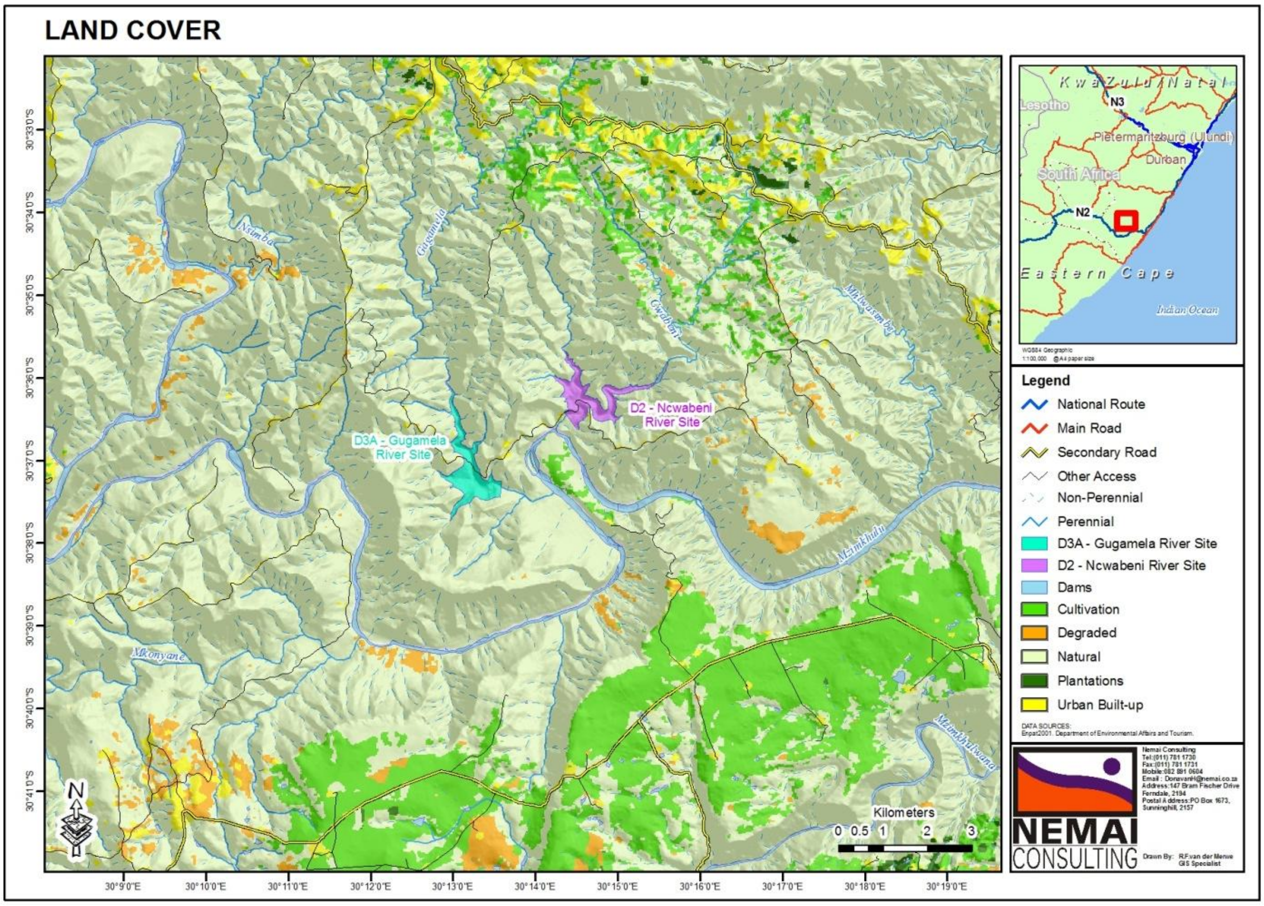



**Figure 22: Land cover**

D2 (Ncwabeni River) and D3A (Gugamela River) will inundate land of approximately 0.95 km$^2$ and 0.98 km$^2$, respectively. Land use affected in D3A includes mostly natural areas, with some sparse human settlements and related subsistence farming. D2 constitutes natural area.

## 10.2 Climate

The closest South African Weather Services (SAWS) meteorological stations are located in Paddock and Margate. Port Shepstone, which is situated approximately 20 km south-east of the project area, lies in a transitional zone between temperate climatic conditions to the south and sub-tropical climatic conditions to the north. Maximum temperatures are experienced in the summer months from December to February and minimum temperatures in winter in June and July. The mean maximum and minimum temperatures are 30.6 ˚C in January and 8.8 ˚C in June, respectively (Mucina & Rutherford, 2006). The temperatures are slightly lower than this for the inland areas where the proposed development site is situated (DWAF, 2004a).

According to DWAF (2004a), rainfall over the area is markedly orographically-related. Average annual rainfall varies from between 1 000 mm to 1 200 mm along the coast to greater than 1 500 mm in the north-west along the Drakensberg mountains. Rain shadows occur in the interior valley basins of the major rivers where the annual rainfall can drop to below 700 mm. The peak rainfall months are December to February in the inland areas and November to March along the coast. The rainfall is seasonal with most rain falling in summer from October to March.

The WMA experiences a high relative humidity in summer in a similar pattern as the rainfall. There is a daily mean peak in February, ranging from 68% in the inland areas to greater than 72% for the coast and a daily mean low in July, ranging from 60% in the inland areas to greater than 68% at the coast (DWAF, 2004a).

As part of the water resources assessment conducted under the Mzimkhulu River Catchment Water Resource Study (DWA, 2011d), rainfall and evaporation data in the Mzimkhulu catchment was fed into the modelling of the system yield analysis.

The impoundments will have larger surface areas than the Ncwabeni or Gugamela Rivers, with an inundation area of approximately 0.95 $km^2$ (/96 Ha) and 0.98 $km^2$ (/98 Ha) for D2 and D3A respectively, which will lead to an increase in evaporation.

## 10.3 Geology & Soils

The simplified geology in the project area is shown in **Figure 23**.

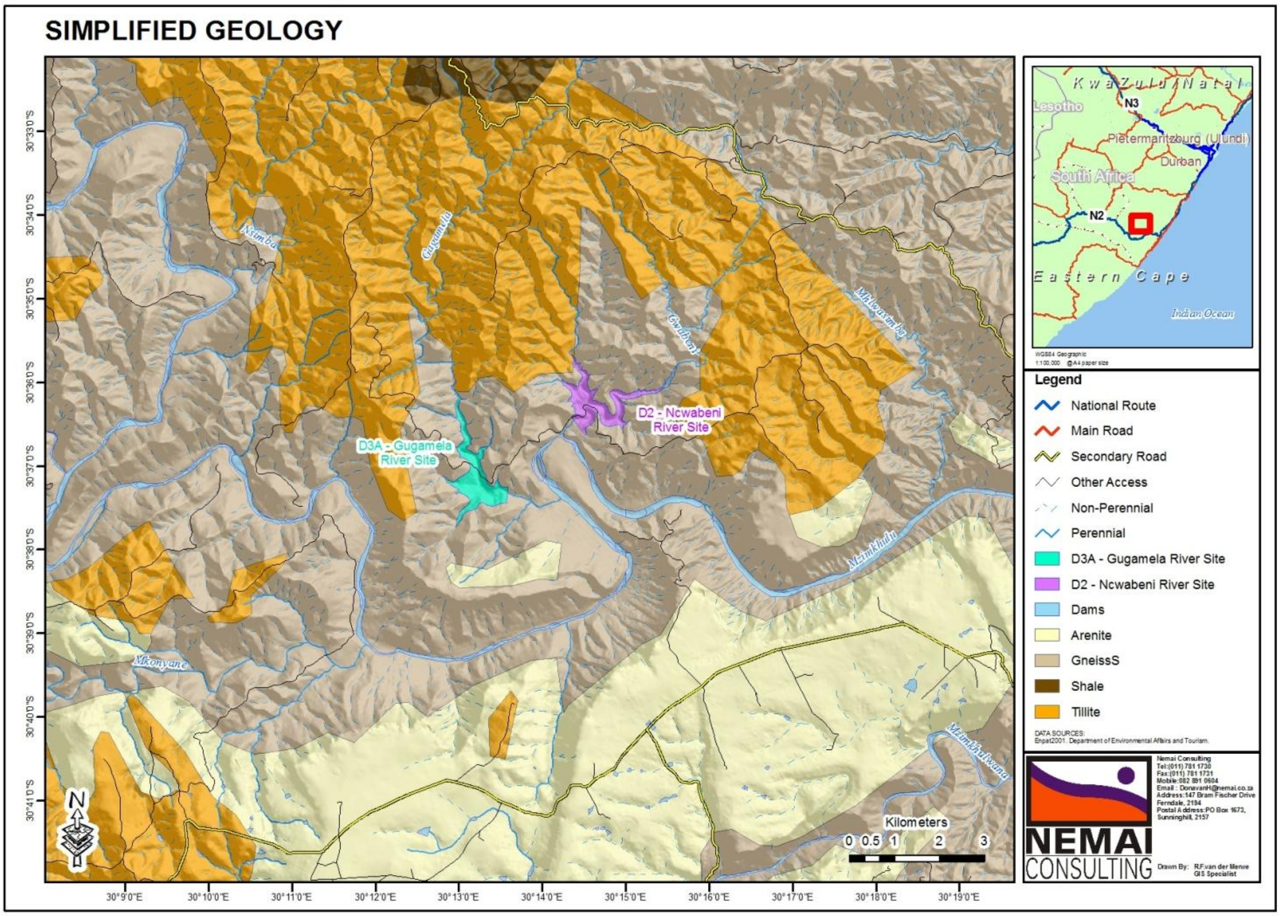



**Figure 23: Simplified geology**

According to DWAF (2004), the Mzimkhulu valley consists of younger rocks of the Natal Group and the Karoo Supergroup, as well as rocks of the approximately 1000 Ma –old Natal Metamorphic and Structural Province. The Natal Metamorphic and Structural Province is subdivided into two groups, the Mapumulo Metamorphic Suite and the Oribi Gorge Suite. Granites of the Oribi Gorge Suite underlie the proposed dam sites.

According to DWAF (2007b), the geological map of the area indicates faults in close proximity to both the D2 and D3A sites. Numerous regional-scale faults were identified from the aerial photograph interpretation, commonly trending north - south, with conjugate sets trending northeast and northwest, respectively. The left flank of the D2 site is marked by the presence of fault breccia (DWAF, 2007b).

A summary of the main findings of the pre-feasibility geotechnical investigations is tabulated below.

**Table 12: Key findings of pre-feasibility geotechnical investigations (DWAF, 2007b)**

| | Site D2 | Site D3A |
|---|---|---|
| **Founding conditions** | Asymmetrical. Deeply weathered flanks. Slightly to moderately weathered granite outcrop in narrow river section not rising much above river bed level. A major fault traverses left flank, with subordinate faults. | Asymmetrical. Bedrock exposures in narrow river section, extending to lower left flank. Left flank largely deeply weathered granite. Right flank comprises thick accumulation of colluvium, with bedrock essentially at same level as river bed. |
| **Engineering geological uncertainties** | • Founding conditions within fault zone on left flank, as well as within subordinate faults<br>• General founding conditions on upper left flank | • Founding conditions on steep left flank<br>• Possible fault upstream of centre-line<br>• Soil parameters of colluvial and alluvial horizons on right flank |
| **Recommended excavation depths** | For the concrete structure, depths of 6 – 25 m on steep right flank, approximately 1 m in river section, and 7 – 8 m on lower left flank. | For the concrete structure, depths of possibly 5 – 20 or 25 m on steep left flank, 1 – 2 m within river, and 7 – 15 m on lower right flank. |

A Seismic Hazard Analysis, issued by the Council for Geoscience, was prepared as part of the Mzimkhulu River Off-Channel Storage Pre-Feasibility Study. The analysis revealed that the seismic parameters do not pose a concern to the stability of the dams (DWAF, 2007b).

Soil cover throughout the area is generally shallow and is strongly parent-material related due mainly to the prevailing topographic conditions. Soils are mainly of sandy types developed on quartzose rocks, or clayey soils developed on argillaceous and basic igneous and metamorphic rocks. Deeper transported soils are present as colluvium on lower slopes, with alluvium occurring in valley bottoms and estuaries at the coast. Pressure on this resource is evident from the high levels of soil erosion, arising from over-grazing, intensive cultivation, informal farming and settlements, timber plantations, and sand winning (Davis, 2004).

Various phases of geotechnical investigations were conducted to *inter alia* establish the availability of material to determine the dam type and to investigate the stability of the sites (founding conditions) for the location of the infrastructure.

The main findings of the second-phase geotechnical investigations (drilling and trenching investigation), which were completed on 16 September 2011, follow (BKS, 2012c):

- **Dam centre line** - Boreholes along the dam centre line confirmed that the core trench for an embankment dam can be founded at shallow depths of 2.5-3.5 m. The plinth of a CFR dam can be founded at depths of 4.2-5.5 m.
- **Rockfill quarry** - The investigated quarry area, which covers about 80,000 $m^2$, is covered by an average of 3 m of soil overburden, followed by an average of 5 m of highly to moderately weathered granite (soft rockfill) above slightly weathered to unweathered strong rockfill. By selecting an area of about 30,000 $m^3$ where the weathering is thinnest, the overburden volume could be reduced to about 80,000 $m^3$ with a similar yield of soft rockfill. The shortfall can then be made up as hard rockfill by quarrying to a greater depth.
- **Weir site** - The upstream weir site has rock at shallow depth on the left flank and in the river channel. However, highly permeable alluvium occurs on the right flank to a depth of 11 m. The downstream weir has rock at shallow depth on both flanks and in the river channel.
- **Pump station** - At the alternative pump station sites, good quality rock occurs at depths of 0.5-1.5 m.
- **Impervious material** - In the basin of dam site D3A and in the adjacent areas of red soils, only very small quantities of marginally suitable core material were found.

The Phase 3A geotechnical investigations (dam type selection on drilling and trenching investigation) found the following (BKS, 2012c):

- Sufficient earthfill materials could not be found;
- Sufficient sandy materials for a bentonite/sand/rockfill dam could also not be motivated; and
- A quarry for rockfill, aggregates and sand was identified close to the D2 dam site.

## 10.4 Geohydrology

According to the ISP for the Mvoti to Mzimkhulu WMA (DWAF, 2004a), groundwater aquifer types present in the region are almost entirely of the ‘hard rock’ secondary porosity, ‘weathered and fractured’, and ‘fractured’ classes. ‘Inter-granular’ primary porosity class aquifers are present to a very limited extent in riverbeds in close proximity to the coast. In the 'fractured' class, zones of preferential groundwater presence include faults, major joints, bedding planes, and the contacts of intrusive Karoo dolerite sheets and dykes with the host rock. The hydrogeological aquifer unit for the quaternary catchment T51M, which encompasses the project area, is Natal sandstone and Dwyka tillite.

The quality of the groundwater in the region is generally very good and it is invariably suitable for human and animal consumption, as well as for agricultural and industrial purposes (DWAF, 2004a).

A water supply scheme consisting of a number of boreholes was previously installed, however there were reportedly water quality issues and the boreholes are no longer in use (DWAF, 2007c). Local households thus rely on water from the Mzimkhulu, Ncwabeni and Gugamela Rivers to meet their domestic water needs. However, according to DWAF (2004a), given the population densities prevailing in the rural areas and the generally steep topographic conditions, water supply from groundwater boreholes in these areas is regarded as the most practical and economic method of water supply. The success of this venture would however pivot on the provision of adequate maintenance.

Surface water and groundwater interactions have been taken into account from a regional perspective when determining the hydrology of the river catchment. Furthermore, the water table of the proposed OCS dam site has been considered during the geotechnical investigations when assessing the foundation conditions for the dam.

As part of the Mzimkhulu River Catchment Water Resource Study (DWA, 2001a), a Groundwater Resources Report was compiled to assess the potential groundwater resources to relate borehole yields to geological formations, including water quality and potential for recharge, as well as identifying potential aquifer formations and related structural features. Key findings from this report include:

1. Magnesium, nitrate and fluoride are the only potentially problematic determinants in the groundwater, with these variables peaking in the southern Mzimkhulu catchment.
2. Agricultural activities constitute the principal source of groundwater pollution;
3. Elevated groundwater yields are related to areas on increased rainfall;

4. Elevated groundwater yields occur to the west and south of Creighton and from north and west to south of Underberg;
5. Populations (both rural and urban) are situated within these areas, such that groundwater supply to these communities appears viable; and
6. Depths to water strikes ate lowest around Centecow Mission (<20 m - <40 m), increasing to 40 m – 60 m north of Rietvlei, west of Creighton and Underberg and potentially up to >100 m north of Underberg. These areas have good potential for further groundwater development.

The groundwater-surface-water interaction is regarded to be generally low as most of the WMA is underlain by low-porosity rock formations (DWAF, 2004a)

## 10.5 Topography

As shown in **Figure 24**, the terrain morphology of the project area is classified as low mountains. The study area lies within the lower reaches of the Mzimkhulu River, which rises out of the Drakensberg Mountains. The catchment is characterised by steep slopes in the river valleys. Areas of moderate slopes do occur within the catchment and these flatter areas are mainly subjected to intensive agricultural activities (DWAF, 2004a).

The slopes of the edges of the rivers on the study area range from approximately 30-45%. The highest elevation in the study area is 412m above mean sea level (BKS, 2011). The terrain at the sites D2 and D3A, as discerned from the digital elevation model, is shown in **Figure 25**.

Upstream of the dam wall the watercourse will change from a river valley to a reservoir. The new water body will represent a significant topographical feature in the immediate altered landscape.

A Visual Impact Assessment to assess impact associated with the building of the dam in the low mountainous area was conducted, and it is contained in **Appendix E6**. Refer to the summary and impact assessment of this study contained in **Sections 11.7** and **12.11**, respectively.

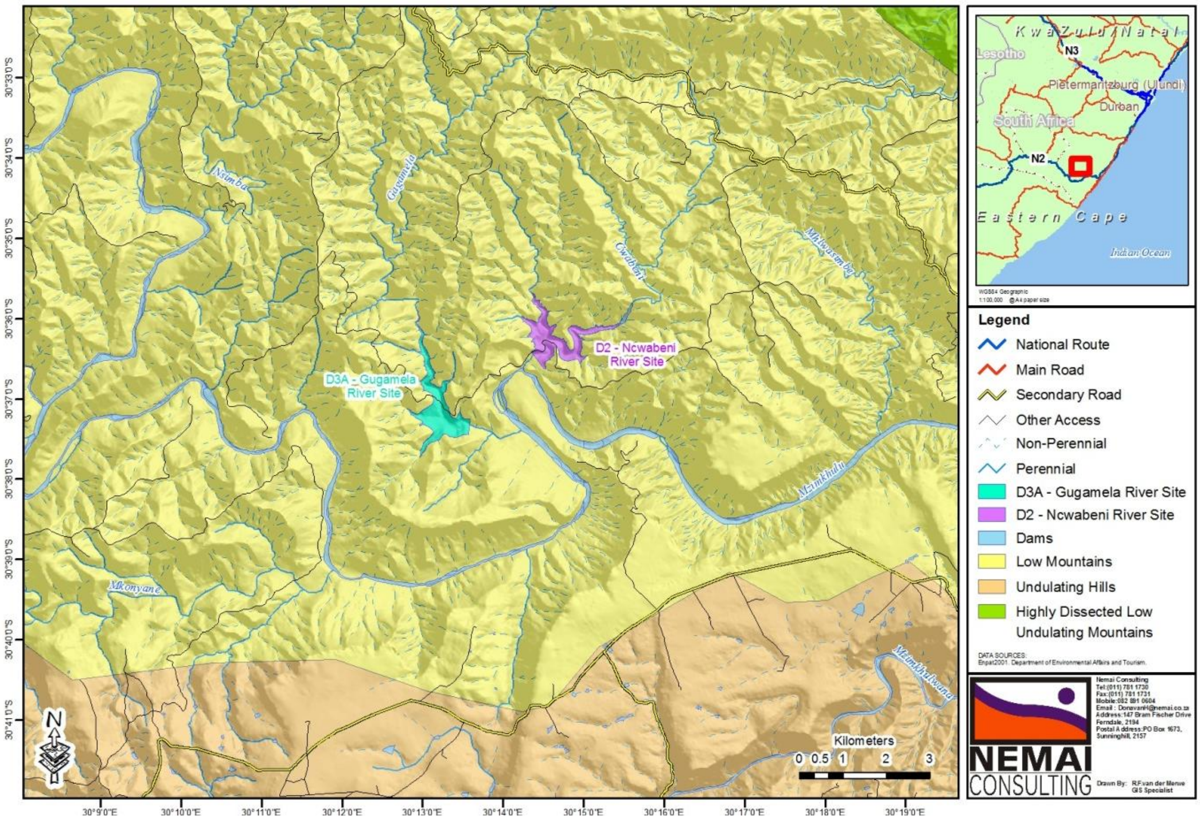



**Figure 24: Terrain morphology**

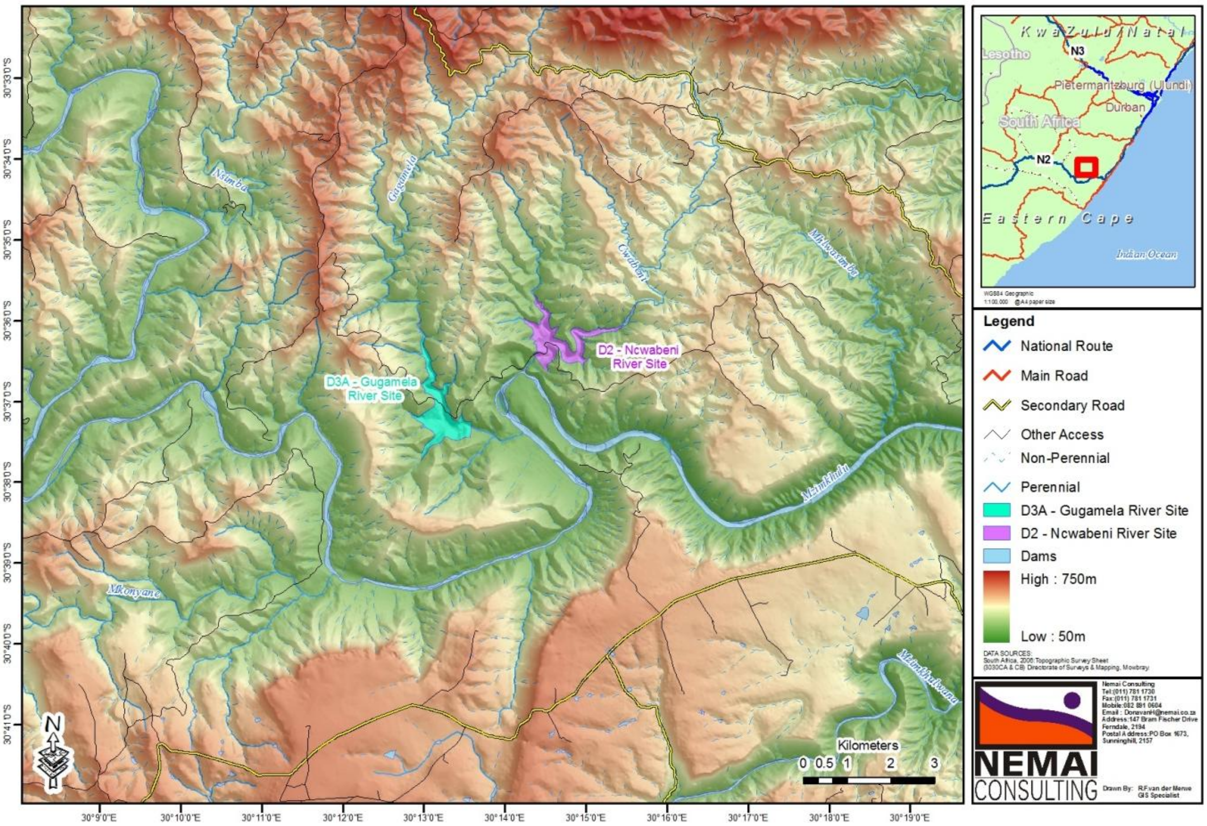



**Figure 25: Terrain depicted through digital elevation model**

## 10.6 Surface Water

### *10.6.1 General Description*

The project area falls within the Mvoti to Mzimkhulu Water Management Area (WMA) and is situated in the T52M quaternary catchment (see **Figure 26**).

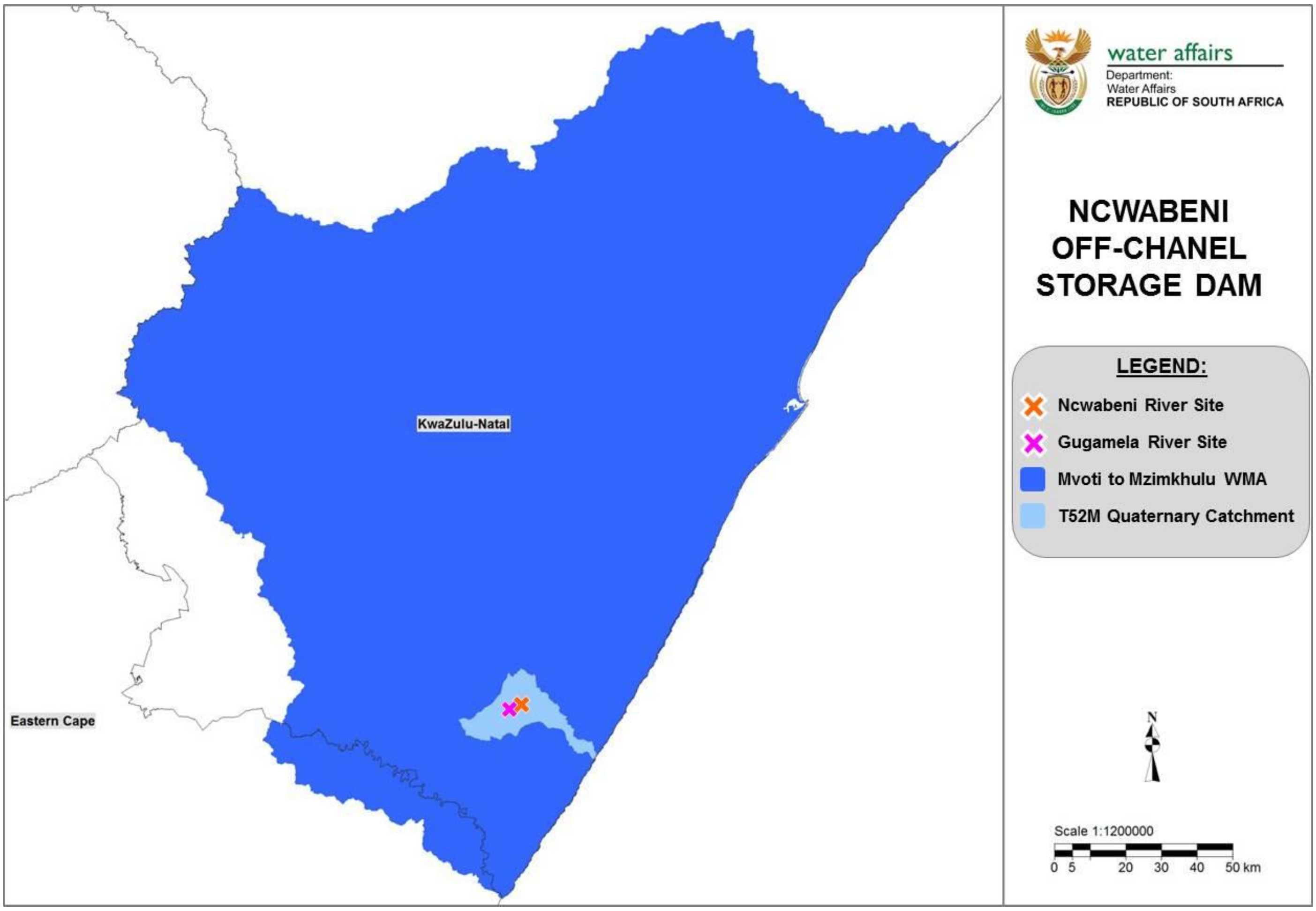



**Figure 26: Map of WMA and Quaternary Catchment**

The Ncwabeni (also known as the Cwabeni) and Gugamela (also known as the Gagamela) Rivers are tributaries of the Mzimkhulu River and originate approximately 6km and 10km north of the main stem, respectively. The Gugamela River joins the Mzimkhulu River roughly 1,8 km upstream of the confluence with the Ncwabeni River. Refer to **Figure 27**.

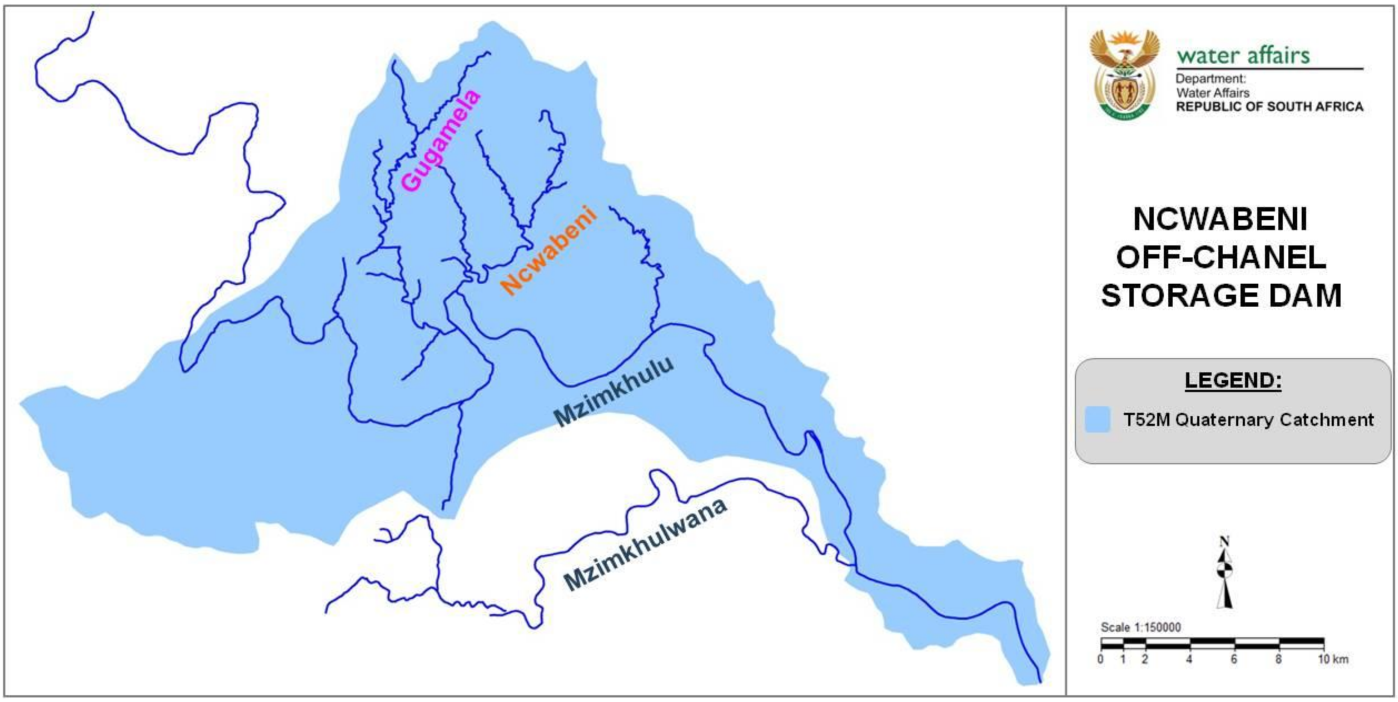



**Figure 27:** **Map of major watercourses relevant to the project**


**Figure 28:** **Views along the Ncwabeni River (Enviross, 2012)**


**Figure 29:** **Views along the Gugamela River (Enviross, 2012)**

The mouth of the Mzimkhulu River is approximately 30km to the south-east of the project area, in Port Shepstone. The confluence of the Mzimkhulu and Mzimkhulwana Rivers is immediately upstream of the St Helen's Rock abstraction works.

Based on the results of the yield analysis (DWAF, 2007b), the catchments of the Ncwabeni and Gugamela Rivers are relatively small and they do not have sufficient water to cater for the 2025 planning scenario water requirements. Supplementary pumping from the Mzimkhulu River is thus necessary.

### *10.6.2 Water Users*

Existing water users include the following (DWAF, 2007c):

- A number of commercial businesses (Illovo Sugar Mill, NPC Cement and Idwala Open Cast Mining) have existing entitlements to abstract water downstream of the proposed dam sites;
- The farm Camro Estates draws water from two points on the Mzimkhulu River, one of which is downstream of the confluence with the Ncwabeni River;
- A number of sand mining operations are located in the lower reaches of the Mzimkhulu River; and
- Local households rely on abstraction of water from the Mzimkhulu, Gugamela and Ncwabeni Rivers to meet domestic water needs (drinking, washing, etc.).

There are no storage impoundments on the Mzimkhulu River.

### *10.6.3 Ecological Status*

According to DWAF (2007b), the Ecological Reserve was determined by the DWA: Directorate: Resource Directed Measures for a section on the Mzimkhulu River, at the confluence with the Ncwabeni River, using the Rapid III methodology. The recommended Ecological Management Class for the river was set at category B,

| **Box 2:** | **What is the "Reserve"?** |
|---|---|
| The **Reserve** is central to water resource management and enjoys priority of use according to the National Water Act (No. 36 of 1998). The Reserve relates to the quantity and quality of water required to satisfy the following two elements:<br>• The **Basic Human Needs Reserve**, which provides for essential needs of individuals; and<br>• The **Ecological Reserve**, which relates to the water required to protect the functional integrity of aquatic ecosystems. | |

which represents a river in a largely natural state. The Reserve was estimated at 34.79% of the Virgin Mean Annual Runoff (MAR). The Reserve at St. Helen's Rock was estimated at a desktop level. The Ecological Reserve was considered in the hydrological and yield assessment, as part of the Mzimkhulu River Off-Channel Storage Prefeasibility Study. A base flow Ecological Reserve release was modelled for both off-channel dam alternatives, but was limited to the medium winter flows. The Ecological Reserve requirements at the St Helen's Rock site were modelled using the flow duration curves (DWAF, 2007b).

As part of the Mzimkhulu River Catchment Water Resource Study, the Riverine Ecological Water Requirements (EWR) (DWA, 2011b) were determined for eight sites in the Mzimkhulu Catchment. The EWR feeds into the Reserve determination process, by representing the quantity and quality of water required to maintain the water resource in its assigned ecological category. The following emanated from this study:

- The EWR determination was conducted using the Intermediate approach for five of the sites and the Rapid III approach for the remaining three sites (see **Figure 30**). The site selected that is in proximity to the Ncwabeni OCS Dam study area is in the lower Mzimkhulu River at Gibraltar (Coordinates: 30°37'42.55"S, 30°14'37.31"E) (MZEWR6I), where the Intermediate approach was applied. The site has a moderate Ecological Importance and Sensitivity largely as a result of being moderately sensitive to flow and flow related water quality changes as well as having fairly good species richness (mainly invertebrates). The Present Ecological State (PES) and Recommended Ecological Category (REC) was determined as A/B.
- Various development scenarios were considered as part of this study, which included various possible dam sites on the main stem and tributaries of the Mzimkhulu River (including the proposed Ncwabeni OCS Dam). Dam sites on tributaries were found to have much less of an impact on the ecosystem than for those sites on the main stem. The study also indicated that avoiding dams on the main stem would support conservation initiatives, where the undammed nature of the Mzimkhulu River has been recognised by the National Freshwater Ecosystem Priority Areas programme and the river is ranked as one of the most important for conservation in the region.

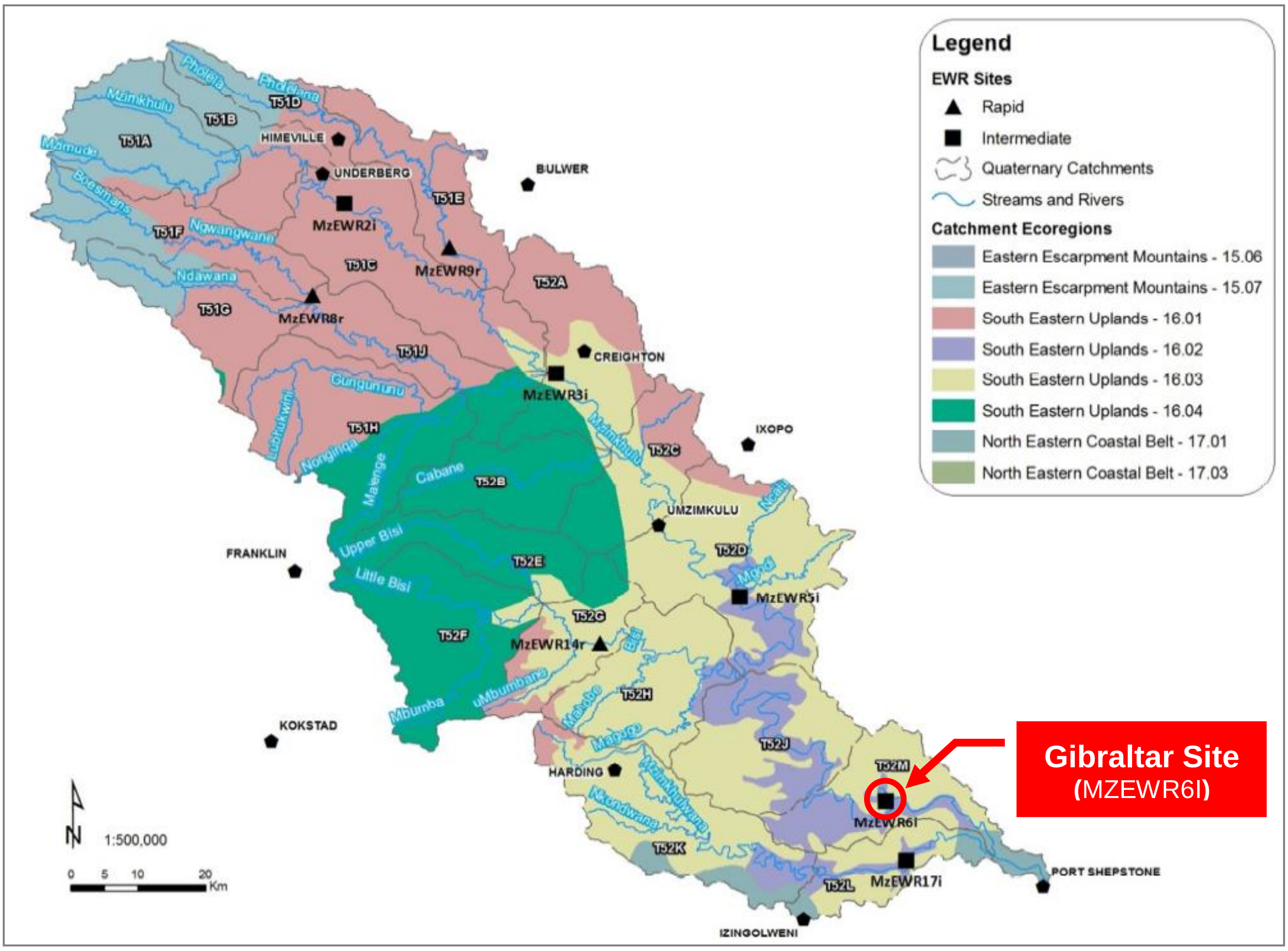



**Figure 30: Map with EWR sites in the Mzimkhulu River Catchment (DWA, 2011)**

The EWR determined as part of the Mzimkhulu River Catchment Water Resource Study were taken into account in both the yield analysis and technical design of the Ncwabeni OCS Dam. The proposed OCS dam intends to provide for the water requirements for all users, including the Reserve. The Reserve requirements will ultimately feed into the NWA licensing process of DWA and the operation of the system.

An Aquatic and Riverine Assessment, was conducted (see **Appendix E1**) for the project. Refer to **Sections 11.2** and **12.4.4** for a synopsis of the study and a related impact assessment, respectively.

### *10.6.4 Water Quality*

#### 10.6.4.1 Prefeasibility Study

During the Mzimkhulu River Off-Channel Storage Prefeasibility Study, water samples were taken and analysed from the following localities (see results in **Table 13**) (DWAF, 2007b):

- Site 1: Mzimkhulu 2 (just upstream of Ncwabeni River);
- Site 2: Ncwabeni River, upstream of the proposed dam site D2 (at road crossing);
- Site 3: Gugamela River, downstream of proposed dam site D3 (at road crossing); and
- Site 4: Mzimkhulu River at St Helens Rock.

**Table 13: Raw water quality data for water from Sites 1, 2, 3 and 4 (DWAF, 2007b)**

| Raw water | Site 1 | Site 2 | Site 3 | Site 4 |
|---|---|---|---|---|
| **pH** | 7,69 | 7,32 | 7,17 | 7,26 |
| **Turbidity (NTU)** | 35,0 | 33,0 | 27,0 | 27,0 |
| **Conductivity (mS/m)** | 10 | 18 | 19 | 20 |
| **Colour (Hazen)** | 280 | 280 | 160 | 140 |
| **Alkalinity (mg/L CaCO3)** | 44 | 34 | 48 | 54 |

These water samples were tested for their response to treatment. The results of this investigation indicate that the water samples from all sites do not pose any significant treatment problems. Indications are that the water from the Mzimkhulu River is the most easily treatable water, although the water from the Ncwabeni and Gugamela Rivers is not expected to pose any treatment difficulties (DWAF, 2007b).

A detailed sedimentation study was conducted during the Mzimkhulu River Off-Channel Storage Prefeasibility Study in order to determine the sediment yields from the individual dam catchments, as well as to determine the volume of sediment deposited in the dams as a result of water pumped from the Mzimkhulu River. The recommended 50 year sediment storage capacity for each of the proposed dams was found to be as follows (DWAF, 2007b):

- D2 - 2.1 million $m^3$; and

- D3A - 1.8 million $m^3$.

#### 10.6.4.2 Feasibility Study

A water quality assessment was conducted as part of the Ncwabeni Off-channel Storage Dam Feasibility Study: Module 1: Technical Study (BKS, 2012a) to guide the design and planning of the proposed Ncwabeni impoundment and its operation to optimise water quality. An extract from this assessment follows.

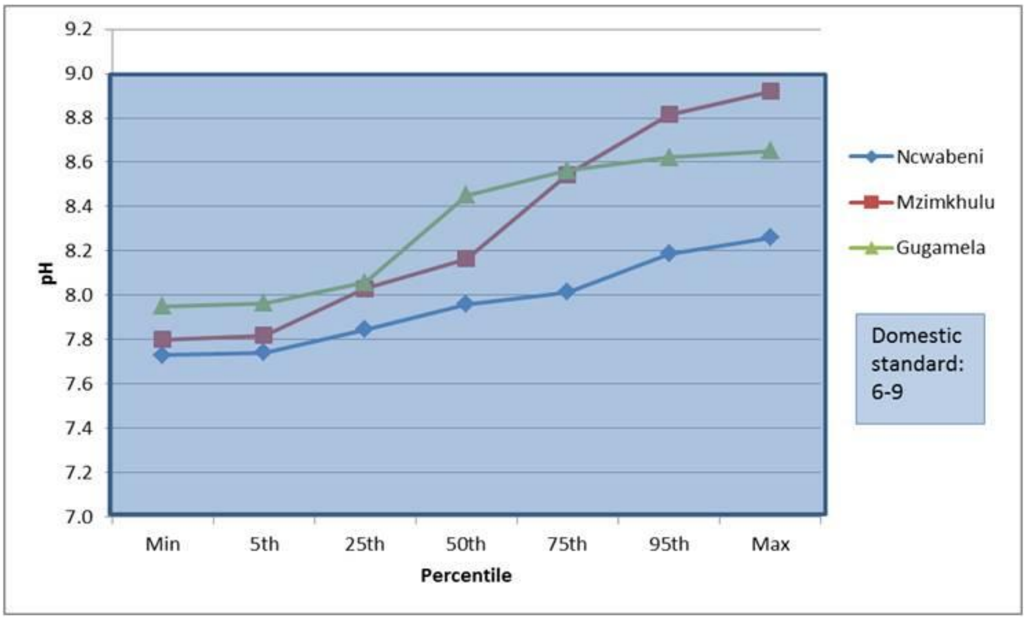
The upper Mzimkhulu catchment is utilised for agricultural, tourism and residential purposes, but the activities are limited and the pollution potential is expected to be low. Population density in the catchment is low and is unlikely to have significant water quality impacts. There are no industries in the catchment, and no mining activities are known, other than some quarrying for road materials. In general, catchment quality is good to very good, and very few water quality problems are anticipated.

Water quality measured in the Mzimkhulu and Ncwabeni Rivers is generally good, with low concentrations of dissolved salts, turbidity and nutrients. Of concern is that iron concentrations, faecal coliform and *E. coli* counts are above DWA standards for domestic use and chlorophyll a concentrations are above DWA aquatic standards.

The feasibility-stage water quality assessment included taking monthly water quality samples from March 2011 from the Ncwabeni, Mzimkhulu and Gugamela Rivers. While this is a short monitoring period, it provides an indication of both the summer high rainfall period and the drier winter period, which is necessary to provide an indication of the average and poorest water quality conditions.

- **pH**

The pH values in the Ncwabeni River ranges between 7.7 and 8.3 (**Figure 31**). These pH values fall within the range of most natural waters. At these ranges, no adverse effects are expected for all users.



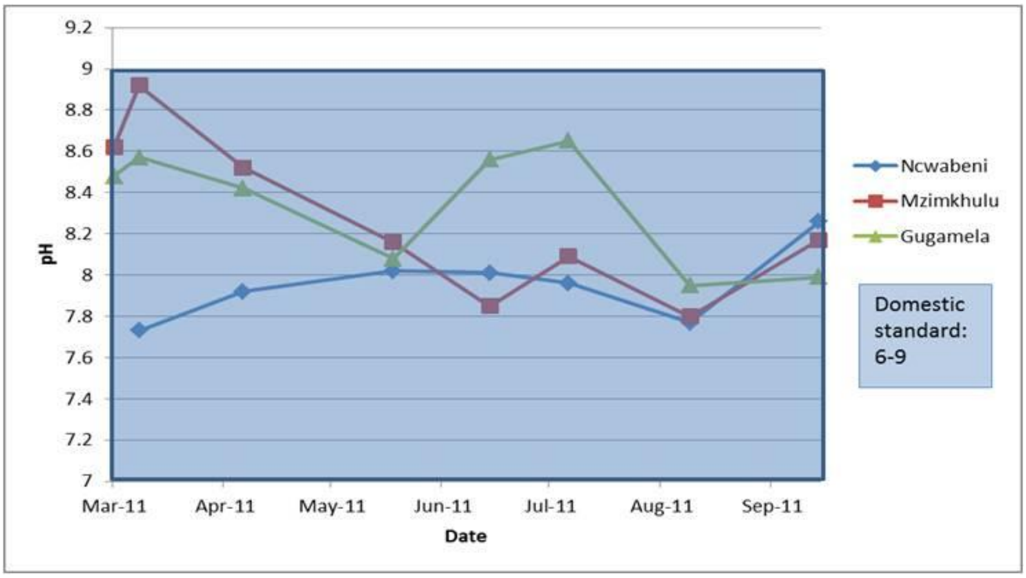
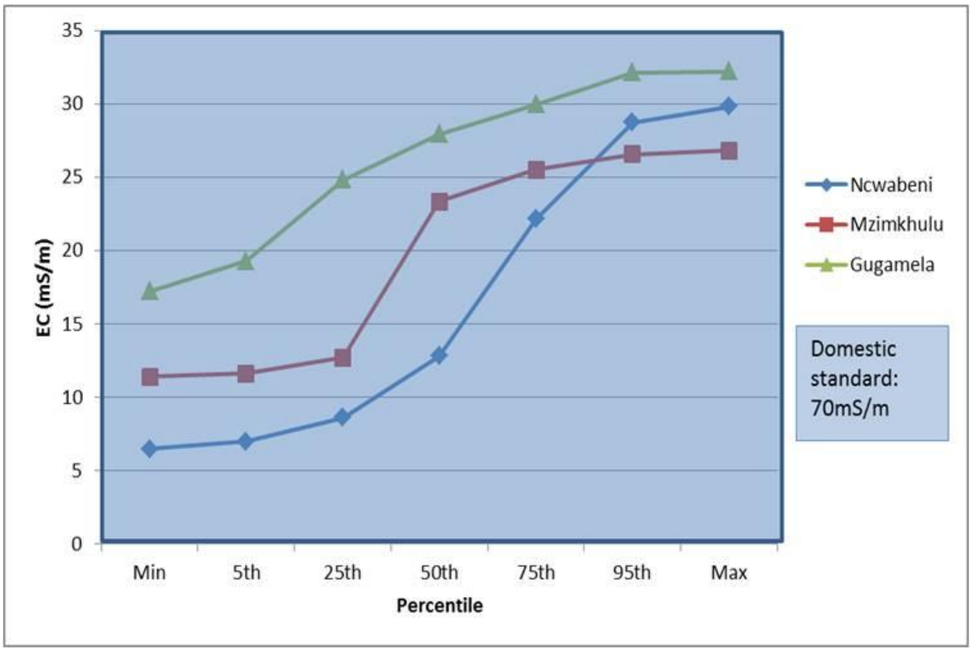
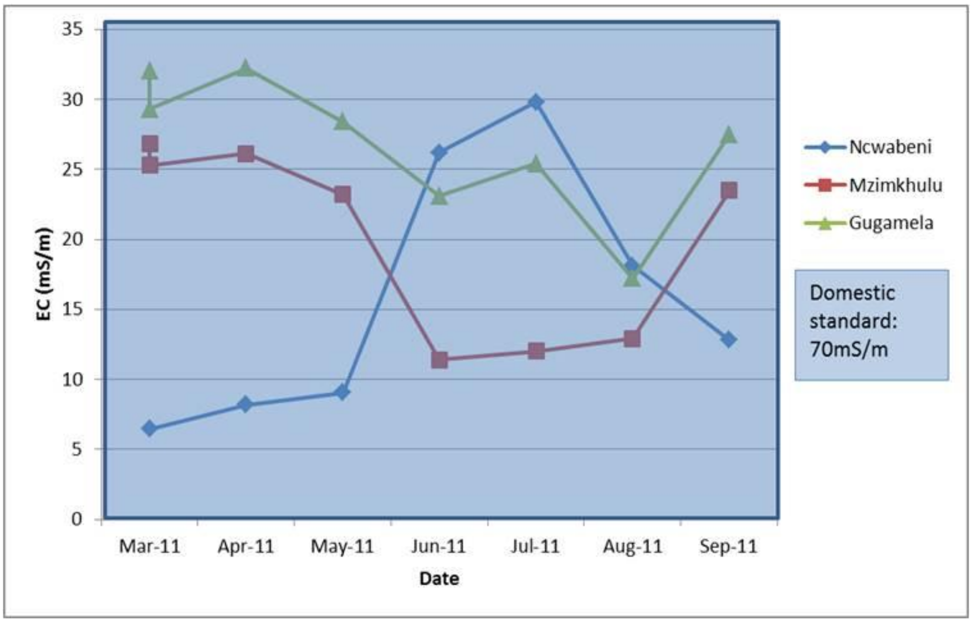




**Figure 31: pH for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **<u>Electrical Conductivity (EC) and dissolved salts</u>**

The range of EC results recorded (6-30 mS/m) reflect a soft water with low dissolved salt concentrations. These concentrations are within the DWA water quality standards for domestic water (**Figure 32 - 33**). The increase in EC and TDS during June and July could be due to low flow conditions during these months. This would have a greater impact on the water in the Ncwabeni River, as there are impoundments where the flow of water is reduced and evaporation of water can occur.




**<u>Figure 32:</u> Electrical conductivity for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

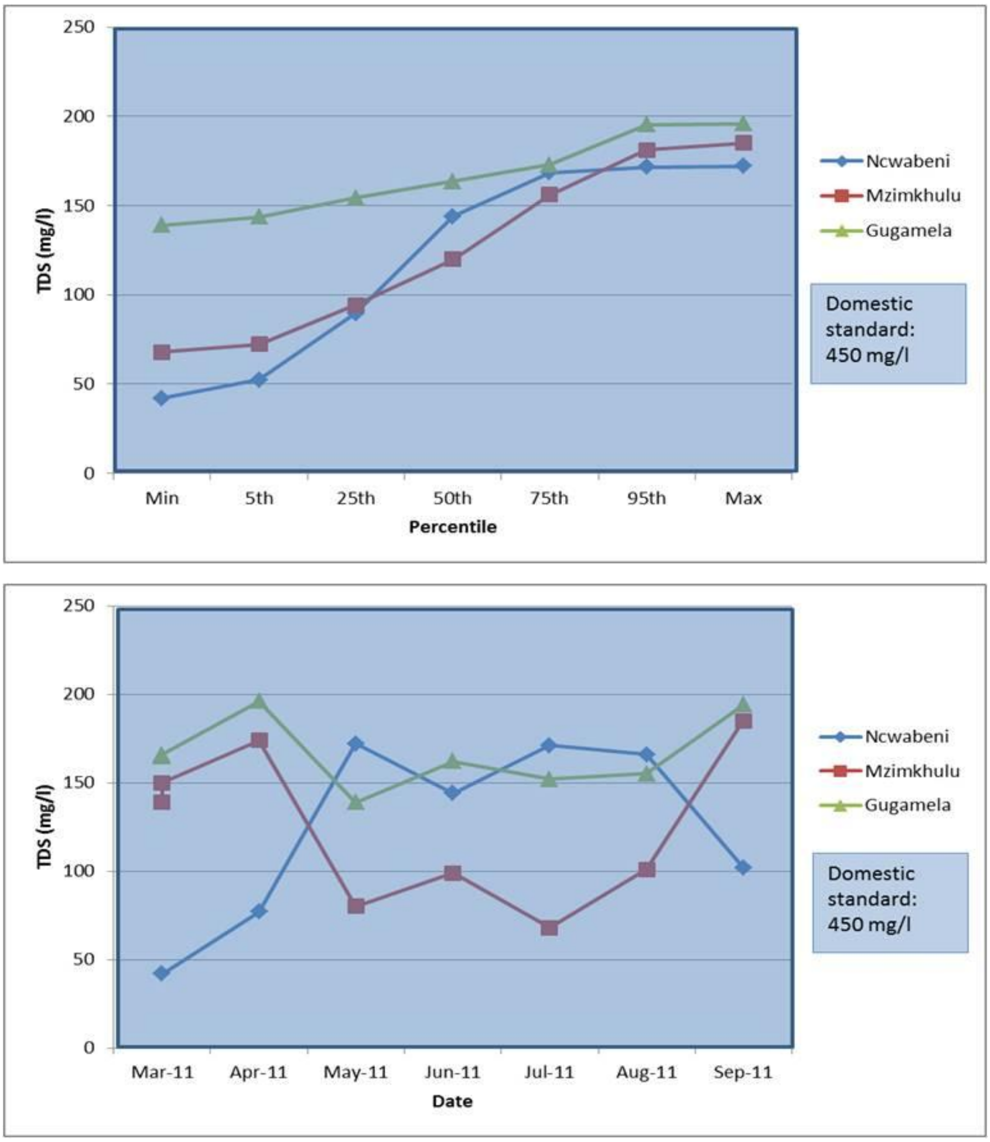
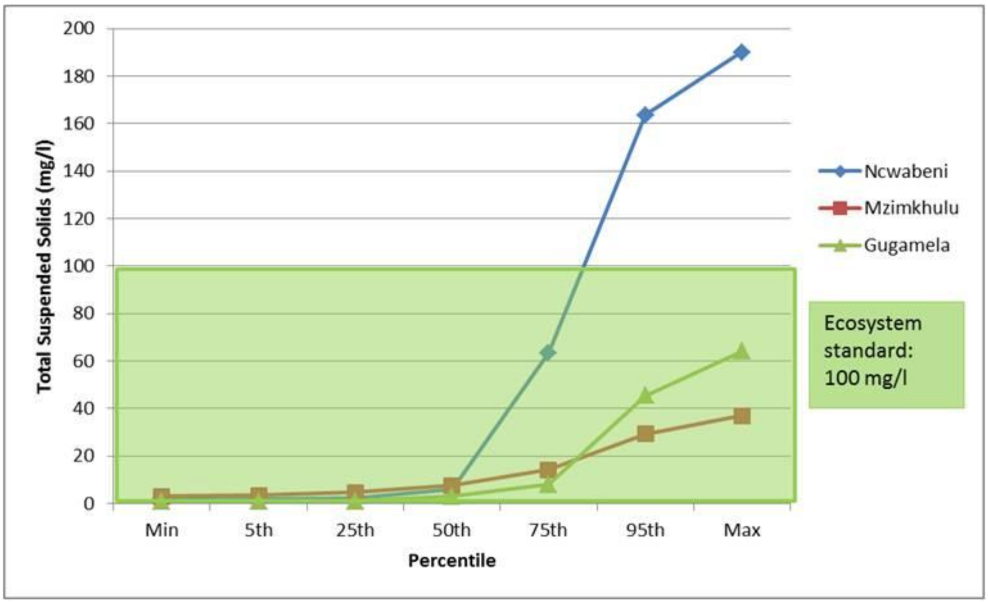



**Figure 33:** **TDS concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **Suspended solids and turbidity**

The median suspended solid concentration in the Ncwabeni River is low, at 6 mg/l. An increase in the suspended solids during March and August is indicated in **Figure 34** and could be ascribed on higher rainfall during these times. The Ncwabeni catchment is in a natural state and not used for agricultural purposes, which is a major source of suspended materials. The higher value of suspended sediment in March 2011 was probably a result of exploration activities taking place upstream of the sampling point.



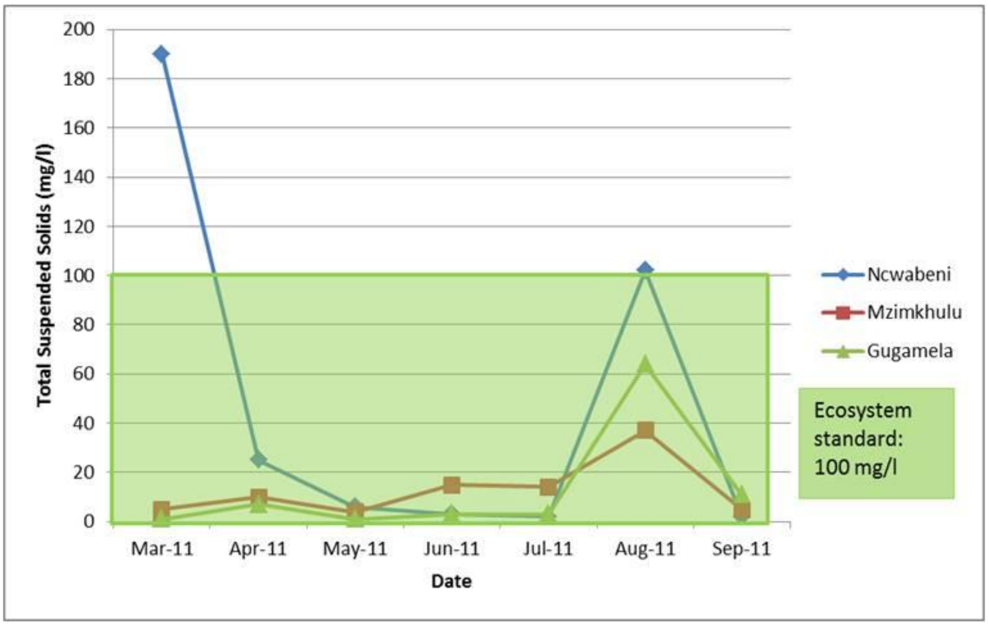




**Figure 34: Total suspended solids for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **Iron and manganese**

Metal concentrations, like suspended solids, display higher concentrations during storm flows in August. Median iron and manganese concentrations for the Ncwabeni River were 0.219 mg/l and 0.013 mg/l respectively. Iron concentrations (**Figure 35**) are mostly above drinking standards (DWAF, 1996), while manganese concentrations (**Figure 36**) are within domestic limits.

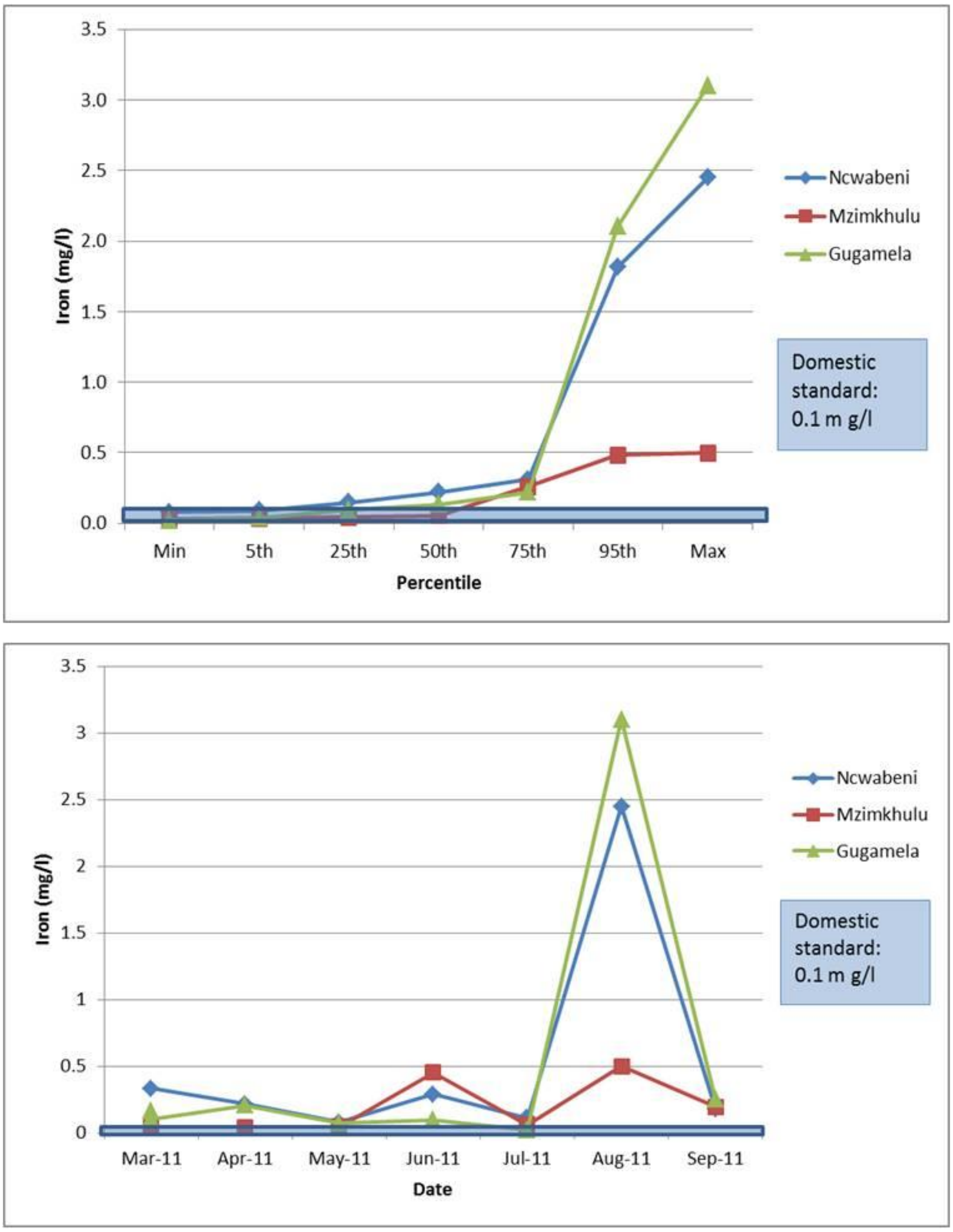
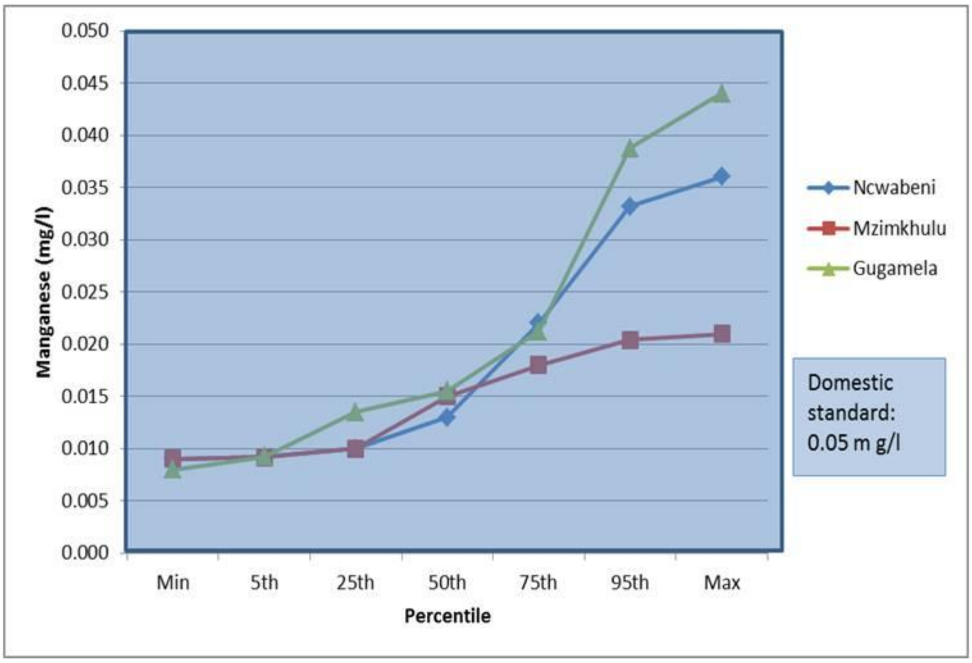



**Figure 35: Iron concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**



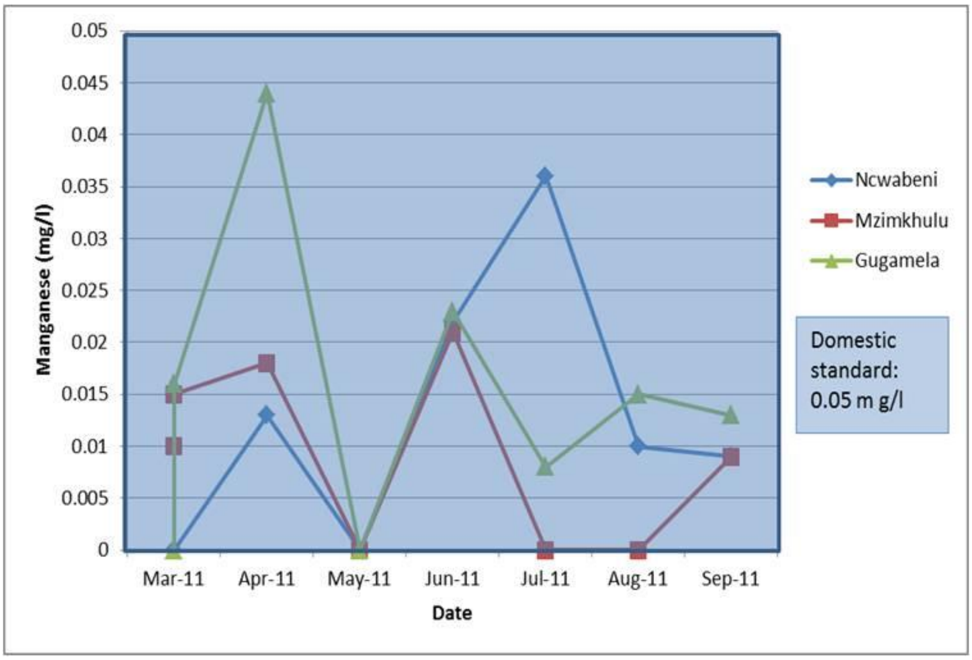




**Figure 36: Manganese concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **Nutrients – Phosphorus**

Phosphorus concentrations for the Ncwabeni, Mzimkhulu and Gugamela Rivers are described in terms of orthophosphate concentrations, because:

- The accuracy of available Total Phosphorus (TP) concentrations were too poor to be used; and

- Ortho-phosphates (OP) are the only form of phosphates that are readily available to algae. Orthophosphates are therefore a driving force behind algal growth in water.

Median concentrations of OP in the Ncwabeni and Mzimkhulu Rivers are below 0.004 mg/l at which the water is classified as oligotrophic. The maximum concentration of orthophosphates in these rivers is 0.02 mg/l, which causes mesotrophic conditions in the rivers (**Figure 37**).

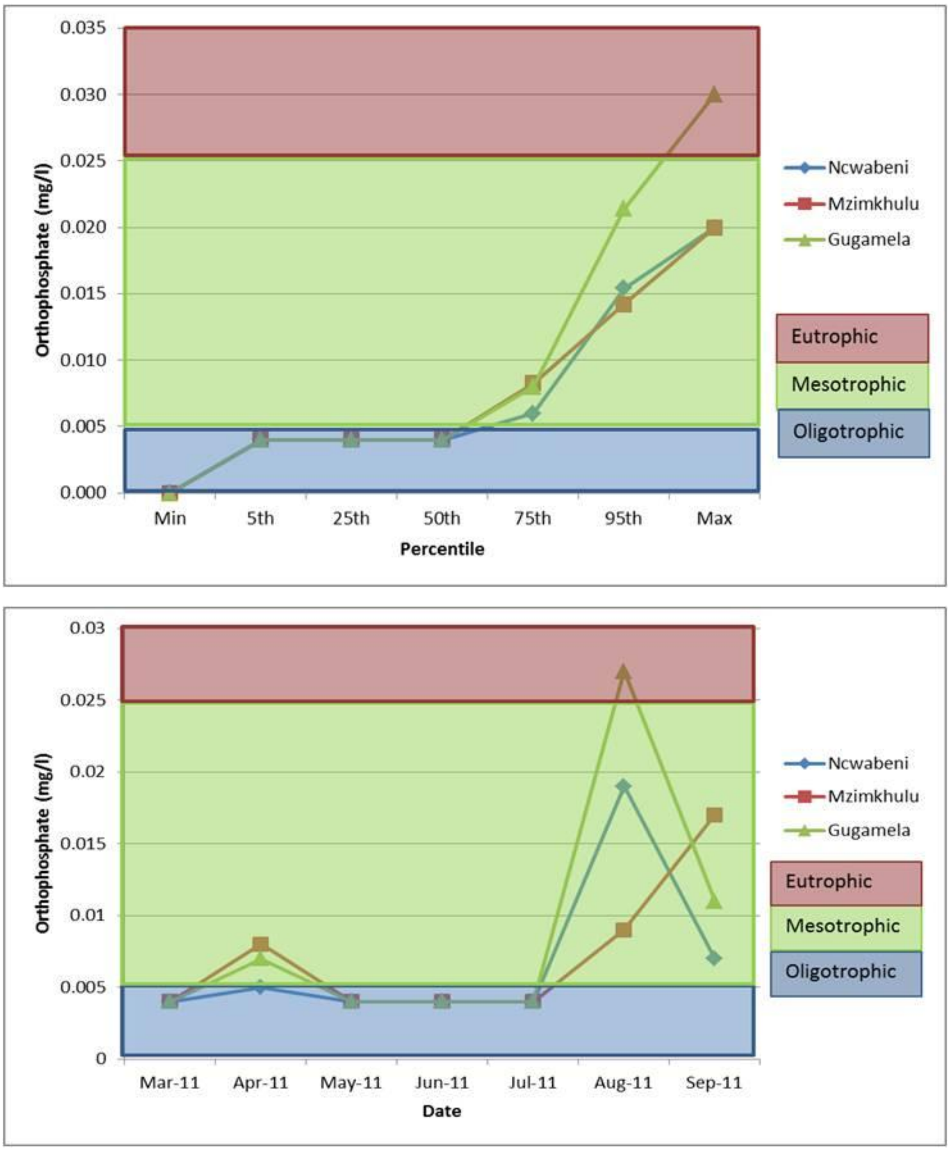
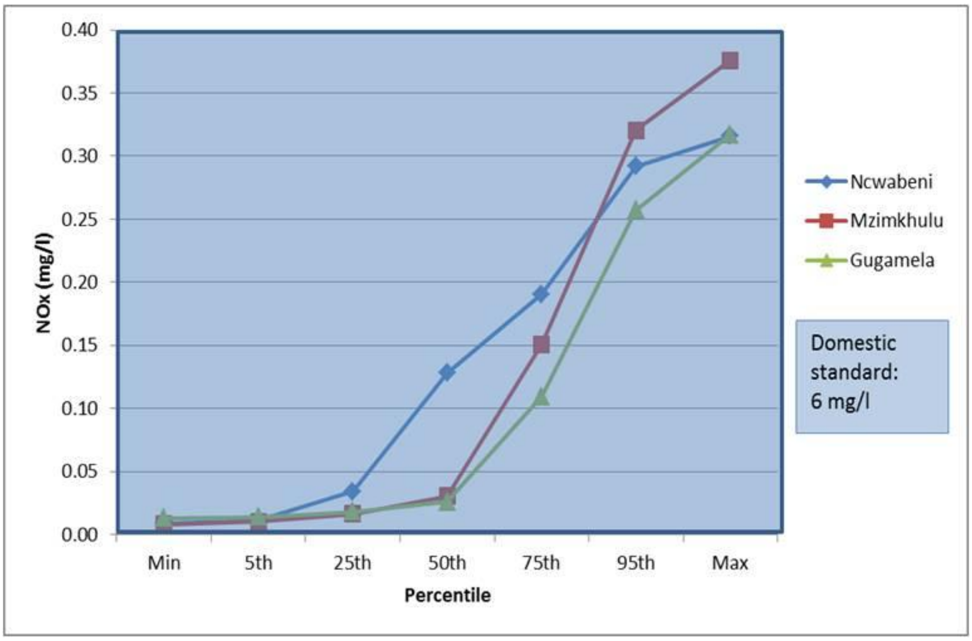



**Figure 37: OP concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **Nutrients – Nitrogen**

As indicated in **Figure 38**, median summer inorganic nitrogen concentrations, which is the sum of nitrite, nitrate and ammonia, were calculated to be 0.128 mg/l indicating oligotrophic conditions (DWAF, 1996). Oligotrophic systems usually have moderate levels of biodiversity and are low productivity systems with rapid nutrient cycling. These systems do generally not have nuisance growths of aquatic plants or a significant presence of blue-green algal blooms.



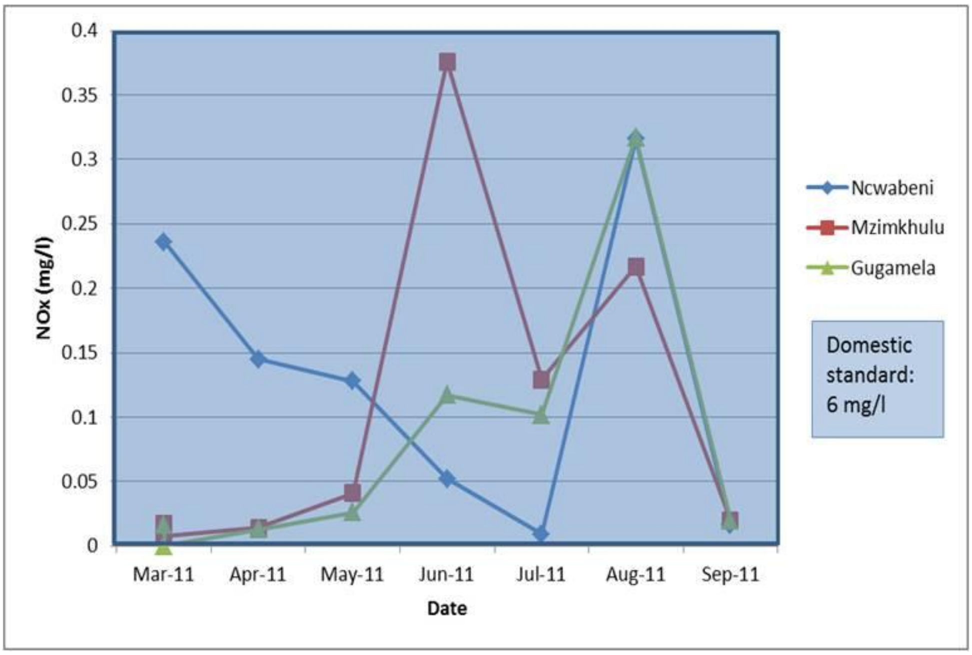
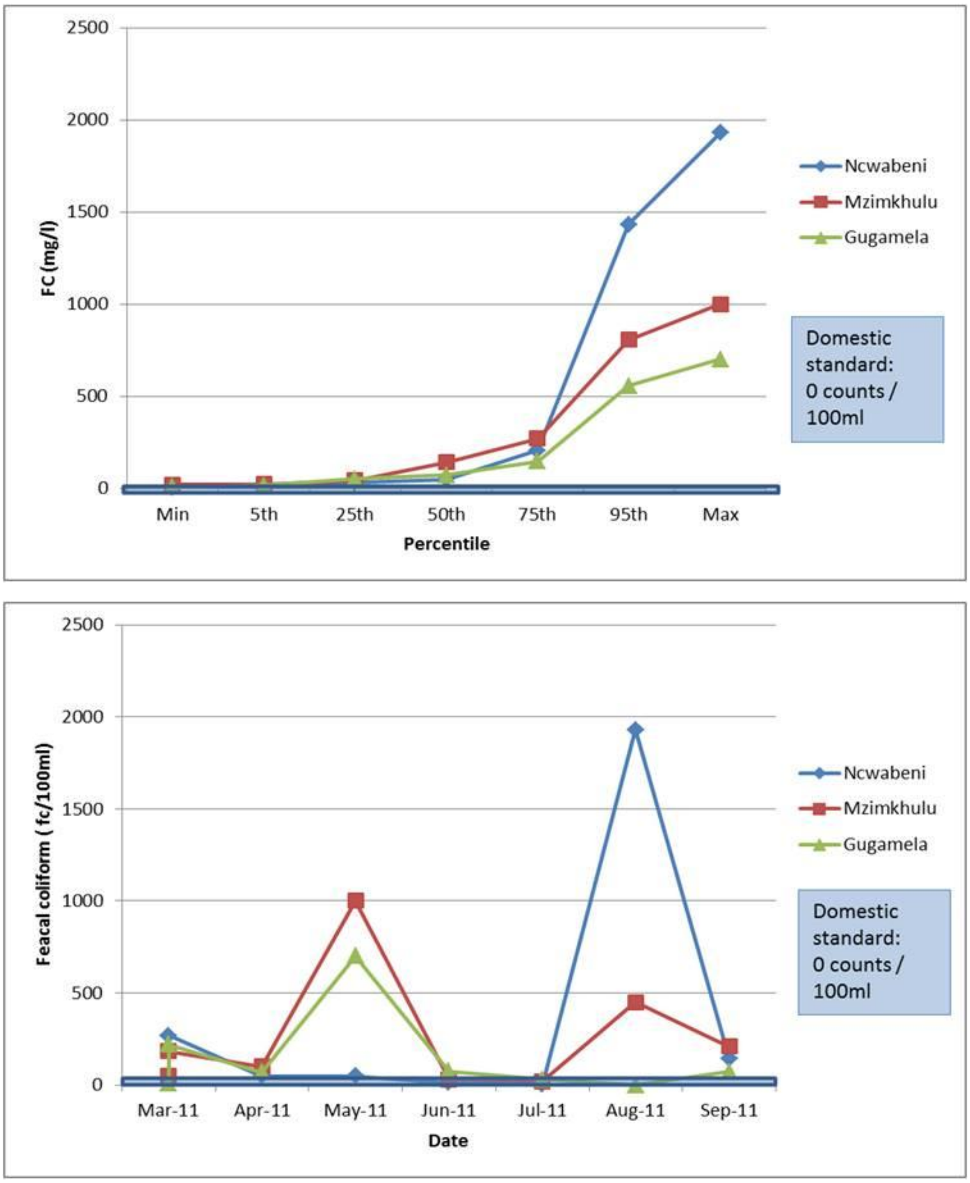




**Figure 38: Nitrate and nitrite concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **<u>Microbiological</u>**

The median *E. coli* count at the proposed Ncwabeni impoundment site is low, with 50 cells/100ml recorded. As the Ncwabeni River catchment is a natural system, the maximum result of 579 cells/100ml in the Ncwabeni River is regarded as an outlier and is probably due to faecal contamination immediately upstream of the sampling point. The median *E. coli* statistic in the Mzimkhulu River (200 *E. coli* per 100ml) exceeds the DWAF *E. coli* target water quality guideline for full contact recreation (130 *E. coli* per 100ml), thus posing a slight risk of gastrointestinal illnesses among swimmers and bathers. **Figure 39** indicates the faecal coliform counts and **Figure 40** indicates the *E. coli* counts from March to September 2011.




**<u>Figure 39:</u>** **Faecal coliform for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

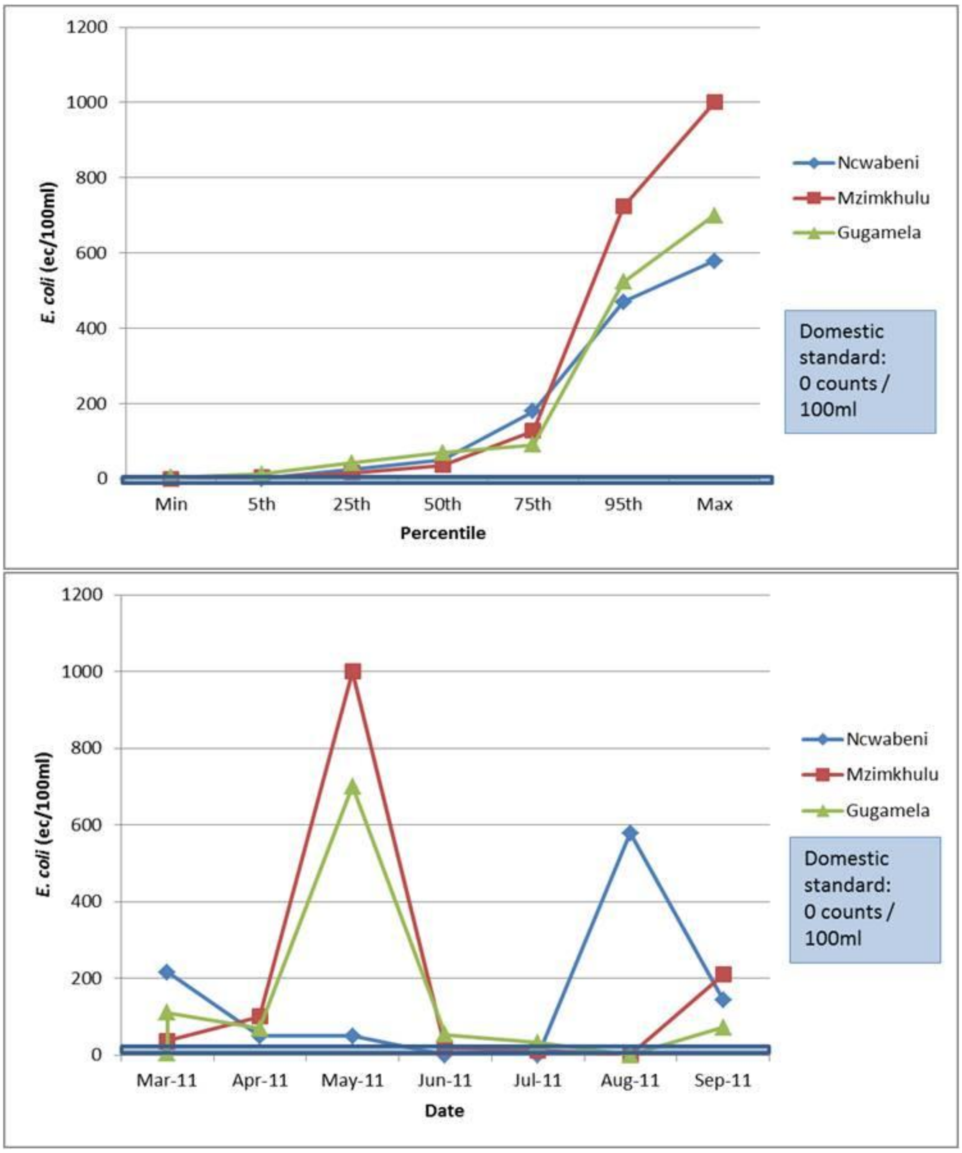



**Figure 40:** ***E. coli*** **for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

- **Chlorophyll a**

Chlorophyll a, which is present in most algae, constitutes approximately one to two percent of the dry weight of organic material in all planktonic algae and is the most convenient indicator of algal biomass estimates. The median value of Chlorophyll a in the Ncwabeni and Mzimkhulu Rivers are within limits of aesthetic standards (DWAF, 1996). Maximum concentrations of Chlorophyll a (**Figure 41**) are well above the standards for aesthetic use of water, and the water is expected to be murky and green with taste and odour problems. Secondary growth of bacteria in the distribution systems can also be expected at these concentrations.

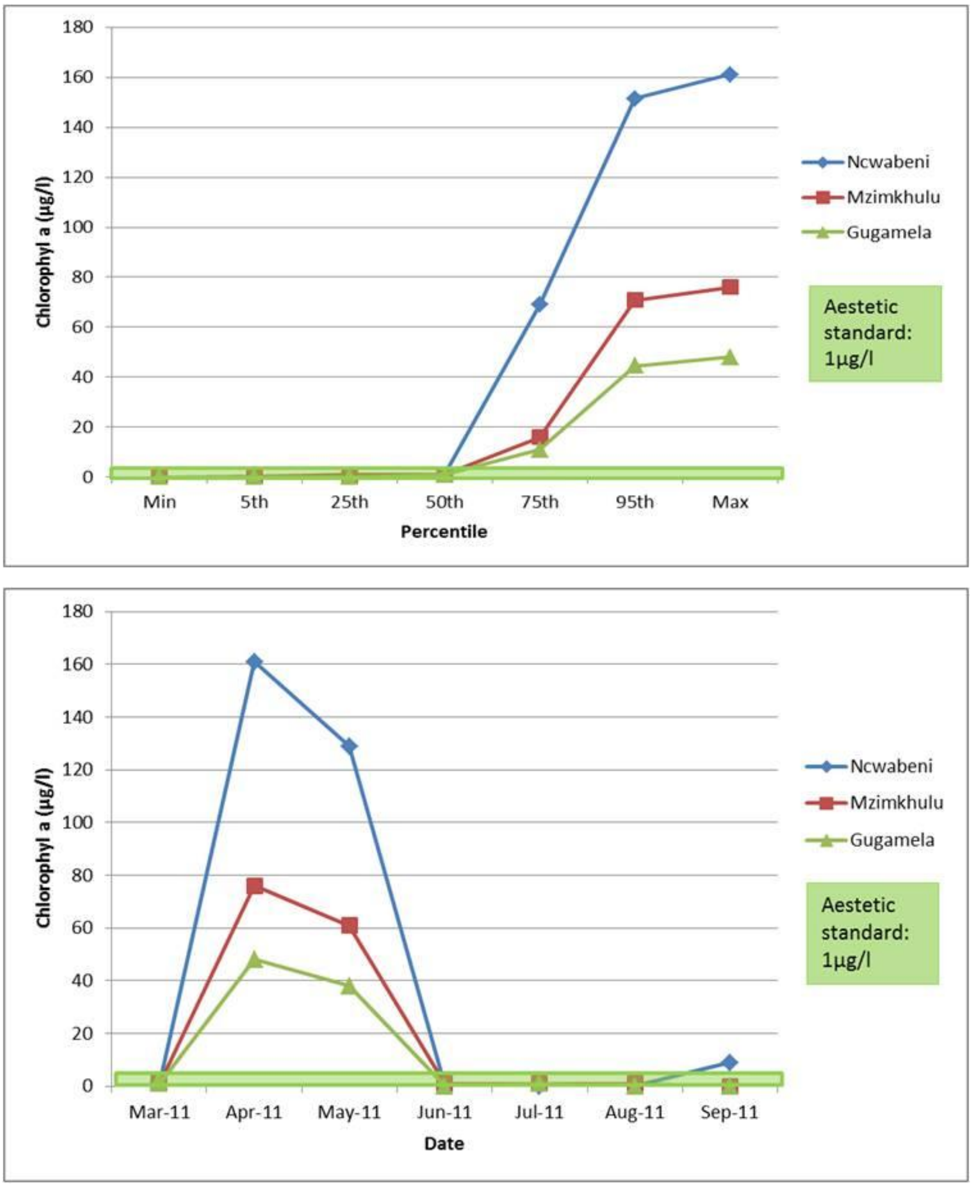



**Figure 41: Chlorophyll a concentration for the Ncwabeni, Mzimkhulu and Gugamela Rivers**

Refer to **Section 12.4.2** for the impact assessment related to water quality.

### *10.6.5 Hydrology*

The Mzimkhulu River catchment has an area of 6 678 km$^2$ and a natural Mean Annual Runoff (MAR) of 1 373 million m$^3$/annum (DWAF, 2004a). Quaternary T52M contributes only 3% of the cumulative MAR at the Mzimkhulu River mouth (DWAF, 2002). A hydrological and yield assessment was undertaken as part of the Mzimkhulu River Off-Channel Storage Pre-Feasibility Study (2007) and a summary of the results follow.

A summary of the MAR at key sites is provided in **Table 14**.

**Table 14: Streamflow Hydrology at Key Locations in the Study Area (DWAF, 2007b)**

| Site Name | Catchment size ($km^2$) | Naturalised MAR (million $m^3/a$) | Present Day MAR (million $m^3/a$) |
|---|---|---|---|
| D2 (Ncwabeni River) | 39.8 | 5.5 | 5.5 |
| D3A (Gugamela River) | 34.6 | 4.8 | 4.8 |
| Mzimkhulu at confluence with Gugamela River | 5 919.0 | 1 254.0 | 1 143.0 |
| Mzimkhulu at confluence with Ncwabeni River | 5 960.0 | 1 259.0 | 1 149.0 |
| Mzimkhulu at St Helen's Rock | 6 657.0 | 1 346.0 | 1 220.0 |

The Technical component of the Feasibility Study is updating the hydrology based on a recent water resources study on the Mzimkhulu River. Based on the updated hydrology, yields were determined at St Helen's Rock for the current abstraction with no additional augmentation. The Water Resources Yield Model (WRYM) was used to perform the yield analyses. The following results were produced:

- 20.2 million $m^3$/annum, if no Ecological Reserve requirements are provided for and assuming that all river flows can be abstracted; and
- 0.2 million $m^3$/annum, if the full Ecological Reserve requirements are released.

For each dam option, the historic firm yield was determined at the proposed OCS dam site, as well as at St. Helen's Rock, with the off-channel dam supporting shortfalls in supply from the Mzimkhulu River. The Ecological Reserve requirements at the St Helen's Rock site were modelled using the flow duration curves, which were determined from the Desktop model for an Ecological Management Class Category B. The basic parameters for each catchment used for modelling are summarised in **Table 15**.

**Table 15: Basic parameters for proposed off-channel dams (DWAF, 2007b)**

| Dam Site | Present day MAR (million $m^3/a$) | Sediment capacity (million $m^3$) |
|---|---|---|
| D2 | 5.5 | 2.1 |
| D3A | 4.8 | 1.8 |

The historical firm yield at St Helen's Rock was determined for a range of OCS dam storage capacities based on the hydrological data from 1925 to 1998, and the 2007 water demands. The yields determined for the dam sizes are shown in **Table 16** (DWAF, 2007b).

**Table 16: Dam base data**

| Dam site | FSL (m.a.m.s.l.) | River bed level (m.a.m.s.l) | Updated Gross Capacity ($10^6m^3$) | Updated 50 - year Sediment Volume ($10^6m^3$) | Updated Net Capacity ($10^6m^3$) |
|---|---|---|---|---|---|
| D2 | 165 | 122.5 | 13.56 | 2.1 | 11.46 |
| D2 | 167.5 | 122.5 | 16 | 2.1 | 13.9 |
| D2 | 170 | 122.5 | 18.19 | 2.1 | 16.09 |
| D3A | 175 | 131.5 | 11.7 | 1.8 | 9.9 |
| D3A | 180 | 131.5 | 15.84 | 1.8 | 14.04 |
| D3A | 185 | 131.5 | 21.7 | 1.8 | 19.9 |

A historical firm yield analysis was performed for the D2 and D3A dam sites and for a range of dam heights and pump rates (pumping from the Mzimkhulu River into the relevant OCS dam). The dam size for OCS dam D2 at Full Supply Level (FSL) of 167.5 meters above mean sea level (m.a.m.s.l.) and for D3A at FSL of 175 m.a.m.s.l. were selected because for these sizes the yields of the dams will be able to supply (supplemented by pumping from the Mzimkhulu River at various pumping rates) the full range of water requirement scenarios in year 2035 (lower limit scenario: 21 million $m^3$/a, planning scenario: 31 million $m^3$/a and upper limit scenario: 39 million $m^3$/a). At these sizes and at a pumping rate of 0.75 $m^3$/s both dams can meet the water requirements for the planning scenario in 2035.

The assurance of supply for a range of target drafts for the proposed OCS dams was determined using 501 stochastic sequences, for a FSL of 167.5 m.a.m.s.l. at Dam site D2

A flood study was conducted as a part of the pre-feasibility study (DWAF, 2007b), to allow for the sizing of the spillways for the relevant proposed off-channel dams. The first parameter identified was the estimated storm rainfall for the Mzimkhulu River (**Table 17**), as well as the Gugamela and Ncwabeni Rivers (**Table 18**). Calculations were based on daily rainfall files from rainfall gauging stations. The daily rainfall was converted to point rainfall for storm duration 1/2tc, tc and 2tc, where tc is the time of concentration. After analysis, storm rainfall for a range of exceedance probabilities was calculated (DWAF, 2007b).

**Table 17: Estimated storm rainfall (mm) for the Mzimkhulu catchment (DWAF, 2007b)**

| Storm Duration | Exceedance Probability (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 50 | 20 | 10 | 5 | 2 | 1 | 0,5 |
| ½ tc | 72 | 103 | 124 | 146 | 175 | 199 | 223 |
| tc | 89 | 125 | 151 | 176 | 211 | 239 | 268 |
| 2tc | 106 | 148 | 178 | 207 | 246 | 278 | 311 |

**Table 18: Estimated storm rainfall (mm) for the Ncwabeni and Gugamela catchments (DWAF, 2007b)**

| Storm Duration | Exceedance Probability (%) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 50 | 20 | 10 | 5 | 2 | 1 | 0,5 |
| ½ tc | 34 | 63 | 85 | 109 | 144 | 174 | 205 |
| tc | 41 | 74 | 100 | 129 | 171 | 205 | 243 |
| 2tc | 45 | 82 | 112 | 144 | 190 | 229 | 271 |
| 3tc | 47 | 86 | 117 | 150 | 199 | 239 | 283 |
| 4tc | 49 | 89 | 121 | 155 | 206 | 247 | 292 |

Statistical, deterministic and empirical methods have been compared according to results obtained on flood peak estimation for the Mzimkhulu, Ncwabeni and Gugamela off-channel storage scheme. The deterministic methods include the Rational, the Direct Runoff Hydrograph (DRH) and Synthetic Unit Hydrograph (SUH). The recommended method for each scheme were selected according the most accurate results, e.g. higher the result is, better is the significance of the method used. It was proposed that results of the Statistical analysis will be used for the Mzimkhulu River (using observed flows), while the results from the Rational method (modelling) be used for the Ncwabeni and Gugamela Rivers.

Thereafter, estimation on Potential Maximum Flood (PMF) was given for the Mzimkhulu, Ncwabeni and Gugamela off-channel storage scheme. The PMF was then compared to the Regional Maximum Flood (RMF) in order to confirm the use of the RMF peak as the maximum probable flood value. From all results the RMF values were always higher than the PMF (**Tables 19 - 21**). Thus, the RMF values have been used as the maximum probable flood value to take into account the worst scenario for risk assessment (DWAF, 2007b).

**Table 19: Comparison between RMF and PMF for the Mzimkhulu catchment (DWAF, 2007b)**

| Deterministic Method | PMF (m3/s) | RMF (m3/s) |
|---|---|---|
| Rational | 6276 | 11350 |
| SUH | 7965 | |
| DRH | 8388 | |

**Table 20: Comparison between RMF and PMF for the Ncwabeni catchment (DWAF, 2007b)**

| Deterministic Method | PMF (m3/s) | RMF (m3/s) |
|---|---|---|
| Rational | 519 | 985 |
| SUH | 386 | |
| DRH | 426 | |

**Table 21: Comparison between RMF and PMF for the Gugamela catchment (DWAF, 2007b)**

| Deterministic Method | PMF (m3/s) | RMF (m3/s) |
|---|---|---|
| Rational | 483 | 905 |
| SUH | 338 | |
| DRH | 375 | |

The impacts associated with the project from a hydrological perspective are discussed in **Section 12.4.3**.

### *10.6.6 Aquatic Biota*

Refer to **Section 11.2** for a synopsis of the Aquatic and Riverine Assessment (Enviross, 2012), as contained in **Appendix E1**. An assessment of the potential impacts to the aquatic health and the concomitant mitigation measures are contained in **Section 12.4.4**. An extract from this specialist study follows.

#### 10.6.6.1 Aquatic macro-invertebrates

Benthic macro-invertebrate communities of the selected sites were investigated according to the South African Scoring System, version 5 (SASS5) approach. The results of the SASS5 survey (see **Table 22**) were based on a cumulative sample over a few sites along each river segment.

**Table 22: Results from the SASS5 survey of the three river sites presented as a comparison to perceived reference state conditions (Enviross, 2012)**

| Taxon | Sensitivity /15 | Reference Abundance | Mzimkhulu | Gugamela | Ncwabeni |
|---|---|---|---|---|---|
| **PORIFERA (SPONGE)** | 5 | | | | A |
| **TURBELLARIA (FLATWORMS)** | 3 | A | | 1 | A |
| Oligochaeta (Earthworms) | 1 | A | A | A | A |
| Leeches | 3 | A | A | A | 1 |
| Potamonautidae* (Crabs) | 3 | | 1 | | 1 |
| Atyidae (Shrimps) | 8 | B | D | D | D |
| **HYDRACARINA (MITES)** | 8 | C | A | 1 | A |
| Perlidae | 12 | B | A | 1 | B |
| Baetidae > 2 sp | 12 | B | C | A | C |
| Caenidae (Squaregills/Cainfles) | 6 | A | A | A | A |
| Heptageniidae (Flatheaded mayflies) | 13 | B | A | A | B |
| Leptophlebiidae (Prongills) | 9 | A | B | A | B |
| Oligoneuridae (Brushlegged mayflies) | 15 | B | | | |
| Prosopistomatidae (Water specs) | 15 | A | | | |
| Tricorythidae (Stout Crawlers) | 9 | A | A | A | A |
| Calopterygidae ST,T | 10 | A | | | |
| Chlorocyphidae | 10 | A | | | |
| Coenagrionidae (Sprites and blues) | 4 | A | | B | A |
| Aeshnidae (Hawkers & Emperors) | 8 | | 1 | | 1 |
| Gomphidae (Clubtails) | 6 | A | A | 1 | A |
| Libellulidae (Darters) | 4 | A | 1 | | 1 |
| Belostomatidae* (Giant water bugs) | 3 | A | 1 | B | |
| Corixidae* (Water boatmen) | 3 | A | A | A | A |
| Naucoridae* (Creeping water bugs) | 7 | A | | | |
| Notonectidae* (Backswimmers) | 3 | A | A | | |
| Pleidae* (Pygmy backswimmers) | 4 | | 1 | A | A |
| Veliidae/M...veliidae* (Ripple bugs) | 5 | B | A | A | |
| Hydropsychidae 1 sp | 4 | | | A | |
| Hydropsychidae 2 sp | 6 | A | | | A |
| Hydropsychidae > 2 sp | 12 | | B | | |
| Leptoceridae | 6 | A | | 1 | |
| Dytiscidae/Noteridae* (Diving beetles) | 5 | A | | | |
| Elmidae/Dryopidae* (Riffle beetles) | 8 | A | | 1 | 1 |
| Gyrinidae* (Whirligig beetles) | 5 | A | B | B | B |
| Hydraenidae* (Minute moss beetles) | 8 | | | 1 | |
| Hydrophilidae* (Water scavenger beetles) | 5 | | 1 | A | A |
| Psephenidae (Water Pennies) | 10 | A | A | A | A |
| Athericidae | 10 | A | | | |
| Ceratopogonidae (Biting midges) | 5 | A | | A | 1 |
| Chironomidae (Midges) | 2 | A | A | A | A |
| Culicidae* (Mosquitoes) | 1 | | | A | |
| Simuliidae (Blackflies) | 5 | A | A | A | B |
| Tabanidae (Horse flies) | 5 | A | | | |
| Ancylidae (Limpets) | 6 | A | A | A | A |
| Physidae* (Pouch snails) | 3 | A | A | A | A |
| SASS Score | | 171 | 168 | 177 | 176 |
| No. of Taxa | | 23 | 27 | 30 | 28 |
| ASPT | | 7.5 | 6.2 | 5.9 | 6.3 |
| | **PES Category** | **A/B** | **B/C** | **A/B** | **A/B** |

***Abundances: 1=1; A=1-10; B=11-100; C=101-1000; D=>1000.**

The results from the SASS5 survey at each site resulted in overall good ecological (biological) integrity of the sites (Classes A/B to B/C). The taxa (families or groups) of aquatic macro-invertebrates that were sampled were dominated by those taxa known to be intolerant of pollution. The SASS5 scores from the various sites are therefore indicative of both good habitat ecological integrity and comparatively good water quality.

Limited data is available on the macro-invertebrate species community structures specific to the lower Mzimkhulu River. The given list of recorded aquatic fish, crustaceans and molluscs provided by BKS (2011) includes a variety of macro-invertebrate species that would require free passage across the abstraction weir to complete a stage in their respective lifecycles (successful larval development), habitat exploitation and genetic dispersal. Adults and juveniles would then migrate downstream toward the estuaries again. The main genera of crustaceans that would require migratory freedom include *Macrobrachium, Varuna* and *Brachipodopsis*. Another species of freshwater shrimp identified through the Scoping Report from Ezemvelo KZN Wildlife's Strategic Environmental Assessment Plan is *Atyoida serrata*. Provision should therefore be made to mitigate the effects of migratory inhibition on macro-invertebrates emanating from the construction of the weir in the Mzimkhulu River.

#### 10.6.6.2 Ichthyofauna

Fish were sampled throughout the study area to determine the fish community structures within the river reach associated with the proposed construction sites. The results are presented in **Table 23**.

**Table 23: Results from the ichthyofaunal survey shown in relation to the relative abundances of the species on record as having been collected at the particular site (Enviross, 2012)**

| Species | Reference: Relative Abundance | Sampled: | | |
|---|---|---|---|---|
| | | Mzimkhulu | Ncwabeni | Gugamela |
| *Awaous aeneofuscus* | 2 | 0 | 0 | 0 |
| *Anguilla marmorata* | 1 | 0 | 0 | 0 |
| *Anguilla mossambica* | 2 | 0 | 0 | 0 |
| *Barbus anoplus* | 2 | 0 | 0 | 0 |
| *Barbus gurneyi* | 1 | 0 | 5 | 0 |
| *Labeobarbus natalensis* | 2 | 5 | 23 | 0 |

| Species | Reference: Relative Abundance | Sampled: | | |
|---|---|---|---|---|
| | | Mzimkhulu | Ncwabeni | Gugamela |
| *Barbus viviparus* | 2 | 14 | 94 | 0 |
| *Clarias gariepinus* | 1 | 4 | 0 | 1 |
| *Oreochromis mossambicus* | 3 | 0 | 3 | 2 |
| | **Totals:** | **23** | **125** | **3** |

Fish species populations were noted to be better represented in the Ncwabeni River than in the Gugamela River. Possible reasons are that the relatively cooler water temperatures of the Gugamela River creates a temperature barrier, making fish reluctant to recruit upstream or the presence of a poorly-designed bridge crossing that poses a migratory barrier under low to moderate flows inhibits upstream migrations.

Aquatic biota require migratory freedom for various reasons, including seasonally-cyclic spawning migrations, genetic dispersal, habitat exploitation, feeding migrations and avoidance of unfavourable conditions (over-wintering, physical habitat or water quality). Some fish species undertake seasonal migrations over vast distances in search of favourable spawning habitat (e.g. Yellowfishes [*Labeobarbus* spp.]), whereas other species undertake relatively shorter migrations (e.g. member of the Cichlidae family, more commonly known as “kurper” (Afr) as well as *Barbus* spp (ghieliemientjies) (Afr) or barbs (Eng). The relatively close proximity to the coast means that the Mzimkhulu River forms an important conduit to inland waters for catadromous Anguillid species (eels). These species include *Anguilla bicolor bicolor, Anguilla benghalensis, Anguilla mossambica* and *Anguilla marmorata* (threatened) – all of which have been recorded from the system. These species breed in the marine environment (at sea) and the planktonic larvae drift with the coastal currents and then migrate into estuaries, where they undergo a stage of maturity and migrate up the rivers along the east coast into freshwater systems as glass eels, where they develop into elvers. A further catadromous species that has been recorded from within 5km of the site is *Mugil cephalus* (Freshwater mullet), which breeds at sea and recruits into freshwater environments as juveniles (typically 20-50mm in length) during late winter.

Refer to **Section 12.4.4** for a discussion on the impacts to the aquatic biota.

### *10.6.7 Riparian Habitat*

Most of the river valleys run along a northwest-northeast axis, which results in unequal distribution of rainfall on respective north-facing and south-facing slopes since the rain-bearing winds blow from the south. The steep north-facing slopes are sheltered from the rain and also receive greater amounts of insulation adding to xerophilous conditions on the slopes (Mucina & Rutherford, 2006).

According to Enviross (2012), the area has largely remained rural in nature, with the north-western banks of the Mzimkhulu River having retained the natural vegetation features. There is a gravel roadway that follows the contours of the terrain within the proposed development area, which has had an impact on riparian vegetation within some isolated areas where the roadway runs into the riparian areas (low-level bridges crossing the Ncwabeni and Gugamela Rivers) and one small area along the edge of the Mzimkhulu River. Further to this, the riparian areas are subject to a small degree of livestock grazing, but have largely retained ecological integrity and functionality. The riparian areas along the south-eastern banks have been impacted by commercial agriculture. This land use has encroached to within the riparian zones in many areas and therefore the natural floral communities have been transformed.

Explanations of the riparian habitat for the two OCS dam sites, as extracted from the Terrestrial Ecology Assessment (Nemai Consulting, 2012b) contained in **Appendix E2**, follows.

#### 10.6.7.1 D2 Riverine Ecosystem

Natural vegetation occurring along the river included *Combretum erythrophyllum* (River Bushwillow), *Celtis africana* (White Stinkwood), and *Leucosidea sericea* (Oldwood). This vegetation is important as it stabilises the riverbank and provide a degree of protection during floods.

Numerous exotic and invasive weeds colonised and dominated the river banks, including some garden escape plants such as *Canna indica* (Garden Canna), *Phragmites australis* (common reed). Other alien invasive species include *Tipuana* *tipu* (Tipu tree), *Chromolaena discolor* (Paraffin weed), *Sesbania punicea* (Red sesbania) (**Figure 42**) and *Rubus* species (Bramble).

**Figure 42: Common reed and Red sesbania dominate the riparian vegetation.**

**Table 24** below indicates the plant species recorded in the riparian vegetation community.

**Table 24: Species found in the riparian vegetation community at site D2 (Nemai Consulting, 2012b)**

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Albizia adianthifolia* | Flat-crown | | Tree |
| *Aloe ferox* | Cape Aloe | Medicinal | Succulent |
| *Arundo donax* | | Weaving | Reed |
| *Bryophyllum delagoense* | Chandelier plant | Declared Weed (Category 1) | Succulent |
| *Caesalpinia decapetala* | Mauritius thorn | Declared Weed (Category 1) | Shrub |
| *Celtis africana* | White Stinkwood | | Tree |
| *Crassula* species | | | Succulent |
| *Euphorbia teragona* | Honey Euphorbia | | Shrub |
| *Ficus sycomorus* | Sycamore Fig | | Tree |
| *Imperata cylindrica* | Cottonwool grass | Increaser 1 | Grass |
| *Leucosidea sericea* | Old wood | | shrub |
| *Melinis repens* | Natal Red Top | Increaser 2 | Grass |
| *Mirabilis jalapa* | Four-o'clocks | Invader 3 | Herb |
| *Nephrolrpis exaltata* | Sword fern | Invader 3 | Herb |

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Olea africana* | Wild olive, | | Tree |
| *Phragmites australis* | Common reed | Decreaser | Reed |
| *Persicaria lapathifolia* | Spotted knotweed | Declared Weed (Category 1) | Herb |
| *Phoenix canariensis* | Canary Island date palm | Weed | Tree |
| *Psidium guajava* | Guava tree | Invader 2 | Tree |
| *Pteridium aquilinum* | Bracken | weed | Herb |
| *Ricinus communis* | Caster-oil plant | Invader 2 | Tree |
| *Senna occidentalis* | Stinking weed | Declared Weed (Category 1) | Shrub |
| *Schoenoplectus corymbosus* | | Cultural-weaving | Reed |
| *Sesbania punicea* | Red sesbania | Declared Weed (Category 1) | Shrub |
| *Setaria sphacelata* var. *Sphacelata* | Common Bristle Grass | Decreaser | Grass |
| *Solanum mauritianum* | Bugweed | Declared Weed (Category 1) | Shrub |
| *Syzygium cordatum* | | | Tree |
| *Tipuana tipu* | Tipu tree | Declared Invader (Category 3) | Tree |
| *Typha capensis* | Bulrush | | Aquatic herb |
| *Verbena bonariensis* | Tall Verbena | Weed | Herb |
| *Zantedeschia* sp. | | | Herb |

#### 10.6.7.2 D3A Riverine Ecosystem

Natural vegetation occurring along the river included *Typha capensis, Syzigium cordatum,* and *Celtis africana* (White Stinkwood), and *Leucosidea sericea* (Oldwood). Numerous exotic and invasive weeds colonised and dominated the river banks, including some garden plants such as *Canna indica* (Garden Canna), *Phragmites australis* (common reed). Other alien invasive species include *Bambusa vulgaris* (common bamboo) (**Figure 43**), *Chromolaena discolor* (Paraffin weed), *Sesbania punicea* (Red sesbania) and *Senna occidentalis* (**Figure 44**).

According to BKS (2011), the riparian vegetation of the Gugamela River at site D3A is degraded and alien vegetation grows abundantly within the riparian zone. This could be attributed to the increased human presence in the D3A area, with various dwellings, subsistence farming and livestock present.

**Table 25** indicates the plant species recorded in this riparian community.

**Figure 43: Bamboo tree growing along the Gugamela River**

**Figure 44: *Senna occidentalis*, an alien invader dominating vegetation along the Gugamela River**

**Table 25: Species found in the riparian vegetation community at site D3A (Nemai Consulting, 2012b)**

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Arundo donax* | | Weaving | Reed |
| *Bambusa vulgaris* | Bamboo tree | | Tree |
| *Bryophyllum delagoense* | Chandelier plant | Declared Weed (Category 1) | Succulent |

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Caesalpinia decapetala* | Mauritius thorn | Declared Weed (Category 1) | Shrub |
| *Celtis africana* | White Stinkwood | | Tree |
| *Crassula obovata* | | | Succulent |
| *Euphorbia teragona* | Honey Euphorbia | | Shrub |
| *Ficus sycomorus* | Sycamore Fig | | Tree |
| *Imperata cylindrica* | Cottonwool grass | Increaser 1 | Grass |
| *Melinis repens* | Natal Red Top | Increaser 2 | Grass |
| *Mirabilis jalapa* | Four-o'clocks | Invader 3 | Herb |
| *Olea africana* | Wild olive, | | Tree |
| *Phragmites australis* | Common reed | Decreaser | Reed |
| *Phoenix canariensis* | Canary Island date palm | Weed | Tree |
| *Persicaria lapathifolia* | Spotted knotweed | Declared Weed (Category 1) | Herb |
| *Psidium guajava* | Guava tree | Invader 2 | Tree |
| *Pteridium aquilinum* | Bracken | weed | Herb |
| *Ricinus communis* | Caster-oil plant | Invader 2 | Tree |
| *Senna occidentalis* | Stinking weed | Declared Weed (Category 1) | Shrub |
| *Schoenoplectus corymbosus* | | Cultural-weaving | Reed |
| *Sesbania punicea* | Red sesbania | Declared Weed (Category 1) | Shrub |
| *Setaria sphacelata* var. *Sphacelata* | Common Bristle Grass | Decreaser | Grass |
| *Solanum mauritianum* | Bugweed | Declared Weed (Category 1) | Shrub |
| *Syzygium cordatum* | | | Tree |
| *Tipuana tipu* | Tipu tree | Declared Invader (Category 3) | Tree |
| *Typha capensis* | Bulrush | | Aquatic herb |
| *Verbena bonariensis* | Tall Verbena | Weed | Herb |
| *Zantedeschia* sp. | | | Herb |

### *10.6.8 Wetlands*

Based on a desktop appraisal of the topographical map, a site investigation and the National Wetlands Map II of the South African National Biodiversity Institute (SANBI) extracted from the National Land Cover 2000 dataset, no wetland systems are situated in the project area.

### *10.6.9 Estuary*

By definition, an estuary constitutes a partly enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea. These systems form a transition zone between river and ocean environments and are subject to both marine influences (e.g. tides, waves, and the influx of saline water) and riverine influences (e.g. flows of fresh water and sediment). The high productivity in estuaries stems from the inflow of both seawater and freshwater, which provide high levels of nutrients in both the water column and sediment.

The Mzimkhulu River Estuary, which is located near Port Shepstone, is a permanently open system. The geographical boundaries of the estuary are as follows (DWA, 2011):

- Downstream boundary – estuary mouth (30°44'21.68"S, 30°27'27.52"E);
- Upstream boundary – 9.5 km from the mouth to the extent of tidal influence; and
- Lateral boundaries – 5 m contour above Mean Sea Level along each bank.

The EWR were determined for the Mzimkhulu Estuary as part of the Mzimkhulu River Catchment Water Resource Study (DWA, 2011c). A specialist opinion was sought regarding the potential implications of the Ncwabeni OCS Dam on the Mzimkhulu Estuary (Anchor Environmental, 2012) – refer to summary contained in **Section 11.3**. The description of the estuary to follow was extracted from the aforementioned studies.

The mean annual runoff for the Mzimkhulu Estuary is estimated at 1 453 $Mm^3/a$. in the reference condition and 1 176 $Mm^3/a$ under present day conditions (i.e. 80.9% of natural). This places the Mzimkhulu amongst the three largest rivers in KZN, along with the Thukela and the Mkomazi systems (DWA, 2011c). Flow in the river is highly seasonal, with most of the runoff (88.3%) occurring between November - April (**Figure 45**).

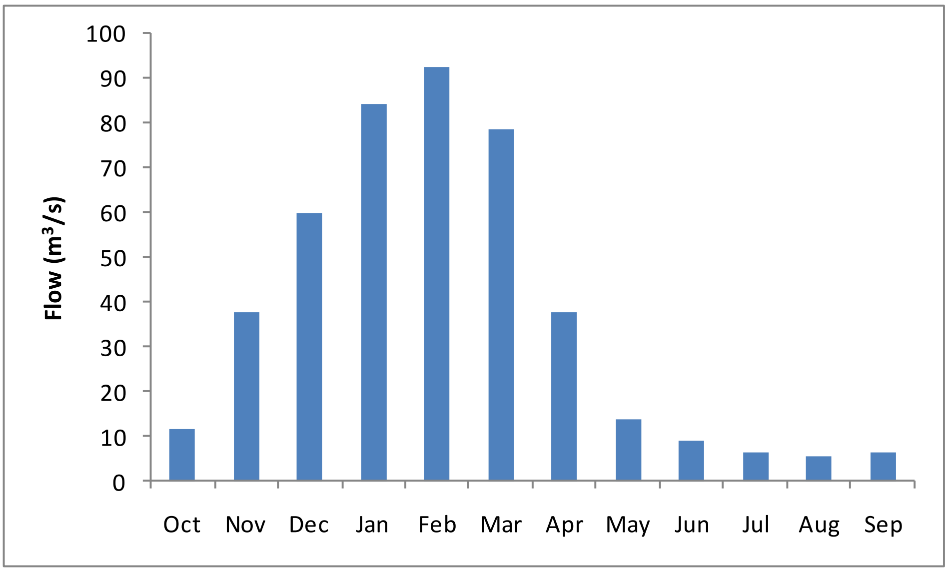



**Figure 45: Seasonal variation in flow to the Mzimkhulu estuary (DWA, 2011c)**

The estuary is estimated to extend approximately 9.5 km upstream from the mouth, based on measured salinities and tidal penetration (**Figure 46**). According to DWA (2011c), the estuary used to close periodically in the past but that the frequency of close may have increased in recent times. The five abiotic states for the system based on mouth state and water quality characteristics are shown in **Table 26**. Transition from one state to another reportedly may take place gradually or can occur within the space of a few hours.

**Table 26: Abiotic states for the Mzimkhulu estuary with associated flow ranges and estimated frequency of occurrence during the reference (natural) and under present day conditions (DWA, 2011c)**

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

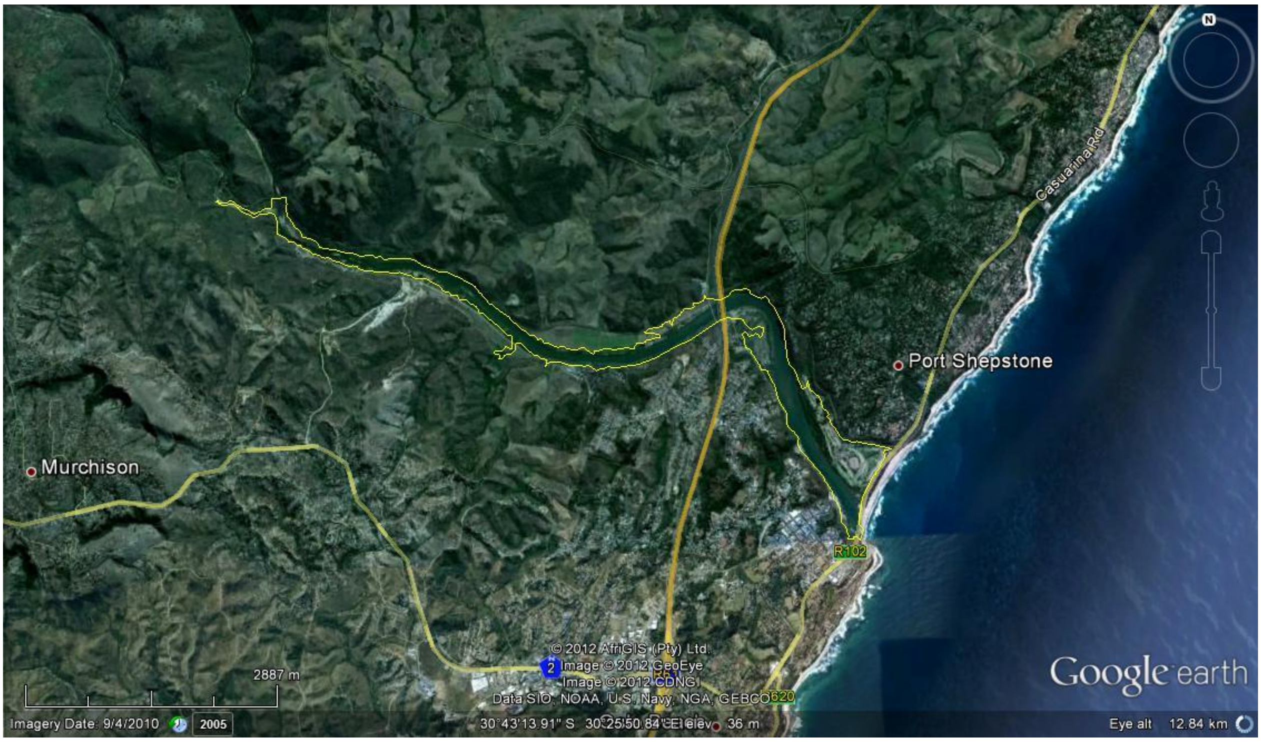



**Figure 46: Extent of the Mzimkhulu estuary (outlined in yellow) (Anchor Environmental, 2012) (Google Earth image)**

According to DWA (2011c), water quality in the Mzimkhulu Estuary system is reportedly good despite the observed reductions in flow and other anthropogenic impacts on the system including bridge construction and rubble deposits placed in the middle reaches of the system, bank stabilisation, construction of a golf course on the south bank of the estuary, sand mining in the estuary, and agriculture in the catchment which has probably increased sediment inputs to the system. Average salinities in the system are estimated to be higher now than in the reference condition, particularly during the summer months when freshwater input is lowest. Dissolved Inorganic Nitrogen (DIN) and Dissolved Inorganic Phosphorous (DIP) are also modestly elevated above reference conditions mostly as a result of anthropogenic inputs into the catchment.

Microalgae (phytoplankton and benthic microalgae) under the present day conditions are reportedly similar to the reference state, but may exhibit localised increases in abundance when nutrient levels spike. Vegetation in around the estuary is also in a good state of health. Some riparian vegetation on the banks of the estuary has been lost due to the construction of the golf course and sugar cane plantations on the south bank, and through invasion by alien species.

Zooplankton, benthic invertebrate and fish communities of the estuary are considered to be healthy and resemble those in the reference conditions reasonably closely. Some reduction in abundance of these faunal groups may have occurred due to habitat loss (bridge construction and sand winning – particular important for the benthic invertebrates), reductions in food supply and fishing pressure (affecting the fish and bird communities), and loss of fringing wetlands (affecting the bird communities in particular).

The PES was determined to be a category B (“largely natural with few modifications”) and the Ecological Importance and Sensitivity (EIS) as “highly important”. The REC assigned to the estuary was a category A, based on the high importance of the system, its requisite protection to achieve the country’s biodiversity targets and its status being categorised as “irreplaceable” by the KZN C-Plan (DWA, 2011c).

## 10.7 Flora

The vegetation types at the dam localities include Kwazulu-Natal Coastal Belt and Eastern Valley Bushveld, according to Mucina and Rutherford (2006) (refer to **Figure 47**). The area also lies within the Maputaland-Pondoland terrestrial priority conservation area, which lies along the east coast of southern Africa, below the Great Escarpment.

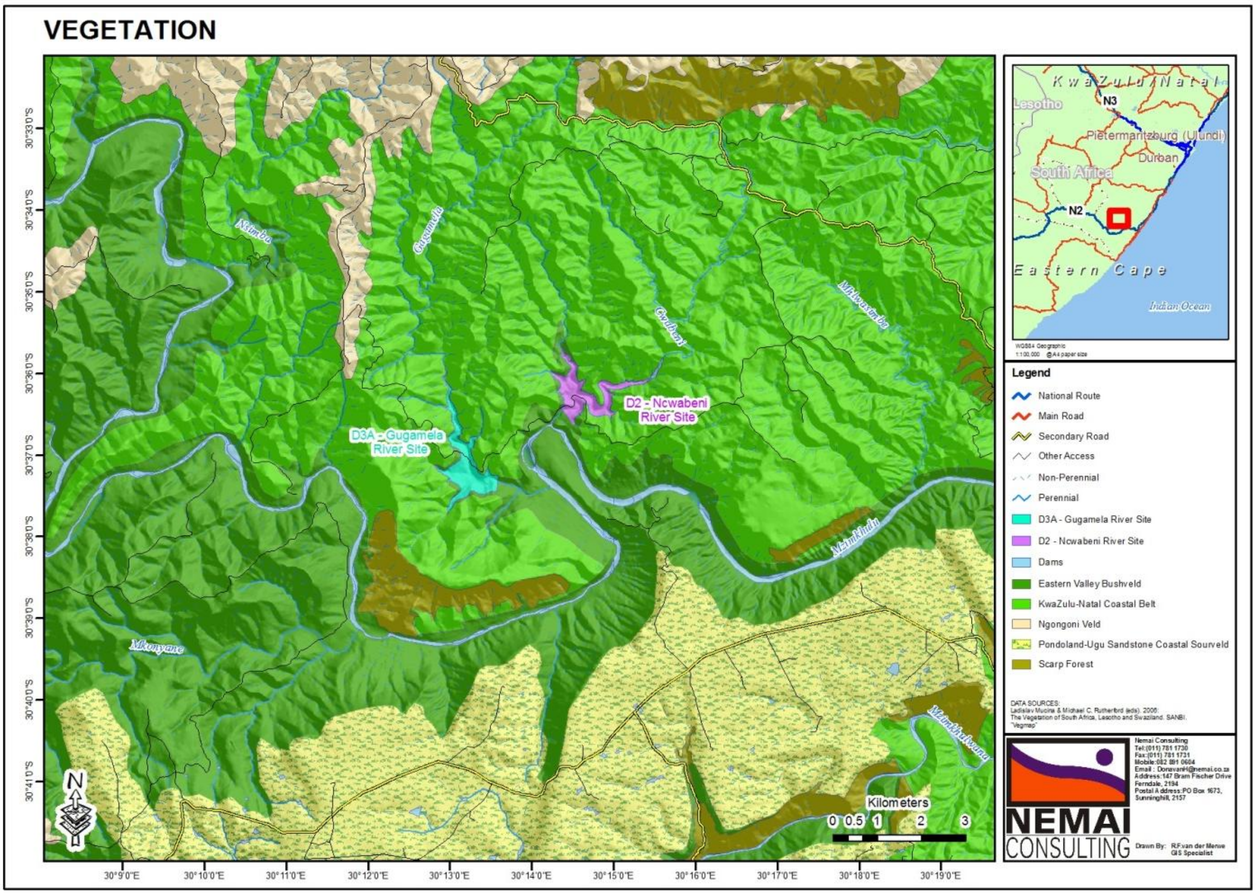



**Figure 47: Vegetation Types in project area**

A Terrestrial Ecology Assessment (Nemai Consulting, 2012b), contained in **Appendix E2**, was undertaken for the project. Refer to the summary and impact assessment contained in **Sections 11.1** and **12.5 -12.6**, respectively. An extract from this study follows.

### 10.7.1 D2 (Ncwabeni River) Site

The following plant communities were identified as part of the Bushland thicket community during the field investigations at site D2.

The plant cover present on this community comprises closed woodland with mixed bushveld averaging 3-8m in height (**Figure 48**). The vegetation is primarily bushland thicket with clumped grasses, and is a mixture of indigenous and invasive alien species. Although the density of woody plants is fairly high in parts, tracts exist where this woody component is scattered and open.

**Figure 48: Bushland thicket community at site D2**

The vegetation has a high prevalence of broadleaf trees and shrubs which contribute to an increase in species-richness. These include *Euclea crispa* subsp. *crispa* (Blue Guarri), *Gymnosporia senegalensis* (Confetti Spikethorn), *Mundulea sericea* subsp. *sericea* (Cork-bush), *Vangueria infausta* (Wild Medlar) and *Ziziphus mucronata* (Buffalo Thorn). As is typical of savanna habitats the herb layer is pronounced, albeit secondary and species-poor in this case. Grasses dominate the basal cover, of which *Digitaria eriantha* (Common Finger Grass), *Panicum maximum* (Guinea Grass) and *Urochloa mossambicensis* (Bushveld Signal Grass) occur in greatest abundance. Also present are *Themeda triandra* (Red Grass) and *Setaria sphacelata* (Bristle Grass).Two sensitive biodiversity features were identified using the EKZNW C-Plan, these being the Southern

Forest and Thornveld and the Coastal Valley Bushveld (DWAF, 2007c). **Table 27** indicates the species recorded in this community.

**Table 27: Species found in the Bushland thicket community (Nemai Consulting, 2012b)**

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Acacia ataxacantha* | | | Tree |
| *Acacia karroo* | Sweet thorn | | Tree |
| *Acacia mearnsii* | Black wattle | Invader 2 | Tree |
| *Albizia adianthifolia* | Flat-crown | | Tree |
| *Acacia nilotica* | | | Tree |
| *Aloe ferox* | Cape Aloe | Medicinal | Succulent |
| *Argemone ochroleuca* subsp *ochroleua* | White-flowered Mexican poppy | Declared Weed (Category 1) | Herb |
| *Ageratina adenophora* | Crofton weed | Declared Weed (Category 1) | Herb |
| *Alternanthera pungens* | Khakiweed | Exotic | Herbs |
| *Achyranthes aspera* | Burweed | Declared Invader 1 | Shrub |
| *Argemone ochroleuca* | White-flowered Mexican poppy | Declared Weed (Category 1) | Herb |
| *Asparagus aethiopicus* | | | Shrub |
| *Bidens pilosa* | Blackjack | Weed | Herb |
| *Berkheya setifera* | Buffalo-tongue Berkheya | Medicinal | Herb |
| *Brachylaena discolor* | Coast silver oak | | Tree |
| *Bryophyllum delagoense* | Chandelier plant | Declared Weed (Category 1) | Succulent |
| *Cannabis sativa* | Dagga | Exotic | Herb |
| *Caesalpinia decapetala* | Mauritius thorn | Declared Weed (Category 1) | Shrub |
| *Canthium kuntzeanum* | | | |
| *Celtis africana* | White stnkwood | | Tree |
| *Conyza bonariensis* | Flax-leaf fleabane | Weed | Herb |
| *Combretum erythrophyllum* | River bushwillow | | Tree |
| *Crassula* species | | | Succulent |
| *Cynodon dactylon* | Couch Grass | Increaser 2 | Grass |
| *Cymopogon excavatus* | | | Grass |
| *Chromolaena discolor* | Triffid weed | Declared Weed (Category 1) | Shrub |
| *Digitaria eriantha* | Common Finger Grass | Decreaser | Grass |
| *Dichroystachys cineria* | Sickle bush | | Tree |
| *Dalbergia obovata* | | | Tree |
| *Datura stramonium* | Common thorn apple | Declared Weed (Category 1) | Shrub |
| *Datura ferox* | Large thorn apple | Declared Weed (Category 1) | Shrub |
| *Euphorbia ingens* | Common tree euphorbia | | Succulent tree |
| *Euphorbia tirucalli* | Rubber Euphorbia | | Shrub |
| *Euphorbia tetragona* | Honey Euphorbia | | Shrub |
| *Enneapogon scoparius* | Bottlebrush Grass | Increaser 3 | Grass |
| *Eragrostis capensis* | Heart-seed love grass | Increaser 2 | Grass |
| *Eragrotis chloromelas* | | | Grass |
| *Euclea crispa* subsp. *Crispa* | Blue Guarri | | Grass |
| *Eragrostis plana* | | | Grass |
| *Gerbera piloselloides* | Small yellow gerbera | Medicinal | Herb |
| *Gomphrena celosioides* | Batchelor's Button | Weed | Herb |
| *Gymnosporia senegalensis* | Confetti Spikethorn | | Tree |
| *Harpochloa falx* | Caterpillar Grass | Increaser 1 | Grass |
| *Helichrysum aureonitens* | Golden everlasting | Medicinal | Herb |
| *Hibiscus trionum* | Bladder Hibiscus | Medicinal | Herb |

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Hyparrhenia hirta* | Common Thatching Grass | Increaser 1 | Grass |
| *Hypoxis hemerocallidea* | Star-flower | Medicinal | Herb |
| *Kalanchoe rotundifolia.* | Common Kalanchoe | Medicinal | Succulent herb |
| *Lantana camara* | Lantana | Declared Weed (Category 1) | Shrub |
| *Lippia javanica* | Lemon bush | Medicinal | Shrub |
| *Melia azedarach* | Syringa | Declared Invader (Category 3) | Tree |
| *Melinis repens* | Natal Red Top | Increaser 2 | Grass |
| *Morus alba* | White mulberry | Invader 3 | Tree |
| *Mundulea sericea* subsp. *Sericea* | Cork-bush | | Shrub |
| *Opuntia ficus-indica* | Sweet prickly pear | Declared Weed (Category 1 | Shrub |
| *Panicum maximum* | Guinea Grass | | Grass |
| *Plantago lanceolata* | Buckhorn plantain | Exotic | Shrub |
| *Plumbago auriculata* | Plumbago | Medicinal | Shrub |
| *Psidium guajava* | Guava tree | Invader 2 | Tree |
| *Ricinus communis* | Caster-oil plant | Invader 2 | Tree |
| *Rumex acetosella subsp angiocarpus* | Sheep sorrel | Exotic | Herb |
| *Rhoicissus tridentata* | | | Shrub |
| *Searsia pyroides* | Common wild currant | | Tree |
| *Setaria sphacelata var. Sphacelata* | Common Bristle Grass | Decreaser | Grass |
| *Searsia lancea* | Karee | | Tree |
| *Searsia chirindensis* | | | Tree |
| *Sonchus asper* | Spiny sowthistle | Weed | Shrub |
| *Solanum mauritianum* | Bugweed | Declared Weed (Category 1) | Shrub |
| *Sporobolus africanus* | Ratstail Dropseed | Increaser 3 | Grass |
| *Tagetes minuta* | Tall Khaki Weed | Weed | Herb |
| *Tecomaria capensis* | Cape honeysuckle | | Tree |
| *Themeda triandra* | Red Grass | Decreaser | Grass |
| *Tristachya leucothrix* | Hairy Trident Grass | Increaser 1 | Grass |
| *Urochloa mossambicensis* | Bushveld signal grass | Increaser 2 | Grass |
| *Vangueria infausta* | Wild Medlar | | Shrub |
| *Verbena bonariensis* | Tall Verbena | Weed | Herb |
| *Verbena officionalis* | Commnon vervain | Declared Weed (Category 1) | Herb |
| *Xanthium strumarium* | Large cocklebur | Declared Weed (Category 1) | Herb |
| *Zanthoxylum davyi* | | | Tree |
| *Zinnia peruviana* | Redstar zinnia | Exotic | Herb |
| *Ziziphus mucronata* | Buffalo Thorn | | Shrub |

### *10.7.2 D3A (Gugamela River) Site*

The following plant communities were identified as part of the Bushland thicket community during the field investigations at site D3A.

The plant cover present in this community comprises short open woodland and wooded grassland communities with mixed bushveld averaging 2-4m in height. The veld is mostly degraded and shows increasing encroachment by opportunist tree species, mainly

*Acacia karroo* (Sweet Thorn) and *Dichrostachys cinerea* (Sickle Bush) (**Figure 49**). Encroachment by these species is generally associated with overgrazing and improper fire regimes which alter the vegetation dynamics over time, as was observed to be the case at the site (DWAF, 2007c).

**Figure 49: Degraded area encroached by opportunist species such as *Solanum mauritianum* and *Dichrostachys cinerea***

Communal land with subsistence agricultural activities are encountered on the site. Indigenous plant species such as *Acroceras macrum, Cynodon dactylon, Sporobolus africanus, Eragrostis curvula, Dichrostachys cinerea, Acacia karroo, Acacia nilotica, Aloe spp*. and the exotic plant species *Melia azedarach* (Syringa trees), *Chromolaena odorata* (Triffid weed), *Lantana camara* and *Solanum mauritianum* (Bugweed) were common at the site. **Table 28** indicates the plant species recorded in this bushland thicket community.

**Table 28: Species found in the Bushland thicket community (Nemai Consulting, 2012b)**

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Acacia karroo* | Sweet thorn | | Tree |
| *Acacia mearnsii* | Black wattle | Invader 2 | Tree |
| *Acroceras macrum* | | | Grass |
| *Acacia nilotica* | | | Tree |
| *Aloe ferox* | Cape Aloe | Medicinal | Succul ent |
| *Argemone ochroleuca* subsp *ochroleua* | White-flowered Mexican poppy | Declared Weed (Category 1) | Herb |
| *Ageratina adenophora* | Crofton weed | Declared Weed (Category 1) | Herb |
| *Alternanthera pungens* | Khakiweed | Exotic | Herbs |
| *Achyranthes aspera* | Burweed | Declared Invader 1 | Shrub |
| *Argemone ochroleuca* | White-flowered Mexican poppy | Declared Weed (Category 1) | Herb |

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Asparagus aethiopicus* | | | Shrub |
| *Bidens pilosa* | Blackjack | Weed | Herb |
| *Berkheya setifera* | Buffalo-tongue Berkheya | Medicinal | Herb |
| *Brachylaena discolor* | Coast silver oak | | Tree |
| *Bryophyllum delagoense* | Chandelier plant | Declared Weed (Category 1) | Succulent |
| *Cannabis sativa* | Dagga | Exotic | Herb |
| *Caesalpinia decapetala* | Mauritius thorn | Declared Weed (Category 1) | Shrub |
| *Canthium kuntzeanum* | | | Shrub |
| *Celtis africana* | White stinkwood | | Tree |
| *Cereus jamacara* | Queen of night | Declared Weed (Category 1) | Shrub |
| *Conyza bonariensis* | Flax-leaf fleabane | Weed | Herb |
| *Combretum erythrophyllum* | River bushwillow | | Tree |
| *Crassula* species | | | Succulent |
| *Cynodon dactylon* | Couch Grass | Increaser 2 | Grass |
| *Cymopogon excavatus* | | | Grass |
| *Chromolaena discolor* | Triffid weed | Declared Weed (Category 1) | Shrub |
| *Digitaria eriantha* | Common Finger Grass | Decreaser | Grass |
| *Dichroystachys cineria* | Sickle bush | | Tree |
| *Datura stramonium* | Common thorn apple | Declared Weed (Category 1) | Shrub |
| *Datura ferox* | Large thorn apple | Declared Weed (Category 1) | shrub |
| *Euphorbia ingens* | Common tree euphorbia | | Succulent tree |
| *Euphorbia tirucalli* | Rubber Euphorbia | | Shrub |
| *Euphorbia tetragona* | Honey Euphorbia | | Shrub |
| *Eragrostis curvula* | | Increaser 2 | Grass |
| *Euclea crispa* subsp. *Crispa* | Blue Guarri | | Grass |
| *Eragrostis plana* | | | Grass |
| *Gerbera piloselloides* | Small yellow gerbera | Medicinal | Herb |
| *Gomphrena celosioides* | Batchelor's Button | Weed | Herb |
| *Gymnosporia senegalensis* | Confetti Spikethorn | | Tree |
| *Harpochloa falx* | Caterpillar Grass | Increaser 1 | Grass |
| *Helichrysum aureonitens* | Golden everlasting | Medicinal | Herb |
| *Hibiscus trionum* | Bladder Hibiscus | Medicinal | Herb |
| *Hyparrhenia hirta* | Common Thatching Grass | Increaser 1 | Grass |
| *Lantana camara* | Lantana | Declared Weed (Category 1) | Shrub |
| *Lippia javanica* | Lemon bush | Medicinal | Shrub |
| *Melia azedarach* | Syringa | Declared Invader (Category 3) | Tree |
| *Melinis repens* | Natal Red Top | Increaser 2 | Grass |
| *Morus alba* | White mulberry | Invader 3 | Tree |
| *Opuntia ficus-indica* | Sweet prickly pear | Declared Weed (Category 1 | Shrub |
| *Panicum maximum* | Guinea Grass | | Grass |
| *Plantago lanceolata* | Buckhorn plantain | Exotic | Shrub |
| *Prunus persica* | Peach tree | | Tree |
| *Psidium guajava* | Guava tree | Invader 2 | Tree |
| *Ricinus communis* | Caster-oil plant | Invader 2 | Tree |
| *Rumex acetosella* subsp *angiocarpus* | Sheep sorrel | Exotic | Herb |
| *Rhoicissus tridentata* | | | Shrub |
| *Searsia pyroides* | Common wild currant | | Tree |
| *Setaria sphacelata* var. *Sphacelata* | Common Bristle Grass | Decreaser | Grass |
| *Searsia lancea* | Karee | | Tree |

| Scientific name | Common name | Ecological status | Form |
|---|---|---|---|
| *Sonchus asper* | Spiny sowthistle | Weed | Shrub |
| *Solanum mauritianum* | Bugweed | Declared Weed (Category 1) | Shrub |
| *Spirostachys africana* | Tamboti | | Tree |
| *Sporobolus africanus* | Ratstail Dropseed | Increaser 3 | Grass |
| *Tagetes minuta* | Tall Khaki Weed | Weed | Herb |
| *Tecomaria capensis* | Cape honeysuckle | | Tree |
| *Themeda triandra* | Red Grass | Decreaser | Grass |
| *Tristachya leucothrix* | Hairy Trident Grass | Increaser 1 | Grass |
| *Urochloa mossambicensis* | Bushveld signal grass | Increaser 2 | Grass |
| *Vangueria infausta* | Wild Medlar | | Shrub |
| *Verbena bonariensis* | Tall Verbena | Weed | Herb |
| *Verbena officionalis* | Common vervain | Declared Weed (Category 1) | Herb |
| *Xanthium strumarium* | Large cocklebur | Declared Weed (Category 1) | Herb |
| *Zanthoxylum davyi* | | | Tree |
| *Zinnia peruviana* | Redstar zinnia | Exotic | Herb |
| *Ziziphus mucronata* | Buffalo Thorn | | Shrub |

## 10.8 Fauna

The dam basin of the proposed D2 site on the Ncwabeni River is in a more natural state than that of the proposed D3A site on the Gugamela River, due to some human settlement and associated activities (e.g. subsistence farming, livestock grazing) in the last-mentioned area. It is thus anticipated that more abundant and possibly diverse habitat types exist in the D2 basin than what can be expected at the D3A site.

*Note that a recommendation that emanated from the EIA phase (see **Section 15.3**) is that a Search, Rescue and Relocation Management Plan needs to be developed that takes into consideration inter alia the red data, protected and endangered species and medicinal plants.*

### *10.8.1 Mammals*

This sub-section contains information extracted from the Terrestrial Ecology Assessment (**Appendix E2**).

A list of potential mammal species in the study area, based on historical recordings, is contained in **Table 29**. The probability of occurrence is based on suitable habitat and the associated threats. Due to the habitat degradation and disturbance, especially at site D3A, the list is likely to overestimate the occurrence of mammal species in the area.

**Table 29: Mammal species that could occur in the study area (Nemai Consulting, 2012b)**

| Common Name | Scientific Name |
|---|---|
| Common Molerat | *Cryptomys hottentotus* |
| Natal Multimammate Mouse | *Mastomys natalensis* |
| Scrub Hare | *Lepus saxtalis* |
| Striped Mouse | *Rhabdomys pumilio* |
| Grey Climbing Mouse | *Dendromus melanotis* |
| Brant's Climbing Mouse | *Dendromus mesomelas* |
| Highveld Gerbil | *Tatera brantsii* |
| Namaqua Rock Mouse | *Aethomys namaquensis* |
| *House mouse | *Mus musculus* |
| *House Rat | *Rattus rattus* |
| *Domestic Dog | *Canis familiaris* |
| *Feral Cat | *Felis catus* |
| Common Duiker | *Sylvicapra grimmia* |
| Oribi | *Ourebia ourebi* |
| Aardvark | *Orycteropus afer* |
| Aardwolf | *Proteles cristatus* |
| Honey badger | *Mellivora capensis* |
| Blesbok | *Damaliscus pygargus phillipsi* |
| Caracal | *Caracal caracal* |
| Bushbuck | *Tragelaphus scriptus* |
| Vervet Monkey | *Cercopithecus aethiops pygerythrus* |
| Water Mongoose | *Atilax paludinosus* |
| Cape Clawless Otter | *Aonyx capensis* |
| Cape Hare | *Lepus capensis* |
| Slender Mongoose | *Galarella sanguinea* |
| Warthog | *Phacochoerus africanus* |
| Serval | *Leptailurus serval* |
| Bushpig | *Potamochoerus larvatus* |
| Southern African Hedgehog | *Aterlerix frontalis* |
| Striped Polecat | *Ictonyx striatus* |
| Large-spotted Genet | *Genetta tigrina* |
| Porcupine | *Hystrix africaeaustralis* |
| Reedbuck mountain | *Redunca fulvorufula* |

** Introduced species*

Mammal species diversity was low across the two proposed dam sites. Good habitat cover is present, especially along the rivers, and therefore a wide diversity of small mammalian species is expected to flourish in these areas. The river forms an ecological corridor that highly-mobile species would utilize for migratory purposes, and therefore this riparian vegetation promotes ecological functionality.

The only species of conservation importance recorded during the brief field survey was the Cape Clawless Otter (*Aonyx capensis).*

### *10.8.2 Avifauna*

This sub-section contains information extracted from the Terrestrial Ecology Assessment (**Appendix E2**).

The aforementioned report contains a full list of the bird species recorded in grid cells 3030CA and 3030CB (Southern African Bird Atlas Project 2). The table to follow indicates the Red Data Bird species that could be found in the study area.

**Table 30: Red Data bird species that could occur in the study area (Nemai Consulting, 2012b)**

| Species | Conservation Status | Preferred Micro habitat |
|---|---|---|
| African Crowned Eagle | Near Threatened | Forest, Dense Woodland |
| Cape Vulture | Vulnerable | Grassland, Savanna, Hills and Ridges |
| Lanner Falcon | Near Threatened | Open grassland, woodland |
| African Finfoot | Vulnerable | Slow-flowing streams |
| Half-collared Kingfisher | Near Threatened | Coastal lagoons, Wooded streams |
| Southern Ground Hornbill | Vulnerable | Savanna, Woodland, Grassland |
| Grey-crowned Crane | Vulnerable | Marshes, pans, grasslands, wetlands |
| African Marsh Harrier | Vulnerable | Wetlands, grasslands |
| Martial Eagle | Vulnerable | Savanna, woodlands, semiarid shrubland |
| Spotted (Natal) Ground Thrush | Endangered | Coastal Forest |

The nearest Important Bird Area to the study area is the Oribi Gorge Nature Reserve.

Within the vegetation types found in the study area and immediate surrounding areas, two major bird habitat systems were identified:

- Rivers and associated riparian zones; and
- Woodland. Woodland areas in the two proposed sites vary from relatively intact in places to a relatively poor state with significant bush encroachment, partly due to sustained overgrazing.

An extract from Ezemvelo KZN Wildlife's Strategic Environmental Assessment Plan indicated that the Denham's bustard (*Neotis denhami*) could be encountered at the D3A site. This bird species has a Red Data Status of 'Nationally Vulnerable', and it is declining due to habitat loss (KwaZulu-Natal Nature Conservation Service, 2000).

No Red Data bird species associated with the two proposed sites were recorded within the study area. However, due to the suitable nature of the habitats, occasional visits cannot be discounted without long-term intensive surveys.

### *10.8.3 Reptiles*

This sub-section contains information extracted from the Terrestrial Ecology Assessment (**Appendix E2**).

The table to follow indicates the reptile species that occur or are likely to occur in the study area due to suitable habitat.

**Table 31: Reptile species that occur or are likely to occur in the study area (Nemai Consulting, 2012b)**

| Common Name | Scientific Name |
|---|---|
| Cape Skink | *Trachylepis* (*Mabuya*) *capensis* |
| Striped Skink | *Trachylepis* (*Mabuya*) *punctatissima* |
| Variable Skink | *Trachylepis* (*Mabuya*) *varia* |
| Yellow-throated Plated Lizard | *Gerrhosaurus flavigularis* |
| Flap-Necked Chameleon | *Chamaeleo dilepis* |
| Nile Monitor | *Varanus niloticus* |
| Herald or Red-lipped Snake | *Crotaphopeltis hotamboeia* |
| Green Mamba | *Dendroaspis angusticeps* |
| Common or Rhombic Night Adder | *Causus rhombeatus* |
| Boomslang | *Dispholidus typus* |
| Spotted Bush Snake | *Philothamnus senivariegatus* |
| Common or Rhombic Egg Eater | *Dasypeltis scabra* |
| Dusky-Bellied Water Snake | *Lycodonomorphus laevissimus* |
| Brown Water Snake | *Lycodonomorphus rufulus* |
| Brown House Snake | *Lamprophis fuliginosus* |
| Green Water Snake | *Philothamnus hoplogaster* |
| Common Slug-eater | *Duberria lutrix* |
| Bibron's Blind Snake | *Typhlops bibronii* |
| Cape and Eastern Thread Snake | *Leptotyphlops conjunctus* |
| Peters' Thread Snake | *Leptotyphlops scutifrons* |

**Table 32** shows species recorded on site and the species that were confirmed to occur by Mr Josh Ngwazi from the Cele K Tribe.

**Table 32: Reptile species recorded in the two proposed dam sites (Nemai Consulting, 2012b)**

| Species Name | Common Name | IUCN Status | Habitat requirements | Proposed Dam Site |
|---|---|---|---|---|
| *Dendroaspis angusticeps* | Green Mamba | Least Concern; Vulnerable (Branch 1988a) | Forests and forested drainage lines | D2 |
| *Dendroaspis polylepis* | Black mamba | Least Concern | Variety of climates, ranging from savanna, woodlands, farmlands, rocky slopes, dense forests and humid swamps. | D3A |
| *Python natalensis** | Southern African Python | Vulnerable (Branch 1988a); Protected under **Status (NEMBA, 2007)** | Savanna and drainage lines in savanna | D2/D3A |
| *Varanus albigularis* | Rock monitor | Least Concern | Arboreal | D3A |

Riparian habitat is traditionally rich in herpetofauna diversity and densities due to the habitat unit supporting a high abundance of prey species such as frogs, birds and small mammals. Species are also very often "forced" into riparian zones due to the lack of suitable habitat elsewhere within catchment areas that have been transformed.

### *10.8.4 Amphibians*

This sub-section contains information extracted from the Terrestrial Ecology Assessment (**Appendix E2**).

A list of the frog species that are likely to occur in the study area is shown in **Table 33**.

**Table 33: Frog species likely to occur in the study area (Nemai Consulting, 2012b)**

| Common Name | Scientific Name | Status/ Distribution | Habitat |
|---|---|---|---|
| Guttural Toad | *Amietophrynus (Bufo) gutturalis* | Common in southern Africa north of Gariep. | Permanent and semi-permanent ponds and backwaters in open grassland. Backwaters and pools within rivers. |
| Natal Tree Frog | *Leptopelis natalensis* | Common in Kwazulu-Natal | Permanent and Seasonal ponds situated in coastal forest, sand forest or coastal bushveld and occasionally grassland. |
| Greater Leaf-Folding Frog | *Afrixalus fornasinii* | Common along the coast of Kwazulu-Natal as far south as Port Edward | Stagnant water bodies containing large stands of saw grass *Cyperus immensus* and bulrushes *Typha capensis* in Coastal Bushveld-Grassland |
| Painted Reed Frog | *Hyperolius marmoratus marmoratus* | Common along Kwazulu-Natal Coast | Reeds and other emergent vegetation along a wide variety of waterbodies including pans and rivers |
| Water Lily Frog | *Hyperolius pusillus* | Common in the low- | Shallow pans, ponds, vleis and dams |

| Common Name | Scientific Name | Status/ Distribution | Habitat |
|---|---|---|---|
| | | lying coastal areas (Eastern Cape and Kwazulu-Natal) but further inland in the southern parts of Limpopo it is found at higher altitudes. | with water lilies (*Nymphaea sp.*) or at least some floating vegetation. |
| Tinker Reed Frog | *Hyperolius tuberilinguis* | Common in the Eastern parts of Southern Africa from Swaziland up to Port Edward | Reed beds on the periphery of rivers or dense vegetation surrounding seasonal pans |
| Bubbling Kassina | *Kassina senegalensis* | Common throughout Southern Africa | Grassy margins of seasonally inundated pans as well as dams |
| Snoring Puddle Frog | *Phrynobatrachus natalensis* | Widely distributed along the eastern sections of Southern Africa | Shallow to fairly deep water in temporary pans and pools, vleis, dams and even slow-flowing streams |
| Sharp-Nosed Grass Frog | *Ptychadena oxyrynchus* | Eastern Parts of South Africa | Vleis, inundated grassland and sedge pans, temporary roadside pools and rock puddles |
| Natal Sand Frog | *Tompoterna natalensis* | Common species in Kwazulu-Natal, Mpumalanga, Gauteng. | Streams, rivers or other places where water flows slowly but also in lothic or standing water |
| Bronze Caco | *Cacosternum nanum* | Common species in Kwazulu-Natal | Vleis, inundated grassland and sedge pans, temporary roadside pools and rock puddles |
| Plaintive Rain Frog | *Breviceps verrucosus* | Eastern Parts of South Africa | Terrestrial breeder with eggs laid in moist leaf litter. |
| Bush Squeaker | *Arthroleptis wahlbergi* | Endemic to the East Coast of South Africa | Terrestrial breeder with eggs laid in moist leaf litter. |

Two red listed frog species are known from the 3030CA and 3030CB Quarter Degree Grid Cell (QDGC) including Natal Kloof Frog (*Natalobatrachus bonebergi*) and Natal Leaf-folding Frog (*Afrixalus natalensis*). Suitable habitat in the form of perennial forest streams and pools with rocky beds especially, but not exclusively in ravines remains within certain perennial streams for Natal Kloof Frog. Suitable habitat remains for Natal-Leaf-Folding Frog in the sedge and grass dominated valley bottom wetlands with large clumps of White Arums.

#### *10.8.5 <u>Invertebrates</u>*

An Invertebrate Survey was conducted (refer to **Section 11.9** and **Appendix E9**) for the study area. A total of 43 insects, representing 14 families in 9 orders, were recorded during the survey period. Four arachnids were collected or observed, and diplopod presence was only confirmed by the presence of exoskeleton remains. Refer to **Table 34**.

**Table 34: Observations from Invertebrate Survey (van der Merwe, 2012)**

| INSECTS | |
|---|---|
| **Order** | **Family** |
| Odonata | Not determined (nymphal stage) |
| Blattodea | Blattellidae |
| Isoptera | Termitidae |
| Hemiptera | Pentatomidae |
| Neuroptera | Myrmeliontidae |
| Coleoptera | Scarabaeinae |
| | Tenebrionidae |
| | Coccinellidae (larval stage) |
| Diptera | Muscidae |
| | Calliphoridae |
| Lepidoptera | Psychidae |
| Hymenoptera | Vespidae |
| | Apidae |
| | Formicidae |
| **ARACHNIDA** | |
| **Order** | **Family** |
| Araneae | Araneidae |
| | Salticidae |

The vast majority of arthropods collected were insects. Hymenoptera was the most diverse (3 families) and abundant (14 specimens) order of insects, followed by the Coleoptera.

According to DWAF (2007c), the KZN C-plan indicates that the following invertebrate species of conservation concern could potentially occur in the project area:

- Site D2 –
  - Strong black millipede (*Doratogonus infragili*), conservation status = endangered;
- Site D3A –
  - Strong black millipede (*Doratogonus infragili*), conservation status = endangered; and
  - Montane Black Millipede (*Doratogonus montanus*), conservation status = least concern.

Neither *Doratogonus infrangii nor Doratogonus montanus* were observed during site visits. The survey was however carried out during a time of the year when millipede activity is greatly reduced. Although signs of millipede activity and some millipede remains were observed the presence or absence of these species in the two study areas was not established.

## 10.9 Protected Areas

The nearest protected areas to the dam sites include two provincial nature reserves, namely the Oribi Gorge Nature Reserve (approximately 7km to the south of D3A) and the Mehlomnyama Nature Reserve (approximately 7km to the east of D2) (see **Figure 50**).

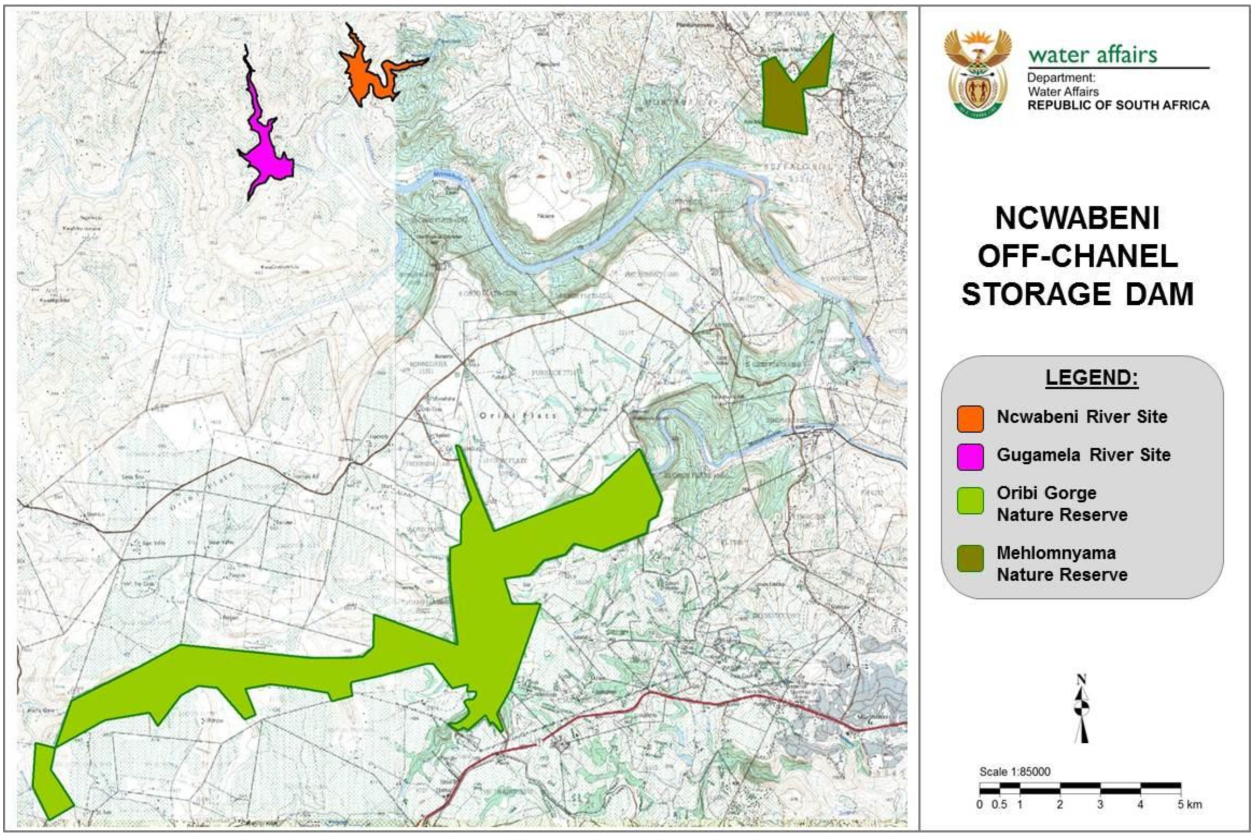



**Figure 50: Protected areas nearest to dam sites**

According to the Manager: Environmental Services from the Ugu District Municipality (Nkqeto pers comm, 2011), no Biodiversity Sector Plan exists for the municipality as yet although it is one of the identified projects in the IDP and is currently being developed.

A brief summary of the Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET) is presented in the table to follow. Based on the information data received from Ezemvelo KZN Wildlife, Ncwabeni OCS falls within Areas of Not Conservation Significance (0Co) while Gugamela falls within a Biodiversity Priority Area (BPA) 3, also known as Critical Biodiversity Area (CBA) 3 Optimal and 0Co (see **Figure 51**) (Nemai Consulting, 2012b). CBA 3 areas reflect the negotiable sites with an Irreplaceability score of less than 0.8 but this does not mean they are of a lower biodiversity value however, only that there are more alternate options available within which the features located within can be met.

**Table 35: A brief summary of the Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET)**

| Category | C-plan | Biodiversity sector and regional plans |
|---|---|---|
| CBA 1 Mandatory (BPA 1) | Irreplaceability = 1 | CBA Mandatory |
| CBA 2 Mandatory (BPA 2) | Irreplaceability Score >= 0.8 and <1.0 | CBA Mandatory |
| CBA 3 Optimal (BPA 3) | Irreplaceability Score >= 0 and < 0.8 | CBA Optimal |

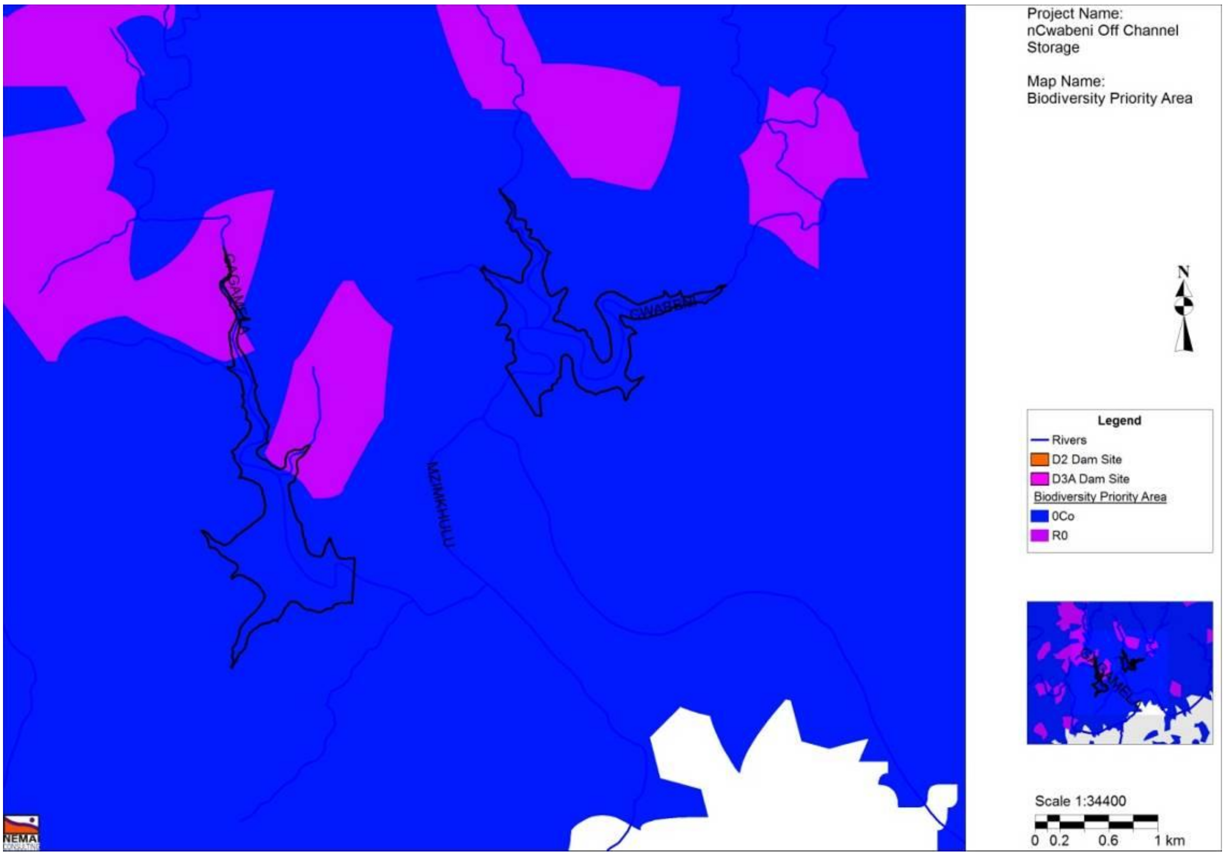



**Figure 51: Occurrence of two proposed sites in the Biodiversity Priority Areas (Nemai Consulting, 2012b)**

The data provided by South African National Biodiversity Institute (SANBI) on terrestrial CBAs around the southern parts of KZN indicates that the two proposed dam sites fall within CBA 2 as indicated in **Figure 52**.

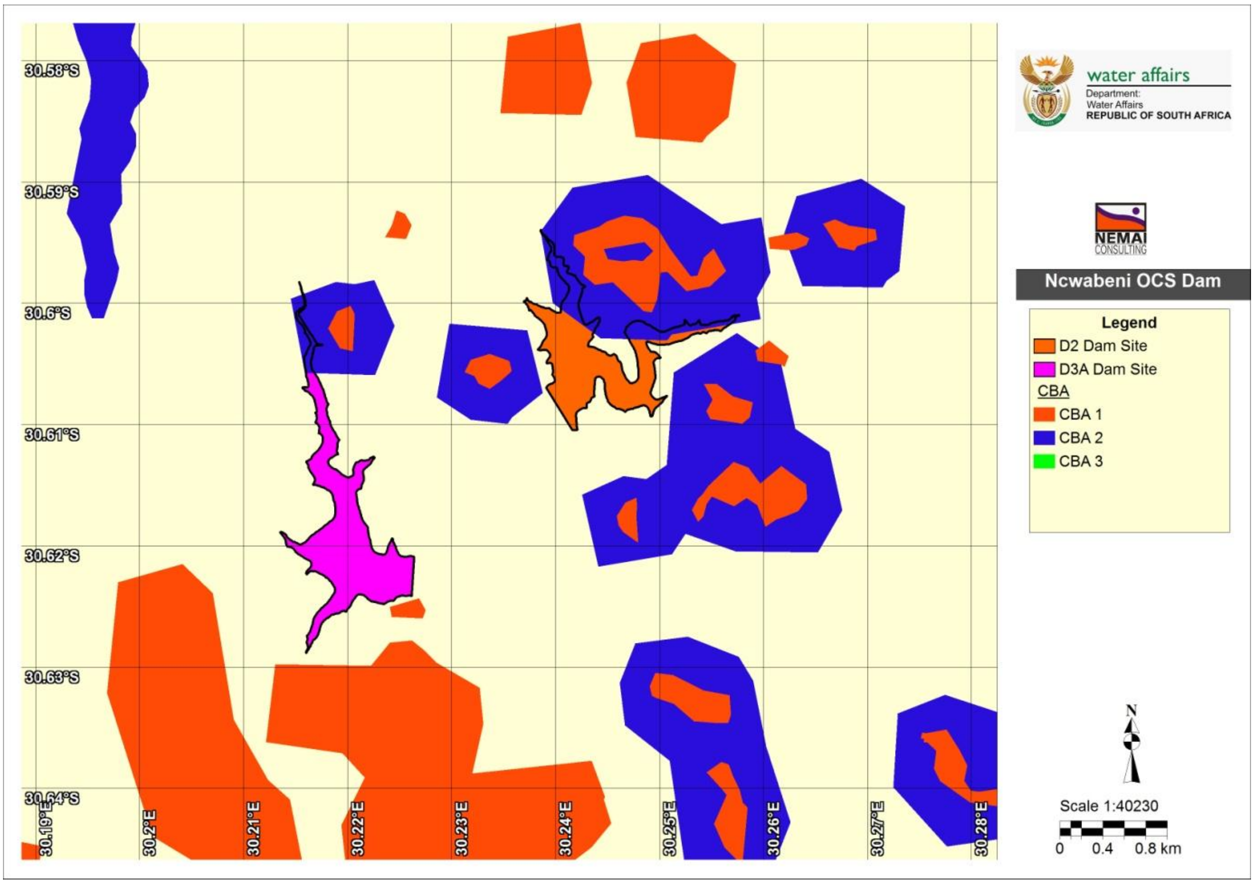



**Figure 52: Occurrence of the OCS dam sites in a CBA (Nemai Consulting, 2012b)**

The future management of the OCS dam and the surrounding land through the RMP needs to take cognisance of the sensitivity of the receiving environment within the context of the above biodiversity factors.

## 10.10 Socio-Economic Environment

### *10.10.1 Demographics*

The Umzumbe Local Municipality is the second largest municipality within the district. According to Statistics South Africa (Stats SA) (2007), the total population within Umzumbe Municipality has been estimated at 176, 287 persons which covers up to 25% of the District. There is high level of poverty and unemployment as well as low economic growth in the Umzumbe Local Municipality. There is also indication of rapid migration of people from the rural areas to urban complexes in search of better living standards. Demographic data for Umzumbe Local Municipality is provided in the table to follow.

**Table 36: Demographic data for Umzumbe Local Municipality (Statistics SA, 2007)**

| Population Group | | |
|---|---|---|
| Black | 175,917 | 99.8% |
| Coloured | 366 | 0.2% |
| Indian or Asian | 0 | 0.0% |
| White | 9 | 0.0% |
| **Gender** | | |
| Male | 79,031 | 44.8% |
| Female | 97,252 | 55.2% |
| **Income - 15-65 years** | | |
| No income | 65,572 | 70.4% |
| R 1 - R 400 | 4,659 | 5.0% |
| R 401 - R 800 | 3,992 | 4.3% |
| R 801 - R 1 600 | 14,276 | 15.3% |
| R 1 601 - R 3 200 | 1,988 | 2.1% |
| R 3201 - R 6 400 | 1,681 | 1.8% |
| **Industry** | | |
| Agriculture; hunting; forestry and fishing | 5,246 | 5.5% |
| Mining and quarrying | 34 | 0.0% |
| Manufacturing | 1,932 | 2.0% |
| Electricity; gas and water supply | 64 | 0.1% |
| Construction | 1,275 | 1.3% |
| Wholesale and retail trade | 2,167 | 2.3% |
| Transport; storage and communication | 330 | 0.3% |
| Financial; insurance; real estate and business services | 1,489 | 1.6% |
| Community; social and personal services | 2,979 | 3.1% |
| **Institution attended 5-24 Years** | | |
| Pre-school | 1,974 | 2.3% |
| Primary school | 33,856 | 38.9% |
| Secondary school | 30,062 | 34.6% |
| College | 295 | 0.3% |
| University/University of technology/Technikon | 435 | 0.5% |
| Adult basic education and training | 0 | 0.0% |
| Other | 789 | 0.9% |
| **Employment** | | |
| Employed | 17,876 | 18.7% |
| Unemployed | 24,789 | 25.9% |
| Not economically active | 50,571 | 52.8% |
| Unspecified | 1,897 | 2.0% |
| Institutions | 592 | 0.6% |

### *10.10.2 Economy*

According to DWAF (2002), the economy of southern KZN is largely reliant on the following sectors:

- Dairy;
- Timber;
- Sugar; and

- Tourism.

Between the highly productive agricultural sectors in the upper reaches of the catchment and those of the coastal areas are large tracts of land under Tribal Authority. These areas, which include the EIA project area for the proposed Ncwabeni OCS Dam, primarily support subsistence agriculture.

A Socio-Economic Study (**Appendix E4**) was undertaken for the project. Refer to the summary contained in **Sections 11.4**.

#### *10.10.3* *Land Tenure*

The project area falls under the Cele K Tribal Authority, on land which is registered under the Ngonyama Trust. The property description is as follows: Alexander Native Location No. 6, Farm Number 16462 (see **Figure 7**). The land on the opposite bank of the Mzimkhulu River (Gibraltar 8258) is privately owned and commercially farmed.

The area is characterised by traditional homestead settlements and rural subsistence agriculture. A typical rural dwelling in the vicinity of the proposed sites, with adjacent subsistence farming practices, is shown in **Figure 53**.

During Scoping a number of structures, including dwellings (occupied and abandoned) and kraal structures, were identified in the proposed FSL of the D3A dam basin. Only abandoned homesteads were found in the dam footprint for site D2. Further investigations into the status of the structures within the D3A basin were undertaken during the EIA phase, via ground-truthing and assistance from the UDM and iNduna Mr Ngwazi from the Cele K Tribe. In addition, interviews were also held with these occupants to share more information regarding the project and to record their concerns, which primarily related to their resettlement and the impacts to family graves. The findings on the on-ground survey are captured in **Table 37** and shown in **Figure 54**. Note that the term ‘cluster’ is used to denote areas where of a number of dwellings, kraals and patches of subsistence farming occur in close proximity to each other.

**Figure 53: Typical dwelling in communal tribal area**

**Table 37: Cluster of structures within / immediately adjacent to the D3A dam basin**

| Cluster No. | Status | Coordinates |
|---|---|---|
| 1 | Abandoned | 30°36'23.3"S; 30°12'58.1"E |
| 2 | Abandoned | 30°36'29.2"S; 30°13'01.2"E |
| 3 | Occupied (Ngwazi Agnes) | 30°36'48.1"S; 30°13'06.6"E |
| 4 | Occupied (Ngwazi Mantombi) | 30°36'49.1"S; 30°13'18.4"E |
| 5 | Abandoned | 30°36'54.0"S; 30°13'02.9"E |
| 6 | Occupied (Ngwazi Ntombenhle) | 30°36'58.6"S; 30°13'19.0"E |
| 7 | Abandoned | 30°37'02.5"S; 30°13'07.8"E |
| 8 | Abandoned | 30°37'08.8"S; 30°13'56.4"E |
| 9 | Abandoned | 30°37'06.6"S; 30°13'11.3"E |
| 10 | Abandoned | 30°37'10.4"S; 30°13'11.0"E |
| 11 | Abandoned | 30°37'16.6"S; 30°13'02.5"E |
| 12 | Abandoned | 30°37'21.3"S; 30°13'07.5"E |
| 13 | Abandoned | 30°37'23.2"S; 30°13'16.7"E |

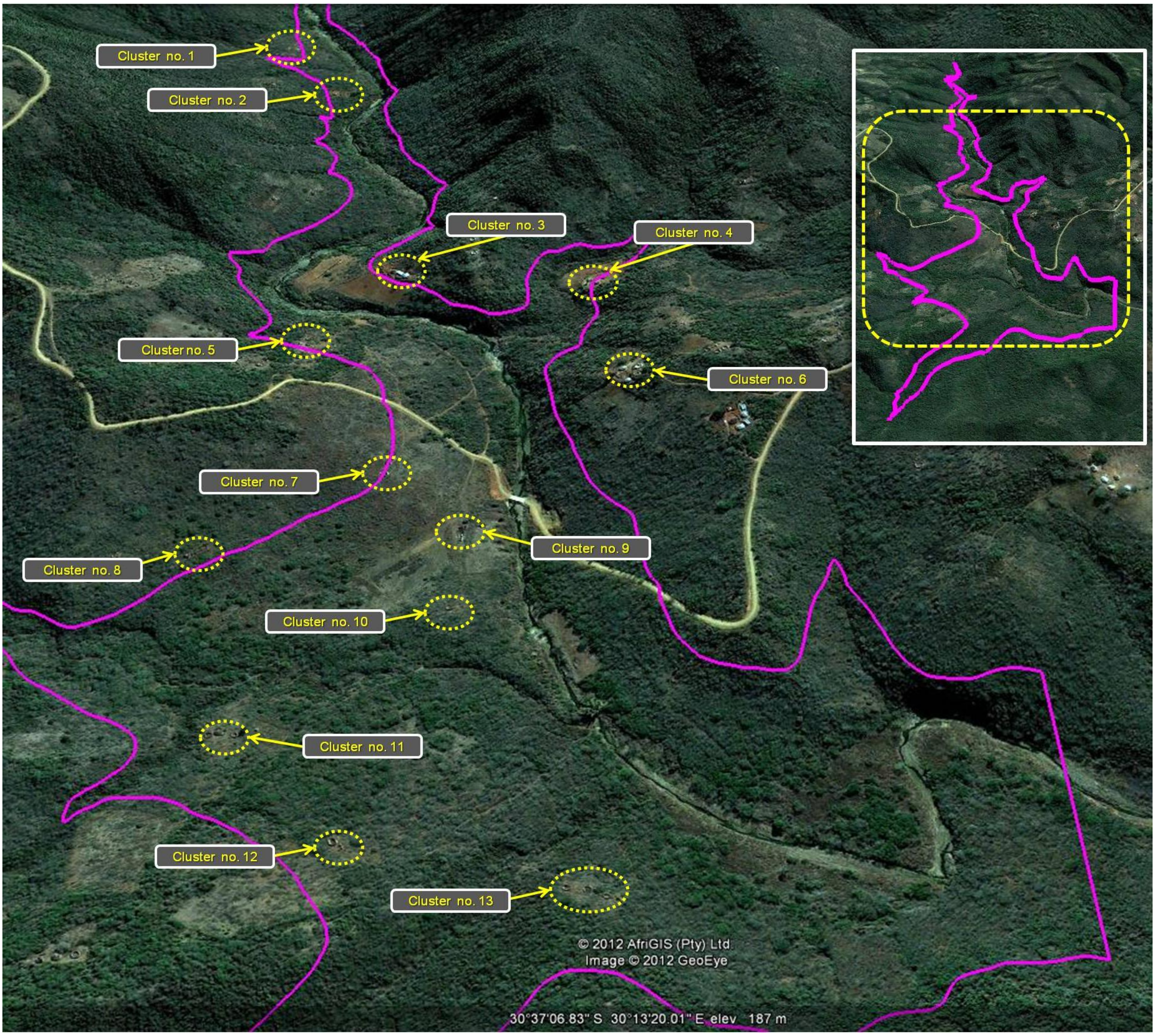



**Figure 54: Localities of clusters in FSL of D3A dam basin (Google Earth image)**

**Figure 55: Photos of occupied dwellings – cluster no. 3 (left), no. 4 (middle) and no. 6 (right)**

**Figure 56: Photos of an abandoned dwelling in FSL of D3A dam basin**

The Heritage Impact Assessment also identified homesteads and graves in the two dam basins – refer to **Section 11.6**. As mentioned, only the remains of homesteads were found in the D2 dam basin.

A Social Impact Assessment (**Appendix E5**) was undertaken for the project. Refer to the summary and impact assessment contained in **Sections 11.5** and **12.9**, respectively.

#### *10.10.4 Land Claims*

Through the KwaZulu-Natal Land Commission, it was established there are no land claims on Location No. 6 ET. However, there are land claims related to Camro Estates (Farm Gibaraltar 8528 ET and Lot 20 of Oribi Flats 12701 ET). The land claim was lodged in 1998 on behalf of the Ndwalane Community (Nemai Consulting, 2012a).

In terms of the OCS Dam project, the above land claim only affects a small portion of the Farm Gibraltar 8528 ET where the diversion weir ties into the right bank of the Mzimkhulu River.

## 10.11 Planning

The project area falls in Ward 1 of the Umzumbe Local Municipality, in Cele (see **Figure 57**). Sub-places, which are divided by the rivers in the region, include Nyamande, Sunduza and Ncane.

Umzumbe Municipality runs along the coast for a short strip between Mthwalume and Hibberdene and then balloons out into the hinterland for approximately 60 km. It covers a vast, large rural area of some 1260 km$^2$ with approximately 1% being built up / semi-urban area (Umzumbe Local Municipality, 2009).

There are no established towns in the municipality, which is characterized by a backlog of basic services, high levels of poverty and virtually no economic base. The most striking physical feature is the extent of undeveloped natural, land which represents almost 60% of the total land area (Umzumbe Local Municipality, 2009).

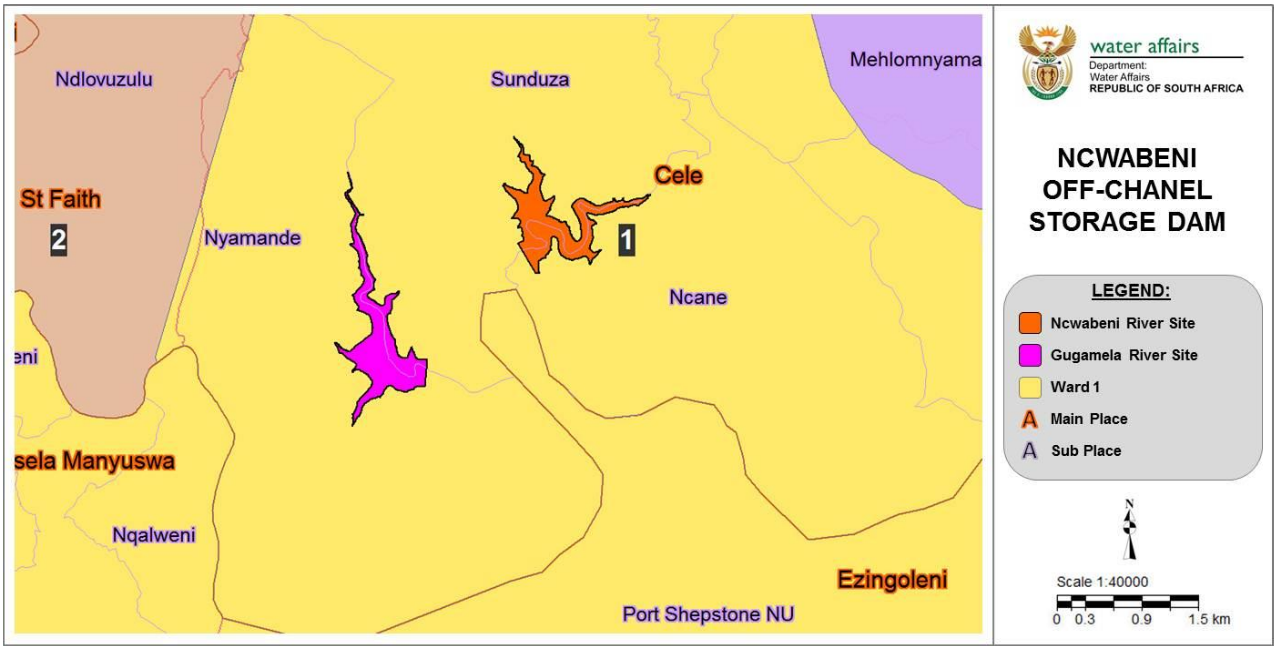



**Figure 57: Demarcation boundaries and places in project area**

The following key spatial issues were listed in the SDF for the Umzumbe Local Municipality (Umzumbe Local Municipality, 2009):

- **Dispersed low-density settlement pattern**, making the provision of physical and social infrastructure (roads, water, electricity, clinics, schools, and police stations), and the costs of installing, maintaining and operating infrastructure very high;
- **Steep river valleys and hilly terrain**, which create obstacles to accessibility, and limits the extent of agricultural production;

- **Weak road and communication linkages** exacerbated by hilly topography, with few tarred surfaces and few bridges across rivers. In particular, north-south linkages are very poorly developed within and beyond the sub-region;
- **Limited farming practices** in traditional areas that do not make optimal productive use of the agricultural potential of the area. **Subsistence farming** in the sub-region is beset by numerous problems: lack of water, destruction of crops by livestock, and inability to afford necessary farming inputs, services and infrastructure. Thus arable land is often left unutilized or underutilized, because the returns of subsistence farming are so minimal;
- **Limited economic activity in traditional areas**, resulting in income leakage outside these areas, exacerbated by a lack of business support services (training, banking, advice, etc.);
- There are **no tourism infrastructure and services beyond the coastal corridor** despite a diverse range of attractions within the rural hinterland; and
- Overgrazing, fire, illegal sand mining operations and encroaching settlement have begun to **cause environmental degradation**, although not irreparable damage.

Given these issues, a key goal of the Umzumbe IDP is to provide an efficient and effective spatial framework that enables the optimal use of resources and delivery of services (Umzumbe Local Municipality, 2009).

Following an appraisal of the Umzumbe Local Municipality SDF, the dam sites are located in an area that has particular value in terms of tourism. The SDF notes that these areas should be promoted for their potential to draw outside visitors. Many of these areas are also environmentally sensitive, thus protection is required. Investment is needed to render these areas attractive and accessible – thereby providing an income source for local residents (Umzumbe Local Municipality, 2009). DWA will develop a RMP (see **Section 6.9**) for the sustainable utilisation of the Ncwabeni OCS Dam, which will take into consideration the tourism aspirations and desired state of the area from a planning perspective.

## 10.12 Agriculture

Outside of the urban areas there are large tracts of commercial and subsistence agricultural land. Timber, sugar cane, pastures and cash crops are the dominant land uses in the commercial agricultural areas, whilst degraded grasslands and scrub are typical of the subsistence agriculture areas (DWAF, 2004a).

Refer to **Table 38** for the major agricultural land use in the Mzimkhulu River.

**Table 38: Major agricultural landuse in the Mzimkhulu Catchment (DWAF, 2004a)**

| | Tertiary catchments | Catchment Area ($km^2$) | Irrigation ($km^2$) | Forestry ($km^2$) | Dryland sugar cane ($km^2$) |
|---|---|---|---|---|---|
| **Mzimkhulu** | T51 & T52 | 6 678 | 60 | 583 | 179 |

The bulk of agricultural activities are mainly subsistence farming on rural communal land. Subsistence agriculture in the project area comprises mostly of livestock, dry land cropping and vegetable production (see **Figure 58**).

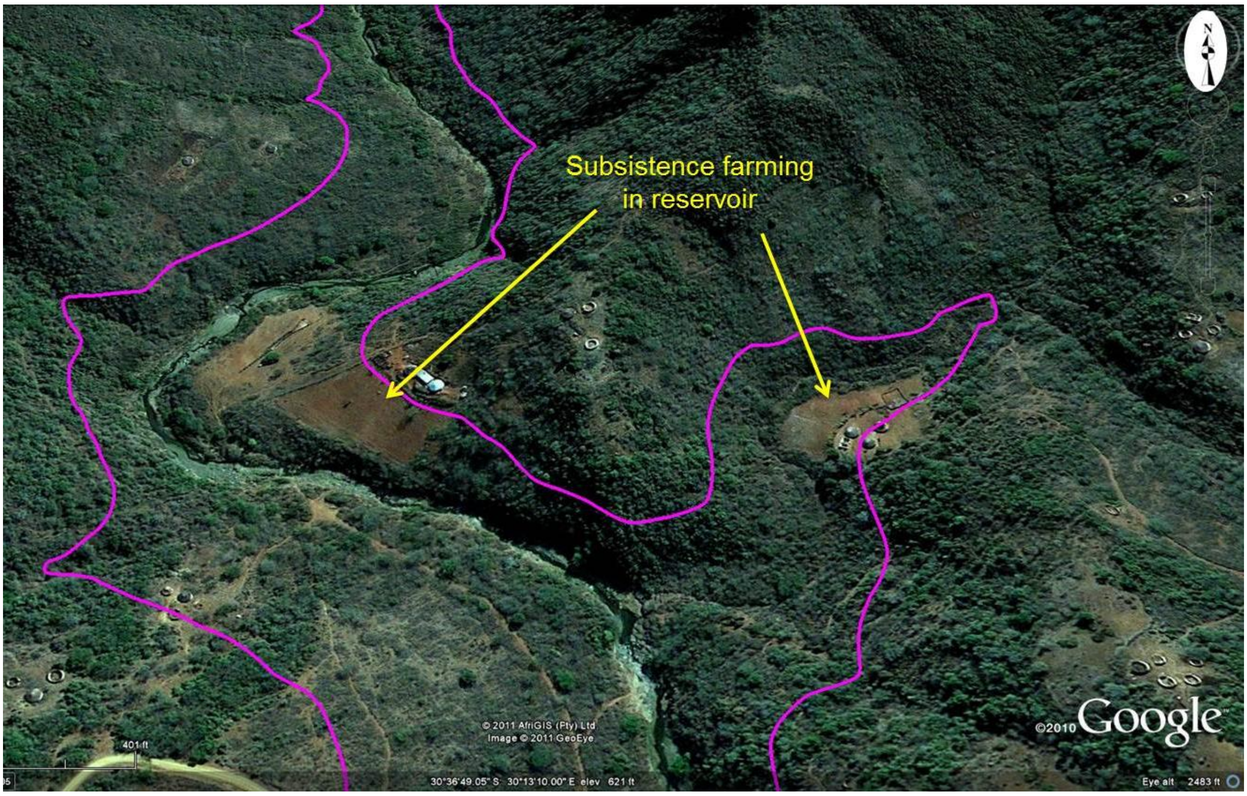



**Figure 58: Examples of subsistence farming in D3A dam reservoir (Google Earth image)**

A privately owned commercial farm named Camro Estates is located on the southern banks of the Mzimkhulu River where it forms a meander (south of site D2 and east of site D3A) (see **Figure 59**). Crops produced on the farm include tomatoes, butternut, lemons, granadillas, bananas and cabbage.

The Agricultural Research Council (ARC) - Institute for Soil, Climate and Water developed and implemented a workable land capability system for South Africa in 2002. Eight land classes were determined of which Class 1 to Class 4 represent arable land with few limitations to agricultural use, and Class 8 has limitations to agricultural use that cannot easily be corrected.

**Figure 59: Agricultural activities at Camro Estates**

The Agricultural and Agribusiness Status Quo Assessment (Mzansi Agriculture, 2012) noted that apart from the few hectares of footslope soils, the entire area falls into Land Class Capability Classes 7 and 8, suitable for livestock and game only, the most compelling determinant being excessively steep slopes.

As part of the Environmental Screening, BKS (2011) noted that there are no areas in any of the alternative dam sites that are suitable for intensive grazing or cultivation of crops. The steep slopes and valleys also restrict the use of these sites for agricultural purposes.

Refer to **Section 11.8** for a summary of the Agricultural and Agribusiness Status Quo Assessment (full report contained in **Appendix E7**).

## 10.13 Air Quality

Due to the predominantly natural state of the project area on the tribal lands, the air quality is regarded to be good. Localised impacts to air quality include burning of fossil fuels, emissions from vehicles travelling on the surrounding road network, dust from un-vegetated areas and dirt roads, smoke (veld fires), agricultural activities, and methane release from cattle. In the greater area, air quality is influenced by the Simuma Plant (approximately 10 km south-east of site D2) and quarry, which are source of particulates (amongst others). Nearer to the coastal region, sugar cane burning constitutes is a substantial seasonal source of particulates and CO emissions.

Sensitive receptors to dust and other air quality impacts include rural dwellings within the dam basin and to the east of the dam at site D3A. The staff quarters and farmhouse at Camro Estates are in excess of 1.5 km from the dam walls and abstraction works of both dam sites.

Refer to **Section 12.7** for a discussion on the potential impacts to the air quality that could be caused by the project.

## 10.14 Noise

The rural and predominantly natural state of site D2 and D3A (to a lesser extent) affords tranquillity to the project area. Dwellings are sparsely situated in the D3A basin, with no households located in the footprint of the dam at D2.

Noise in the region emanates primarily from households, farming operations at Camro Estates (e.g. use of farming equipment), and vehicles on the road network. The low mountainous terrain serves as a noise attenuation feature, although the ambient noise levels are regarded as insignificant.

Sensitive receptors to noise include rural dwellings within the dam basin and to the east of the dam at site D3A. The staff quarters and farmhouse at Camro Estates are in excess of 1.5 km from the dam walls and abstraction works of both dam sites.

The possible impacts of the project to ambient noise levels are discussed in **Section 12.8**.

## 10.15 Archaeological and Cultural Features

A Phase 1 Heritage Impact Assessment, in accordance with the National Heritage Resources Act (Act No. 25 of 1999) and KZN Heritage Act (Act No. 04 of 2008), was conducted (see **Appendix E3**) for the project. Refer to **Sections 11.6** for a synopsis of the study. An extract from this specialist study that explains the heritage features of the receiving environment follows below.

The available evidence indicates that the greater Ugu District municipality area contains a wide spectrum of archaeological sites covering different time-periods and cultural traditions. The project area has not been systematically surveyed for archaeological sites in contrast to the coastal areas of Port Shepstone and the greater Oribi Gorge. Archaeological sites in the near vicinity of the project area include two Middle Stone Age sites and eleven Later Stone Age rock art sites situated within the greater Oribi Gorge and adjacent areas.

Many African groups moved through the project area due to the turmoil caused in part by the expansionistic policies of King Shaka Zulu in the 1820's and subsequent civil wars in Zululand. The history of the period was characterised by the displacement, fragmentation and migration of groups and the re-aggregation into new, enlarged entities with a handful of larger chiefdoms continuing as well as local groups that survived the upheaval including the Memela, Nhlangwini, Bhaca and Cele.

Specific information regarding the project area is very limited. According to oral sources, there was conflict between clans over resources such as land and grazing rights and that the fighting took place during two periods, namely between 1963 and 1967 and again in the 1980s, the result of which was the large number of abandoned homesteads in the project area.

The various homesteads (occupied and abandoned) and associated graves identified during the Heritage Impact Assessment are listed in **Table 42** and shown in **Figure 69**.

*Note that a recommendation that emanated from the EIA phase (see **Section 15.3**) is that a Search, Rescue and Relocation Management Plan needs to be developed that takes into consideration inter alia the heritage resources and graves.*

## 10.16 Infrastructure

The following main infrastructure occurs in the project area:

- A hydropower scheme is located downstream of the D2 dam wall on the banks of the Mzimkhulu River, on the Farm Gibraltar 8258 (see **Figure 60**);
- An existing pipeline for water abstraction is currently used for irrigation and domestic purposes on site D3A (see **Figure 61**);
- Access road D859 traverses the basins of options D2 and D3A;
- Occupied dwellings, kraals and areas used for subsistence farming are situated in D3A reservoir; and
- Abandoned dwellings are situated in the D2 and D3A reservoirs.

Depending on the site selected for the development of the OCS dam, the existing infrastructure could be affected by the project.

The hydropower plant at Camro Estates (see **Figure 60**) diverts water through a tunnel across the narrow part of the peninsula on which the estate is positioned. Currently Camro Estates operates the hydropower plant to generate energy to drive their irrigation pumps. The landowner has indicated that he is interested in operating the hydropower to its full potential in the future and sell the generated electricity. This could be a potential energy source for the pumping water to the OCS dam, which needs to be explored further. According to BKS (2012b), the water diverted through the tunnel of the hydropower plant will not pass the abstraction weir for off-channel pumping, and as such this must be taken into account when determining yields of the system. It appears that neither can the hydropower divert all the flow in the river, nor should it divert all the flow in the river, from an ecological or business case perspective. The off-channel pumping will also be conducted during the summer months when flows in the river are higher. Diversion of lower flows in the winter months will have little impact on the off-channel pumping, but will need to be factored into the releases from the OCS dam. As such the impact of the existing hydropower plant, even if developed to its full potential, should have little impact on the yield of the system (BKS, 2012b).

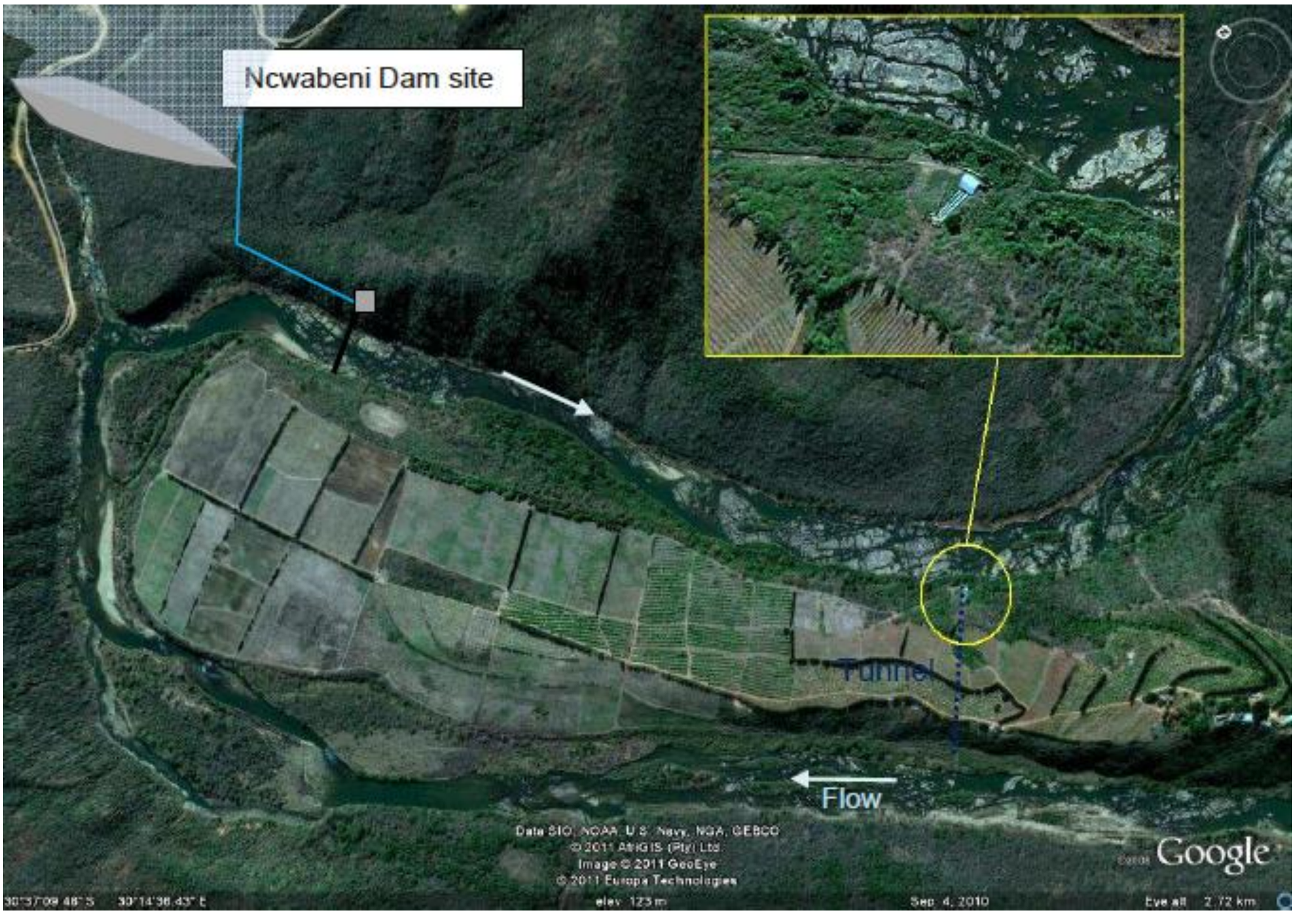



**Figure 60: Existing hydropower plant at Camro Estates and relation to the OCS Dam at D2 (BKS, 2012b)**

The section of the D859 to be inundated will need to be re-aligned and selective upgrading of the road will be required for construction purposes. A longer section of road will need to be diverted for D3A.

In the case of site D3A, the inhabited homesteads and adjoining areas used for subsistence living purposes, will become inundated and the affected people will need to be relocated. The existing pipeline used for water abstraction (shown in **Figure 61**) will also be inundated, and alternative arrangements will need to be made.

## 10.17 Services

The dispersed low-density settlement pattern and topography in the project area complicate the provision of service, and substantially increase the costs of installing, maintaining and operating the associated infrastructure.

### *10.17.1 Water*

The Ugu District Municipality is a Water Services Authority (WSA) and is therefore responsible to provide access to basic infrastructure and services. Access to water in Umzumbe Local Municipality is shown in the table to follow.

**Table 39: Access to water (Stats SA, 2007)**

| | |
|---|---|
| **Piped water** | 39.1% |
| **Borehole/spring** | 13.8% |
| **Dam/pool/river/stream** | 43.7% |
| **Other** | 3.4% |

According to the Ugu District Municipality (2011), the water supply to the District is derived from dams, rivers, ground water and bulk purchases from eThekwini and Umgeni Water. The northern coastal strip (i.e. Umzinto and Mtwalume) is serviced by potable water purchased in bulk from Umgeni Water. The central and southern coastal strip is serviced by water extracted from a number of rivers and dams which is then treated at several treatment plants, owned by district municipality before being distributed to households.

Ugu has a rudimentary water supply programme incorporating the use of boreholes and spring water. There is a spring protection and borehole maintenance programme to support supply to communities. However, the ground water potential is not very good in most areas, resulting in the failure of such schemes (Ugu District Municipality, 2011).

Local households rely on water from the Mzimkhulu, Ncwabeni and Gugamela Rivers to meet their basic water needs. The initial indications from Ugu District Municipality are that water from the new OCS dam will be purified and supplied to the local community.

Water requirements during the construction phase of the project will be met through the municipality (delivered by tanker trucks) and river abstraction.


**Figure 61: Abstraction of water for irrigation and domestic use upstream of the D3A site (DWAF, 2007c)**

### *10.17.2 Sanitation*

The UDM is responsible for providing sanitation services to the area under its jurisdiction. A backlog of 33% exists in the local municipal area (Ugu District Municipality, 2011). Access to sanitation in Umzumbe Local Municipality is reflected in the table to follow.

**Table 40: Access to sanitation (Stat SA, 2007)**

| | |
|---|---|
| **Flush** | 1.9% |
| **Pit (including VIPs)** | 66.6% |
| **Chemical** | 20.9% |
| **None** | 10.7 |

Sanitation facilities during the construction phase for construction workers will primarily be in the form of chemical toilets, which will be located to minimise the environmental impacts and serviced regularly.

### *10.17.3 Electricity*

According to UDM (2011), irregular topography, lack of bulk infrastructure and lack of funding pose challenges to providing electricity to the rural areas. Access to energy for lighting in Umzumbe Local Municipality is shown in the table to follow.

**Table 41: Access to electricity (Stat SA, 2007)**

| | |
|---|---|
| **Electricity** | 46.1 |
| **Gas** | 0.2 |
| **Paraffin** | 3.2 |
| **Candles** | 50.1 |
| **Solar** | 0.0 |
| **Other** | 1.2 |

As discussed in **Section 6.7.6**, a new high voltage power line will supply electrical power to the site and a separate EIA will be undertaken to seek approval for this component of the project.

The electrical switchgear for the pumps will be located above the 1:100 year flood level and power-cables and control cables will be protected against floods and other possible damage, by means of appropriate pipe conduits.

An alternative option of utilising hydropower that is already being generated at the Camro Estates farm for pumping purposes has been identified, which needs to be investigated further.

### *10.17.4 Transportation Network*

From Port Shepstone, the project area is accessed by travelling north-westwards on the P68-2 Main Road (St Faiths Road) and then turning southwards on the D859 District Road, which leads to the sites (see **Figure 62**).

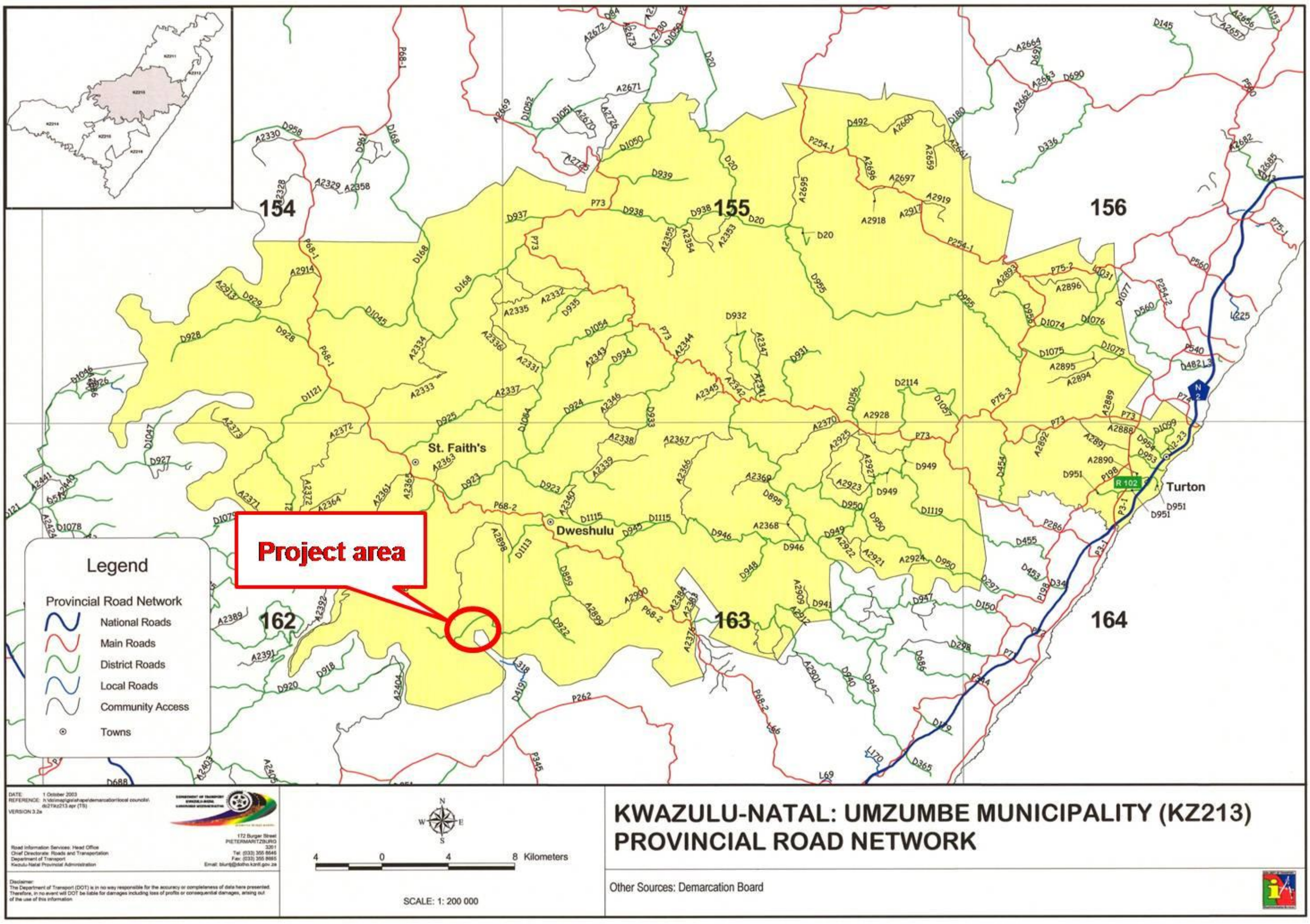



**Figure 62: Provincial Road Network in Umzumbe Local Municipality (KZN Department of Transport, 2003)**

The river crossings along the D859 at the two dam sites are shown in **Figures 63 - 64**. Refer to **Section 12.10** for an assessment of the potential impacts to the road network. Mitigation measures associated with access roads are contained in the EMPrs.

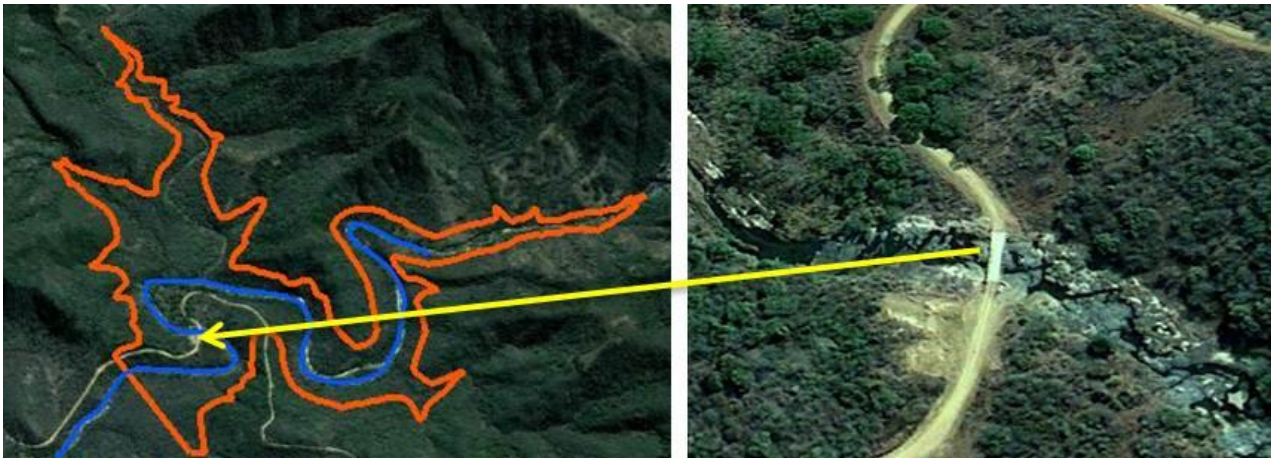


**Figure 63: River crossing on Ncwabeni River (to be inundated) (Google Earth image)**

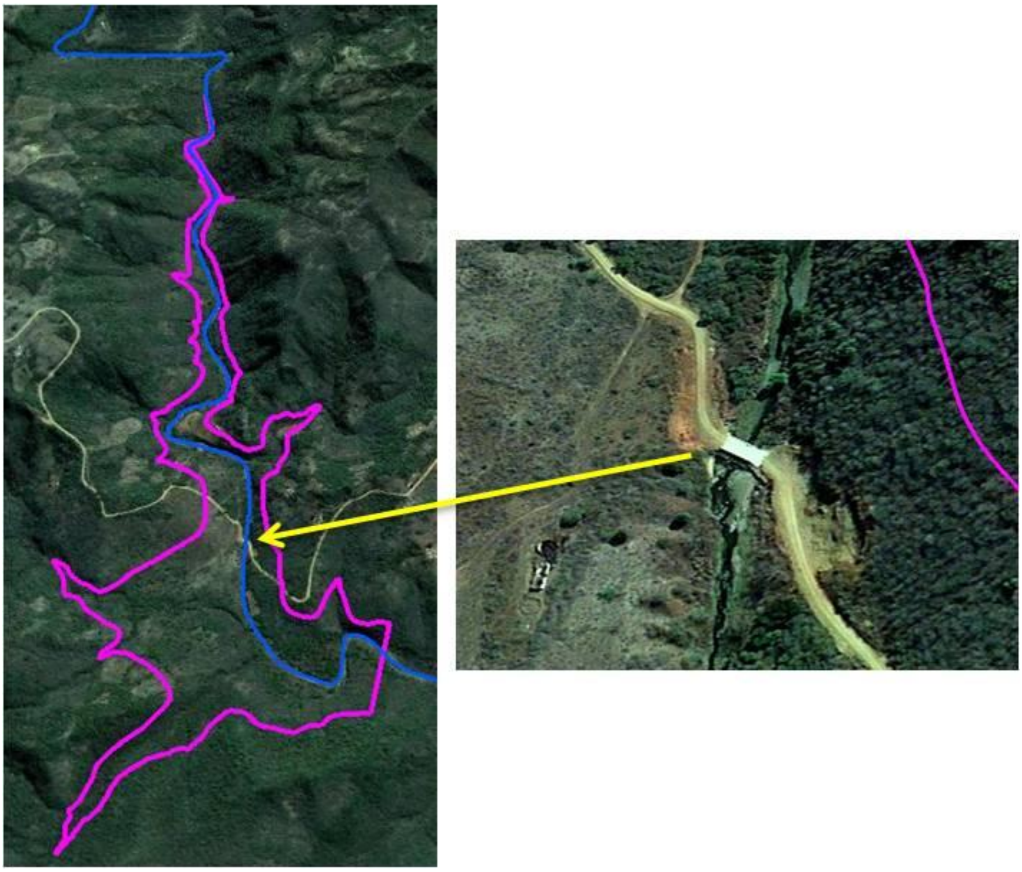


**Figure 64: River crossing on Gugamela River (to be inundated) (Google Earth image)**

### *10.17.5 Solid Waste*

According to Govender (pers comm, 2011), the nearest permitted waste disposal site to the project area is Oatlands Regional Refuse Site near Margate. There is no solid waste disposal service provided in the rural areas at present and solid waste is usually disposed of around the homesteads in pits. The Umzumbe Local Municipality has developed an Integrated Waste Management Plan.

The project will directly or incidentally generate various types of solid waste during the construction phase, such as:

- Waste generated from site preparations (e.g. plant material);
- Domestic waste;
- Surplus and used building material; and
- Hazardous waste (e.g. chemicals, oils, soil contaminated by spillages, diesel rags).

Wastewater will also be produced during construction from the sanitation facilities, washing of plant, operations at the batching plant, etc.

The EMPrs makes adequate provision to address waste management.

## 10.18 Visual

As shown in **Figure 65**, the project area is afforded high aesthetic appeal through topographical features such as low mountains, valleys and watercourses. The area's natural state and dense vegetation further contribute to the visual quality encountered in the area.

A waterfall is also situated on the Ncwabeni River, between 175 and 177 m.a.m.s.l. (see **Figure 66**). The waterfall is located outside of the FSL, and will thus not be inundated by the OCS dam.

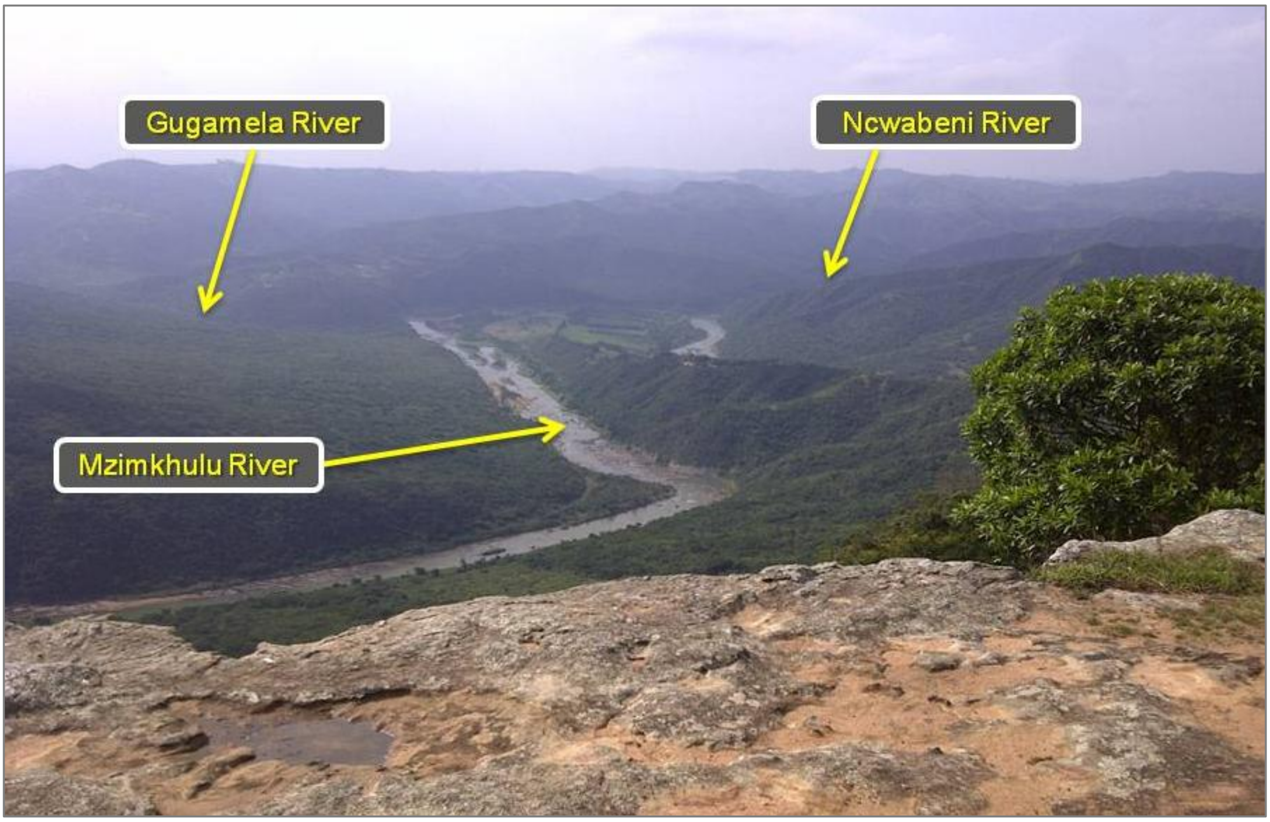



**Figure 65:** **Picturesque view (in a north-west direction) of the 'horse shoe' meander in the Mzimkhulu River**

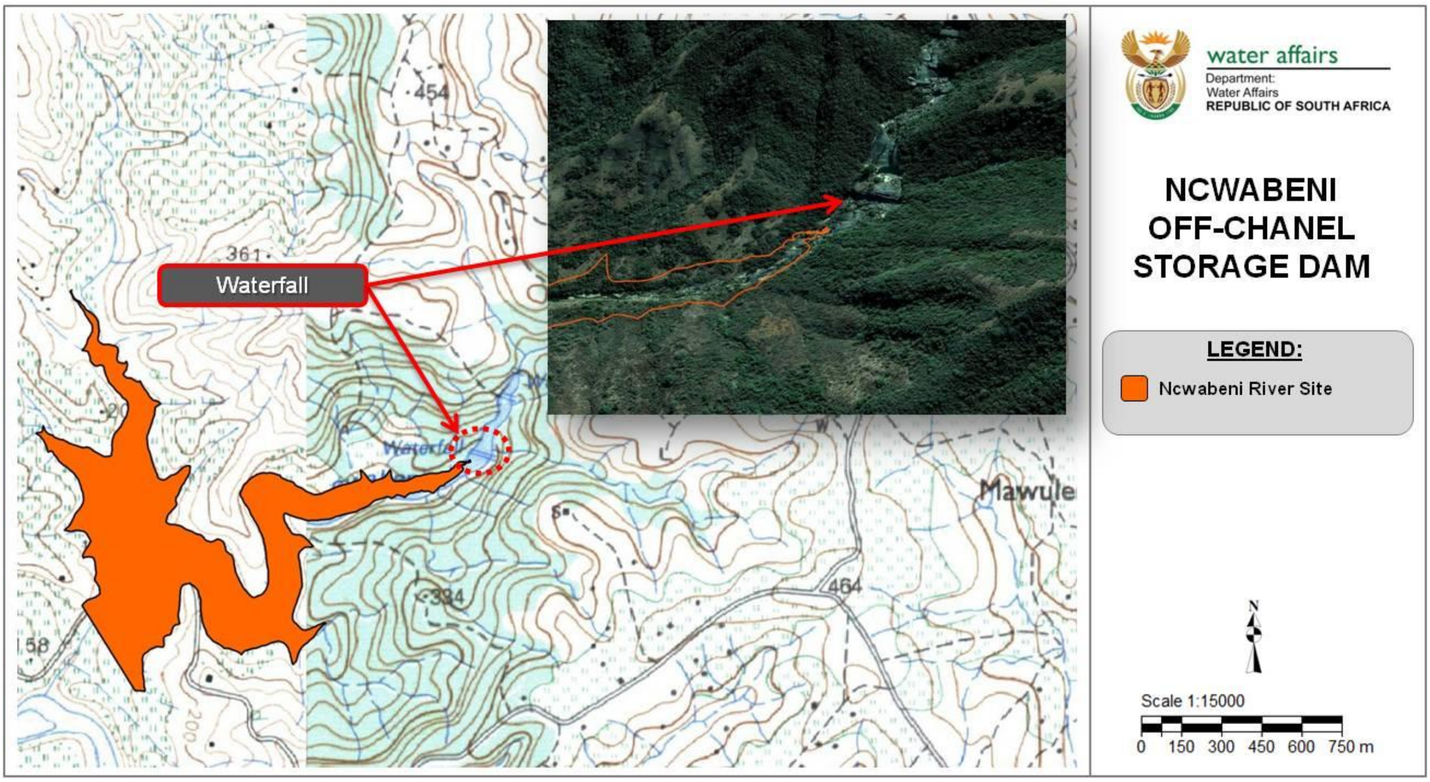



**Figure 66:** **Location of waterfall outside site D2**

A Visual Impact Assessment was undertaken for the project, and it is contained in **Appendix E6**. Refer to the summary and impact assessment of this study contained in **Sections 11.7** and **12.11**, respectively.

## 10.19 Tourism

According to the Umzumbe Local Municipality SDF, the dam sites are located in an area that has particular value in terms of tourism. The SDF notes that these areas should be promoted for their potential to draw outside visitors, and many of these areas are environmentally sensitive, thus protection is required. However, investment is required to make them attractive and accessible – thereby providing an income source for local residents.

The Oribi Gorge Nature Reserve, which constitutes the most significant tourist destination in proximity to the project area, lies approximately 7km to the south of site D3A.

The reservoir may be suitable for a variety of recreational activities (e.g. fishing, camping etc.). However, the river is not currently used for recreational activities suggesting that relative remoteness will tend to restrict such uses. DWA will develop a RMP (see **Section 6.9**) for the sustainable utilisation of the Ncwabeni OCS Dam, which will take into consideration the tourism aspirations and desired state of the area from a planning perspective.

Visual impacts during the construction phase may influence the tourism potential of the area, although the remoteness of the area needs to be taken into consideration. The EMPrs includes measures to manage visual impacts and to rehabilitate the areas affected by construction activities that fall outside of the basin.

The Visual Impact Assessment (**Appendix E6**) includes an appraisal of the project's impacts on tourists from an aesthetics perspective. - refer to the summary and impact assessment of this study contained in **Sections 11.7** and **12.11**, respectively.

# 11 SUMMARY OF SPECIALIST STUDIES

A crucial element of the Plan of Study for the EIA prepared during the Scoping phase was to provide the Terms of Reference for the requisite specialist studies triggered during Scoping. According to Münster (2005), a 'trigger' is "*a particular characteristic of either the receiving environment or the proposed project which indicates that there is likely to be an issue and/or potentially significant impact associated with that proposed development that may require specialist input*". The requisite specialist studies 'triggered' by the findings of the Scoping process, aimed at addressing the key issues and compliance with legal obligations, include:

- Terrestrial Ecology Assessment;
- Heritage Impact Assessment;
- Aquatic and Riverine Assessment;
- Agricultural Impact Assessment;
- Visual Impact Assessment;
- Estuarine Study;
- Socio-Economic Study; and
- Social Impact Assessment.

In addition, DWA also commissioned an Economic Study to consider the strategic need for the project on a regional scale, which included the economic rationale and implications of a no-go option (further discussed under **Section 12.12**).

For the inclusion of the findings of the specialist studies into the EIA report, the following guideline was used: *Guideline for the review of specialist input in EIA processes* (Keatimilwe & Ashton, 2005). Key considerations included:

- Ensuring that the specialists have adequately addressed I&APs' issues;
- Ensuring that the specialists' input is relevant, appropriate and unambiguous; and
- Verifying that information regarding the receiving ecological, social and economic environment has been accurately reflected and considered.

The information obtained from the respective specialist studies was incorporated into the EIA report in the following manner:

1. The assumptions and limitations identified in each study were included in **Section 9**;
2. The information was used to complete the description of the receiving environment (**Section 10**) in a more detailed and site-specific manner;
3. A summary of each specialist study is contained in the sub-sections to follow (**Sections 11.1 – 11.9**), focusing on the approach to the study, key findings and conclusions drawn;
4. The specialists' impacts assessment, and the identified mitigation measures, were included in the overall project impact assessment contained in **Section 12**;
5. The evaluations performed by the specialists on the alternative dam sites and associated infrastructure were included in the comparative analysis (**Section 13**) to identify the most favourable option;
6. Specialist input was obtained to address comments made by I&APs that related to specific environmental features pertaining to each specialist discipline; and
7. Salient recommendations made by the specialists were taken forward to the final EIA Conclusions and Recommendations (**Section 15**).

Refer to **Appendix E11** for declarations from the respective specialists, stating their independence and that the information presented in the EIA Report is a true reflection of their studies.

## 11.1 Terrestrial Ecology Assessment

The key issues and triggers identified during Scoping for the Terrestrial Ecology Assessment include:

- I&AP issues raised –
  - Both sites for the OCS dam fall within a proposed stewardship site in terms of the National Protected Area Expansion Strategy;
  - Endangered plants could occur in the study area
  - The study area is earmarked for conservation in terms of freshwater resources;
  - The study area is significant in terms of the River Disturbance Index;
  - The study area falls within a Critical Biodiversity Area;

    - The site forms parts of Environmental Atlas Site;
- Species with a known conservation status occur in the project area;
- Identify medicinal plants and suggest suitable mitigation measures (in consultation with tribal authority);
- Measures to mitigate impacts (e.g. search-and-rescue, relocate, transplant); and
- Management actions for controlling exotic vegetation.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Nemai Consulting |
| **Name:** | Ronald Phamphe |
| **Qualifications:** | MSc – Botany |
| **No. of years experience:** | 7 |
| **Affiliation (if applicable):** | • Professional Member of South African Institute of Ecologists and Environmental Scientists<br>• Candidate Natural Scientist: South African Council for Natural Scientific Professions |

A summary of the Terrestrial Ecology Assessment, as extracted from the specialist report (Nemai Consulting, 2012b) contained in **Appendix E2**, follows.

*The assessment consisted of two complementary approaches:*

- *A desktop analysis, which included a review of literature, topographical maps and Google Earth imagery; and*
- *Site visits were conducted during March 2012.*

*The study area falls within two biomes, namely the Savanna and Indian Ocean Coastal Belt. The vegetation types at the dam localities (D2 and D3A) include Kwazulu-Natal Coastal Belt (Endangered) and Eastern Valley Bushveld (Least threatened). KwaZulu-Natal Coastal Belt is listed as a threatened terrestrial ecosystem. The study area also lies within the Maputaland-Pondoland terrestrial priority conservation area, which lies along the east coast of southern Africa, below the Great Escarpment.*

*According to the Terrestrial Systematic Conservation Plan: Minimum Selection Surface (MINSET), the two proposed dam sites fall within the Critical Biodiversity Area 2, which includes Mandatory areas that represent areas of significantly high biodiversity value.*

*One Red Data plant species was found on the study site (D2) namely Hypoxis hemerocallidea (Star-flower or African potato). This species is listed as Declining and will have to be relocated to another area of the same habitat during construction. The exotic plant species Melia azedarach (Syringa trees), Chromolaena odorata (Triffid weed), Lantana camara (common lantana) and Solanum mauritianum (Bugweed) were common at the proposed D3A site while Chromolaena odorata (Triffid weed) and Lantana camara were the dominant exotic vegetation on proposed D2 dam site. According to the Ezemvelo KZN Wildlife (EKZNW) Threatened or Protected Species programme, Celtis africana (White stinkwood), which is currently listed as Vulnerable (VU) on the National Threatened or Protected Species was recorded on both of the proposed dam sites.*

*Several protected trees have distributions that include the two sites according to National Forests Act 1998 (Act No 84 of 1998). These tree species are Prunus africana, Rhizophora mucronata, Sideroxylon inerme subsp inerme, Mimusops caffra, Ocotea bullata, Pittosporum viridiflorum, Podocarpus falcatus, P. henkelii, P. latifolius, Colubrina nicholsonii, Curtis dentate, Barringtonia racemosa, and Bruguiera gymnorrhiza.*

*The National Protected Area Expansion Strategy is mandated to expand its formal protected area network. Using nationally developed guidelines, an acquisition target of 9% has been set for KwaZulu Natal's for purchase by 2028. The nearest proposed Stewardship site, Umgano Community Project, lies approximately 80 km north east of the two proposed dam sites.*

*An avifaunal study indicated that while the bushland thickets should provide natural habitats for bird species, no Red data bird species were observed in the two proposed sites. The riparian areas of the proposed sites provide suitable habitat for water-dependent bird species. Species recorded during field survey are common and widespread. The proposed dam will only have a negative impact during the construction phase whereafter the birds will return to the area.*

*Four reptile species were recorded in the two proposed sites, namely Green Mamba, Black mamba, Southern African Python, and Rock monitor.*

*Two Red Data invertebrate species, Strong black millipede (Doratogonus infragili) (Endangered) and Montane Black Millipede (Doratogonus montanus) (Least Concern), are known to occur on D3A site while Montane Black Millipede is known to occur on D2 site. Even though the preferred habitats of the two Red Data millipede species occur on the two proposed sites, no species were recorded or observed during the field assessment. The presence of these species, especially on D3A site, is threatened by overgrazing, large scale crop and subsistence agriculture, and alien invasive plants.*

*The dam basin of the proposed D2 on the Ncwabeni River is in a more natural state than that of the proposed D3A site on the Gugamela River, due to some human settlement in the Gugamela dam basin and therefore D3A will be the more preferred option. The human settlement in the area increases the invasion of alien plants as it was evident during the site visit.*

## 11.2 Aquatic and Riverine Assessment

The key issues and triggers identified during Scoping for the Aquatic and Riverine Assessment include:

- I&AP issues raised - water quality impacts during construction phase;
- Impacts associated with in-stream works during construction;
- Impacts associated with watercourse crossings;
- Downstream impacts to aquatic ecology due to reduction in water quality in basin (e.g. temperature and dissolved oxygen stratification);
- Downstream impacts on affected tributary's riparian habitat;
- Downstream impacts due to alteration of the flow regime;
- Prevention of up- and downstream movement of aquatic biota;
- Fragmentation of the tributary from the main stem;
- Loss of habitat for aquatic biota within the inundation zone;

- Loss of riparian habitat within inundated area;
- Proliferation of aquatic weeds; and
- Impacts to protected fauna and flora species (aquatic and riparian) and sensitive ecosystems.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Enviross Environmental Impact Studies CC |
| **Name:** | Mathew James Ross |
| **Qualifications:** | MSc – Aquatic Health (presently completing PhD) |
| **No. of years experience:** | 6 |
| **Affiliation (if applicable):** | • South African Society for Aquatic Scientists (SASAqS) |

A summary of the Aquatic and Riverine Assessment, as extracted from the specialist report (Enviross, 2012) contained in **Appendix E1**, follows.

*The aim of the survey was to assess the overall ecological integrity of the Ncwabeni, Gugamela and Mzimkhulu Rivers in order to evaluate the potential impacts of the various development activities on the systems. This would allow for the implementation of appropriate mitigation measures and allow for the delivery of biological information and requirements to the engineers and design teams to be incorporated into the overall planning and implementation of the various structural features.*

*The following methodologies were applied during the survey:*

- *General riparian and habitat assessments -*
  - *Walk-about surveys both upstream and downstream of the survey sites;*
- *Aquatic habitat assessments -*
  - *In situ water quality (pH, oxygen content, dissolved oxygen, electro-conductivity, total dissolved solids and temperature);*
  - *IHAS (Integrated Habitat Assessment System) for habitat particular to aquatic macro-invertebrates;*
  - *IHI (Index of Habitat Integrity) - a general impact assessment tool for each river reach;*
- *Aquatic macro-invertebrates -*

  - *SASS5 collection protocol;*
- *Ichthyofauna -*
  - *Electro-narcosis and cast netting at the various sites.*

*The catchment areas of all three watercourses within the vicinity of the survey sites were found to have retained a high degree of functionality and overall integrity. Some commercial agriculture does occur, but limited impacts were noted to emanate from this.*

*Rivers and streams within the area were noted to be dominated by bedrock, boulders and gravel substrates. A diversity of biotopes was present within all the watercourses, which provided good habitat cover and flow-depth classes for fish and aquatic macro-invertebrate inhabitation.*

*The results from the in situ water quality parameter testing indicated that there were no limiting factors in terms of water quality that could potentially limit the aquatic biota. It was noted that the water temperature recorded at the Gugamela River was considerably colder than that taken at the Ncwabeni and Mzimkhulu Rivers, which could feature as a limiting factor to recruitment of fish from downstream.*

*The macro-invertebrate community structures from the SASS5 sampling scored overall high values, showing the habitat integrity and water quality features to have been retained. All the survey sites scored Present Ecological State (PES) ratings, according to the macro-invertebrate populations structures, of A to B/C. A relatively good average score per taxon was noted, reiterating the high degree of overall functionality of the riverine habitat.*

*Fish species populations were noted to be better represented in the Ncwabeni River than in the Gugamela River. Possible reasons are that the relatively cooler water temperatures of the Gugamela River creates a temperature barrier, making fish reluctant to recruit upstream or the presence of a poorly-designed bridge crossing that poses a migratory barrier under low to moderate flows inhibits upstream migrations. It is recommended that this be rectified accordingly.*

**Figure 67: Some fish collected during the survey (Enviross, 2012)**

*The fish survey showed that the implementation of a fishway to mitigate the migratory barrier formation of the proposed weir is a necessity. The river at the survey area forms an important conduit for obligatory migratory species that would not be able to complete their life cycle within the system if migratory freedom was inhibited. A vertical slot fishway channel was proposed for the weir. Further recommendations include the terracing of the weir with sloping sides to allow for splash zones to allow for migrational movements of juvenile eels and migrating invertebrates. It is recommended that a monitoring programme be undertaken after the completion of the construction phase in order to evaluate the functionality of the fishway.*

*An impact evaluation was undertaken for the various construction features and alternatives associated with the proposed development activities. After an evaluation of the two alternative locality proposals for the off-channel storage dam and the overall impacts imposed on the aquatic systems and catchments, it was established that the Ncwabeni option is the preferred alternative. This is largely due to the establishment of the quarry areas that are associated with the Ncwabeni site. After the dam construction, this quarry area will be inundated. This will therefore have a lesser overall impact footprint than if the dam was constructed on the Gugamela River as the quarry activities would still be undertaken at the Ncwabeni River.*

## 11.3 Estuarine Study

The key issue and trigger identified during Scoping for the Estuarine Study included:

- Impacts to aquatic ecosystem and Mzimkhulu Estuary due to flow alterations and sediment loads.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Anchor Environmental Consultants CC |
| **Name:** | Dr Barry Clark |
| **Qualifications:** | • Ph.D. Marine Biology, 1997, University of Cape Town<br>• BSc (Hons) Marine Biology, 1991, University of Cape Town |
| **No. of years experience:** | 21 |
| **Affiliation (if applicable):** | • Professional Natural Scientist, registered with the South African Council for Natural Scientific Professions<br>• Professional member of the South African Institute of Ecologists and Environmental Scientists<br>• South African representative to the SURVAS Network<br>• Member of the International Association of Impact Assessors<br>• Member of the Subsistence Fisheries Task Group<br>• Member of the Subsistence Fisheries Advisory Group<br>• Member of the South African Network for Coastal and Oceanic Research (SANCOR) Economics Task Team |

This section provides a summary of the assessment of potential impacts of the Ncwabeni OCS Dam on the Mzimkhulu Estuary (Anchor Environmental, 2012), as contained in **Appendix E8**.

*The study provides a brief description of the affected environment (the Mzimkhulu Estuary) and its importance from a biodiversity conservation perspective, an assessment of the significance of all potential impacts on the estuary associated with all project alternatives (direct, indirect and cumulative) using suitable evaluation criteria, and recommends suitable mitigation measures as required. A statement of the significance of impacts associated with each issue is also provided, which specifies whether or not a pre-determined threshold of significance (i.e. changes in effects to the environment which would change a significance rating) has been exceeded, and whether or not the impact presents a potential fatal flaw or not, both before and after application of impact management actions.*

*The following observations are pertinent to the assessment of impacts for this study, and provide an assessment of the significance of the likely impacts of the proposed project on the Mzimkhulu estuary:*

- *The level of aforestation and abstraction of water from the Mzimkhulu catchment for agriculture and domestic and industrial use is likely to increase in the future under the "Do nothing" or status quo scenario and will lead to a gradual decline in the freshwater flows reaching the estuary over time, particularly in the low flow months (May-Oct each year), which are most critical for the estuary, leading to a decline in the health of the estuary.*
- *The implementation of the proposed OCS dams on the Ncwabeni River or the Gugamela River has the potential to mitigate the negative impacts of reduced freshwater flows during the low flow months by abstracting water from the mainstem of the system during the high flow months (November to April each year), pumping this water up to the dams and releasing it again during the low flow months. Mitigation will only be effective, however, if this scheme is able to ensure that flows reaching the estuary are not permitted to decline below present day levels.*
- *A potential positive impact on the estuary could be achieved by ensuring that releases from the dam during the low flow period are sufficient to restore flow levels at this time of the year back towards those experienced under natural conditions, and that any future increases in abstraction from the system are also maintained within reasonable limits.*
- *Projected yield for the two dams is very similar, at 23.0 $Mm^3$ p.a. for the Ncwabeni River dam and 22.9 $Mm^3$ p.a. for the Gugamela River dam. The likely difference between these two alternatives for the estuary is thus likely to be negligible.*
- *The projected pumping rate for the scheme is estimated at 0.5 $m^3/s$, and if maintained at this rate would reduce the average flow rate during the high flow months (Nov-Apr each year) by a nominal 1.3% which is also very unlikely to have significant impact on the ecology of the Mzimkhulu estuary.*
- *The two proposed dams on are both off-channel storage (OCS) dams and as such they, along with the abstraction / gauging weir on the Mzimkhulu River, do not have the potential to influence flood flows in the systems, and hence impacts from this source are likely to be negligible.*

Based on the outcome of this study, it was not deemed necessary to assess the impact of the project on the Mzimkhulu Estuary further.

## 11.4 Socio-Economic Study

The key issues and triggers identified during Scoping for the Socio-Economic Study include:

- Loss of land through inundation and project infrastructure; and
- Resettlement of dwellings.

The details of the nominated specialist follow.

| **Specialist** | |
|---|---|
| **Organisation:** | Nemai Consulting |
| **Name:** | Ciaran Chidley |
| **Qualifications:** | BA (Economics); BSc Eng (Civil); MBA |
| **No. of years experience:** | 10 |
| **Affiliation (if applicable):** | N/A |

This section provides a summary of the Socio-Economic Study (Nemai Consulting, 2012a), as contained in **Appendix E4**.

*The scope of analysis was limited to a one kilometre buffer around each of the proposed alternatives OCS dam sites (see **Figure 68**). Thus the direct effect of the dam on the surrounding community was analysed.*

*A desktop analysis and a site visit were undertaken. The site visit was conducted with the assistance of Ugu District Municipality and the iNduna of the Cele K Tribe. Amongst others, the aim of the visit was to identify the homesteads that would require relocation and those that required both relocation and resettlement of persons.*

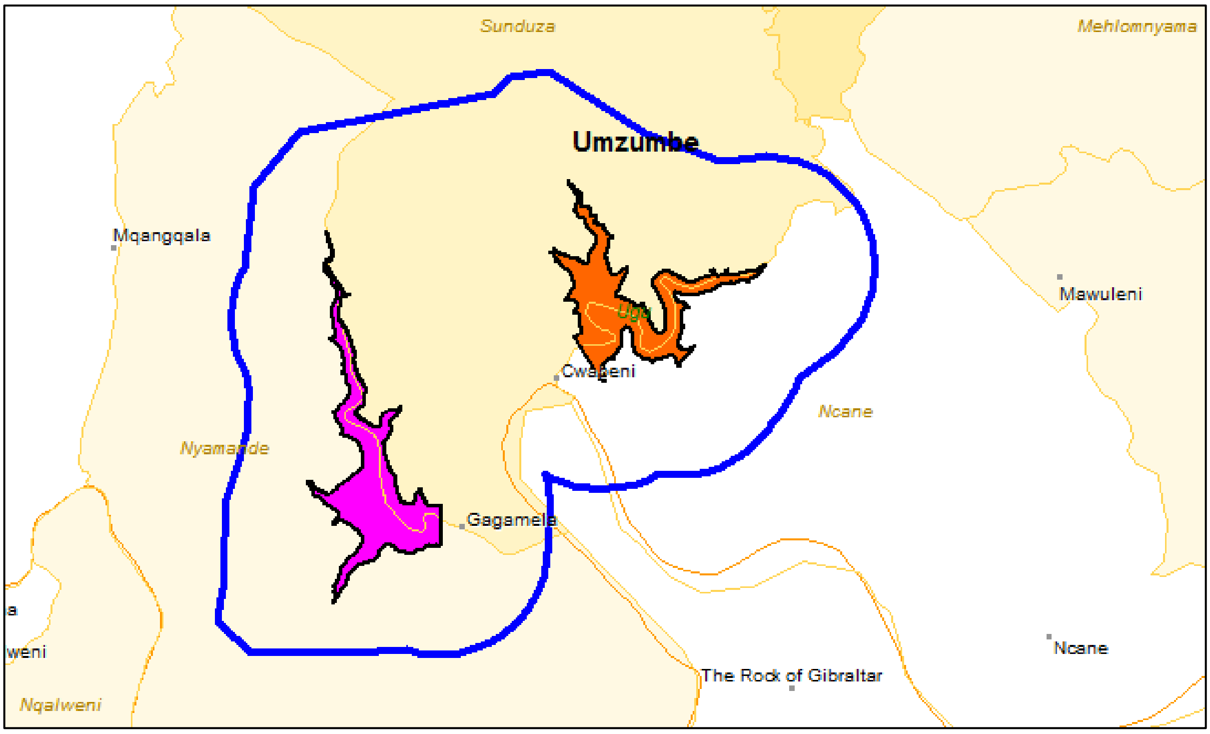



**Figure 68: Study area for Socio-Economic Study (Nemai Consulting, 2012a)**

*The status quo of the area was established, which provided an understanding of the demographics, economy and accessibility to social services in the area. The population within the one kilometre buffer region is 4 300, of which 42 percent are youth under 14 years of age. Education level and municipal services are low in the area well little access to the necessary facilities. There was no school or health facility identified within in the one kilometre buffer. Unemployment in the area is high which has contributed to the outward migration of males from the areas leaving an imbalance in the number of males and females in the areas.*

*The impacts of the dam were classified into two large categories, namely major impacts and other impacts. Major impacts identified were direct impacts that would affect the dam and surrounding community causing a positive, neutral or negative disturbance to the current economic and social structure. Other impacts of the dam were identified based on assumptions and potential impacts of the dam. Most of these potential impacts require Ugu District Municipality or Umzumbe Local Municipality to provide clear plans on whether or not water supply to the communities will be impacted as a result of the dam and how it would be impacted. These are important from both a social and economic* *impact on the community as well as the broader economy, but the analysis falls beyond the scope of the document hence they were discussed very briefly.*

*Finally a comparative summary was drawn on the two alternative sites. It was found that should the dam be constructed at site D2 (Ncwabeni River) there will be less economic and social disturbance than at site D3A (Gugamela River).*

## 11.5 Social Impact Assessment

The key issues and triggers identified during Scoping for the Social Impact Assessment include:

- Loss of land through inundation and project infrastructure;
- Resettlement of dwellings in basin;
- Risk to livestock; and
- Influx of people seeking employment and associated impacts (e.g. foreign workforce, cultural conflicts, squatting, demographic changes, anti-social behaviour, and incidence of HIV/AIDS).

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Dr. Neville Bews & Associates |
| **Name:** | Neville Bews |
| **Qualifications:** | • BA (Hons)<br>• Henley Post-Graduate certificate in Management (United Kingdom)<br>• MA (cum laude)<br>• D. Litt et Phil |
| **No. of years experience:** | Over 25 years in Human Resource Management and 10 in Social Impact Assessments |
| **Affiliation (if applicable):** | International Association of Impact Assessors South Africa IAIAsa |

This section provides a summary of the Social Impact Assessment (Dr Neville Bews & Associates, 2012), as contained in **Appendix E5**.

*Data for the Social Impact Assessment was gathered through:*

- *A comprehensive scan of the Draft Comments and Response Report;*
- *A review of maps and aerial photographs of the routes;*
- *Interviews and discussions with the Public Participation Consultant;*
- *Interviews and discussions with the Environmental Impact Assessment Consultants;*
- *A literature review of various documents such as the relevant municipal IDPs and other specialist reports and documents;*
- *Statistics South Africa, Census 2001; Community Survey 2007; Mid-year population estimates; Quarterly Labour Force Survey;*
- *Municipal Demarcation Board; and*
- *A broader literature scan.*

*Based on the demographic and project description and the comments of various I&APs the following impacts were identified and assessed (see* ***Section 12.9****):*

- *Access;*
- *Crime and security;*
- *Disturbance of cultural, spiritual and religious sites;*
- *Economic;*
- *Fire hazard;*
- *Health issues;*
- *Farming operations;*
- *Job creation;*
- *Nuisance factors during construction;*
- *Resettlement;*
- *Safety hazards for people and animals;*
- *Sense of place;*
- *Services and infrastructure;*
- *SMME opportunities;*
- *STDs, HIV and AIDS risk; and*
- *Social stability.*

*It was found that on a social basis, no obvious fatal flaw emerged in relation to either site. Site D2 emerges as the socially preferred site on the following basis:*

- *Access and infrastructure requirements are less affected in respect of site D2 as site D3A requires a significant length of road construction resulting in significant burden for maintenance being placed on the KZN Department of Transport.*
- *Although there are no areas in any of the alternative dam sits suitable for intensive grazing or cultivation, various subsistence farming activities do occur and have been identified in site D3A.*
- *At least 12 households have been identified in the dam basin of site D3A, these households will require resettlement and local communities have a very strong attachment to the land.*

*It is, however, possible that the social preference could be overridden on either technical and/or biodiversity grounds.*

*With regard to the do nothing option, if the project did not proceed it is likely that:*

- *Water security in the Mzimkhulu Regional Water Supply Scheme, which forms part of the KwaZulu Natal's Lower South Coast System would be severely compromised;*
- *An opportunity to enhance the economic development of the region would be lost; and*
- *The impacts as described above would not materialise.*

*In concluding, the global concerns regarding water security were identified as were the limiting factors that South Africa faces in managing the country's water resources. The need for South Africa to effectively harness and manage its water resources and more evenly distribute water amongst the population is critical to ensure optimal social and economic performance and human security.*

## 11.6 Heritage Impact Assessment

The key issues and triggers identified during Scoping for the Heritage Impact Assessment include:

- I&AP issue - engage with tribal authority on location of graves and cultural sites and identify suitable mitigation measures; and

- Potential occurrence of heritage resources, graves and structures older than 60 years within project footprint.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Name:** | • Jean Beater (lead consultant)<br>• Frans Prins |
| **Qualifications:** | • Jean Beater -<br>  ○ MA (Heritage Studies)<br>• Frans Prins -<br>  ○ MA in Archaeology |
| **No. of years experience:** | Jean Beater - 21 years experience in the Heritage field. |
| **Affiliation (if applicable):** | • Jean Beater -<br>  ○ International Association of Impact Assessors (IAIA)(SA Branch)<br>  ○ Member: Heritage Impact Assessment Adjudication Committee for the Gauteng Provincial Heritage Resources Authority<br>  ○ Affiliate member of the Association of Southern African Professional Archaeologists – member No. 349<br>  ○ Accredited heritage practitioner with Amafa aKwazulu Natali |

This section provides a summary of the Heritage Impact Assessment (Beater, 2012), as contained in **Appendix E3**.

*The approach to the Heritage Impact Assessment included the following:*

- *The project site was visited over a period of two days. The team was accompanied by Induna Cele and Induna Ngwase on 18 May 2012 and Mr. Alson Kwela on 19 May 2012. The two OCS dam sites were inspected as well as the footprint of associated dam infrastructure where this was possible;*
- *Various sources of literature and databases were investigated to obtain information regarding the archaeology and history of the study area as well as the surrounding area and KwaZulu-Natal;*
- *A desktop study was conducted of the archaeological databases housed in the KwaZulu-Natal Museum and the SAHRA inventory of heritage sites; and*
- *Aerial photographs of the area were surveyed as well as the relevant 1:50000 and 1:250000 maps of the area.*

*During the field investigation, various homesteads (occupied and abandoned) and associated graves were pointed out in both dam sites as listed in **Table 42** (shown in **Figure 69**).*

**Table 42: Affected homesteads and graves – Sites D2 and D3A (Beater, 2012)**

| No. | Description/Oral information provided | Coordinates (Approximate) | Impact of development | Mitigation |
|---|---|---|---|---|
| | | **SITE D2** | | |
| 1 | *Remains of homestead, less than 10 graves; oldest grave± 1971* | *30°36´19.43˚S 30°14´35.50˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 2 | *Three homesteads, possible graves* | *30°36´.345˚S 30°14´516˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 3 | *Homestead & graves of Mhlabashana Cele - father of Induna Cele; >2 graves* | *30°36´22.66˚S 30°14´27.98˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 4 | *Three graves below road; not confirmed as access not possible* | *30°36´24.70˚S 30°14´26.56˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 5 | *Cele family graves, no remains of homestead; more than 1 grave* | *30°36´36.24˚S 30°14´18.11˚E* | *Not inundated; however could be affected by roads* | *Leave in situ; if construction activity is to affect graves, graves to be cordoned off with a 20m buffer around them; allow access to graves by family members* |
| 6 | *Abandoned homestead & graves?* | *30°36´19.85˚S 30°14´22.46˚E* | *In close proximity to footprint of dam* | *Site to protected by 20m buffer during construction; allow access to graves if any by family* |
| | | **SITE D3A** | | |
| 1 | *Homestead & possible grave/s: Gitsho or Potsoli Ngwase* | *30°36´54.28˚S 30°13´2.56˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 2 | *Homestead & possible grave/s: Gitsho or Potsoli Ngwase* | *30°36´56.28˚S 30°13´0.74˚E* | *Close to footprint of dam* | *Site to protected by 20m buffer during construction; allow access to graves if any by family* |
| 3 | *Homestead & 3 graves: Ndukuzezwe Msomi* | *30°37´2.28˚S 30°13´8.19˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 4 | *Unidentified homestead & possible graves* | *30°37´6.51˚S 30°13´11.41˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 5 | *Unidentified homestead; according to Alson Khwela no graves* | *30°37´10.36˚S 30°13´11.02˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 6 | *Homestead & possible graves: Sokesimboni Msomi* | *30°37´7.96˚S 30°12´59.67˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 7 | *Homestead & possible graves: Mthethiswa Msomi* | *30°37´8.80˚S 30°12´56.31˚E* | *Close to footprint* | *Site to protected by 20m buffer; allow access to graves by family if any* |

| No. | Description/Oral information provided | Coordinates (Approximate) | Impact of development | Mitigation |
|---|---|---|---|---|
| 8 | *Unidentified homestead with possible graves* | *30°37´15.26˚S 30°12´52.17˚E* | *Close to footprint* | *Site to protected by 20m buffer during construction; allow access to graves by family if any* |
| 9 | *Homestead & possible graves: Khumalo / Msomi/Khwela (1)* | *30°37´16.63˚S 30°13´2.63˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of remains of homestead* |
| 10 | *Homestead & possible graves: Khumalo / Msomi/Khwela (2)* | *30°37´21.41˚S 30°13´7.60˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 11 | *Homestead & possible graves: Khumalo / Msomi/Khwela (3)* | *30°37´23.32˚S 30°13´16.93˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 12 | *Unidentified homestead/building & possible graves* | *30°37´14.60˚S 30°13´20.28˚E* | *Inundated* | *If any graves, to be exhumed & relocated with permission of family & Amafa; inundation of remains of structure* |
| 13 | *Unidentified homestead & possible graves* | *30°37´26.64˚S 30°13´21.06˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 14 | *Unidentified homestead, possibly occupied, possible graves* | *30°36´49.29˚S 30°13´17.67˚E* | *Inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 15 | *Unidentified homestead & possible graves* | *30°36´29.02˚S 30°13´1.42˚E* | *On boundary of dam; inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 16 | *Unidentified homestead & possible graves* | *30°36´23.54˚S 30°12´57.47˚E* | *On boundary of dam; inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 17 | *Unidentified homestead & possible graves* | *30°36´17.14˚S 30°13´1.02˚E* | *On boundary of dam; inundated* | *Exhume & relocate graves with permission of family & Amafa; inundation of homestead* |
| 18 | *Unidentified homestead & possible graves* | *30°36´40.94˚S 30°13´1.39˚E* | *Close to boundary of dam; could be inundated* | *Secure with 20m boundary; if inundated, any graves found to be relocated* |
| 19 | *Occupied homestead of Calu Ngwase; 1 grave; cultivated fields* | *30°36´48.34˚S 30°13´6.59˚E* | *Inundated* | *Family occupying homestead will have to be relocated as well as single grave* |

*Site D2 (Ncwabeni River site) is less impacted in terms of habitation and farming activities than site D3A (Gugamela River site). Of the homesteads in site D2, very little remains apart from a few low walls and some foundations and there are no occupied homesteads in the Ncwabeni River valley.*

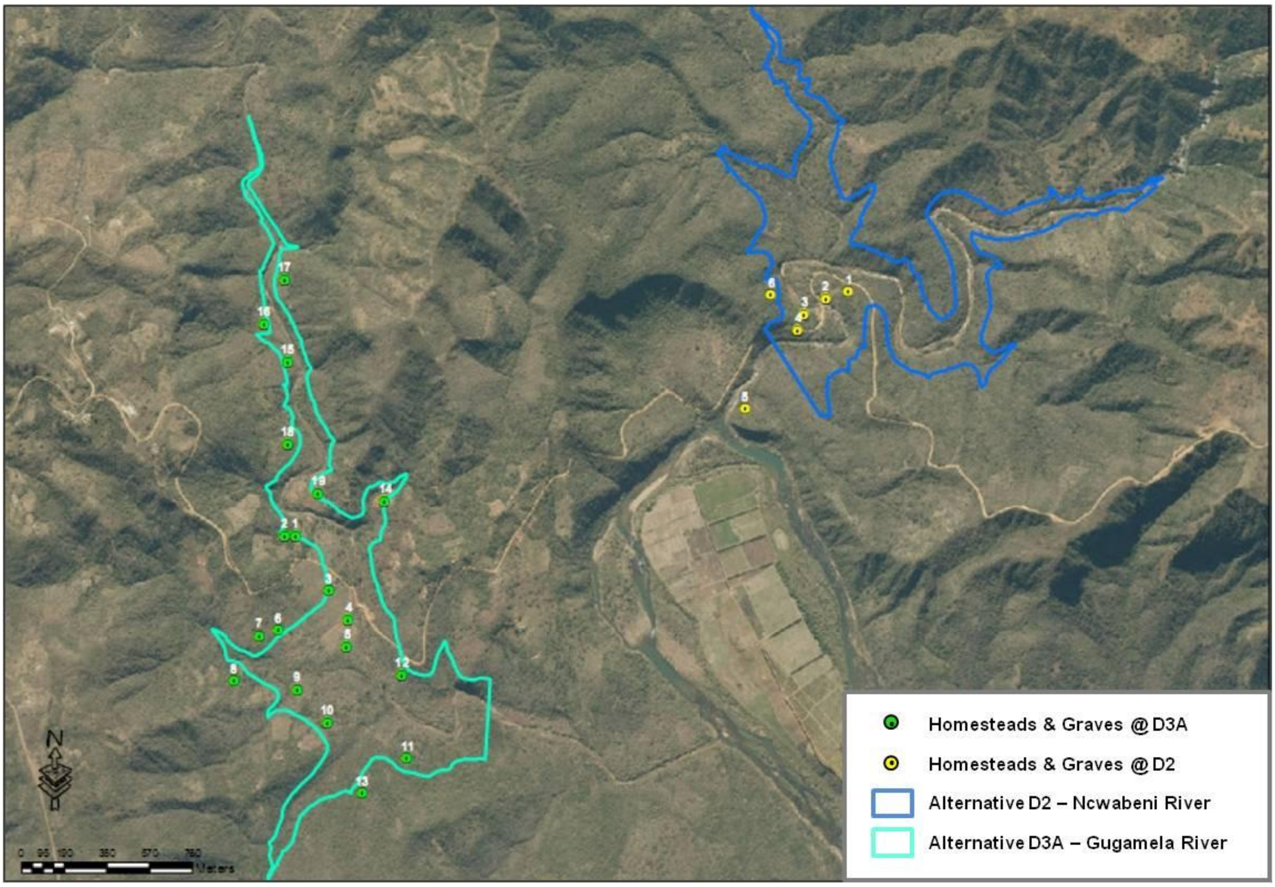



**Figure 69: Map indicating Homesteads and Graves in relation to Proposed Dam Sites (Beater, 2012)**

*There are numerous homesteads in the Gugamela River valley that are abandoned and in various stages of disrepair. There is at least one occupied homestead that will be affected by the development. Oral reports by the community members testified that there is a good possibility that graves could be found at many of these homesteads (both occupied and unoccupied).*

*No archaeological sites were discovered in the project area during the site visit. However, there is a high probability that Early Iron Age sites could occur on colluvial areas on the southern side of the Mzimkhulu River. The proposed abstraction weir for the project will tie in to the southern bank (i.e. right bank) of the Mzimkhulu River where such Early Iron Age sites may be found given the setting of the weirs on colluvial soil adjacent to a major east flowing river in an altitude below 1000m.*

*The cultural landscape is one of low density rural settlement with traditional homesteads ('umuzi') consisting of one or more buildings as well as cattle kraals that are dotted* *across the valley some occupied, others unoccupied. Traditional building techniques and styles still occur in the area. Subsistence farming and livestock herding take place.*

*The landscape within the Gugamela River valley of abandoned homesteads reflects the results of the fighting that took place in the area during the 1960s and 1980s. If the proposed dam is located in the Gugamela River with the resulting loss of this landscape, it is suggested that a data gathering and recording exercise of the area is undertaken in order that this history is recorded.*

*Mitigatory steps for the development of the dam include the exhumation and relocation of the affected graves and the protection of sites close to the footprint of the dams by a 20m buffer around the sites in which no construction can take place. Due regard should be taken of the cultural sensitivities regarding grave relocation.*

*Most of the homesteads, according to oral history, appear to be younger than 60 years as do the associated graves. The graves are protected by section 26 of the KwaZulu-Natal Heritage Act, subsections (4) (a) and (b) that refers to the protection of traditional burial places. Such graves are not be damaged, altered, exhumed, removed from their original positions, or otherwise disturbed except under the authority of a permit issued after consultation with Amafa aKwaZulu-Natali.*

*The majority of homesteads and possible associated graves that will be impacted by the proposed OCS dam development are found in site D3A (Gugamela River site). Only the remains of homesteads occur at site D2, together with their associated graves. The preferred site for the location of the OCS dam is thus at site D2 (Ncwabeni River dam site).*

*It is recommended that all sites situated close to the footprint of the proposed dams are protected by a 20m buffer in which no development may take place. Graves found near the footprint of the dam should be left in situ and access to the graves by family members should be allowed.*

## 11.7 Visual Impact Assessment

The key issues and triggers identified during Scoping for the Visual Impact Assessment include:

- Visual impacts to the aesthetics of the project area as a result of the proposed project activities and infrastructure;
- Visual impact to Camro Estates; and
- Visual impact as a result of the borrow areas outside of the basin for the Gugamela River option.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Axis Landscape Architecture |
| **Name:** | Gerhard Griesel |
| **Qualifications:** | Masters Degree In Landscape Architecture (University of Pretoria); ML(Prof) |
| **No. of years experience:** | 7 |
| **Affiliation (if applicable):** | Member of the South African Council of Landscape Architects (SACLAP) |

This section provides a synopsis of the Visual Impact Assessment (Axis Landscape Architecture, 2012), as contained in **Appendix E6**.

*The approach to the Visual Impact Assessment included the following:*

- *The extent of the study area was limited to a radius of 5 km;*
- *The site was visited to establish a photographic record of the site, views and areas of particular visual quality and or -value;*
- *The project components and activities were described and assessed as elements that may cause visual and landscape impacts;*
- *The receiving environment was described in terms of its prevailing landscape- and visual character;*
- *Landscape- and visual receptors that may be affected by the proposed project were identified and described;*
- *The sensitivity of the landscape- and visual receptors were assessed;*

- *The severity of the landscape- and visual impacts was determined;*
- *The significance of the visual and landscape impacts was assessed; and*
- *Mitigation measures were proposed to reduce or alleviate adverse impacts.*

*The area is dominated with steep sided river valleys that cut into the undulating landscape creating a very dramatic landscape character and resource.*

*The study area was divided into two landscape types that are relatively homogenous in character. Landscape types are distinguished by differences in topographical features, vegetation communities and patterns, land use and human settlement pattern. The two landscape types that occur in the study area are:*

- *Ncwabeni Rural Settlements; and*
- *Ncwabeni Bushland.*

*Both the landscape types have very similar topographical characteristics but are distinguished due to the difference in land use.*

*'Rural Settlements' is a descriptive name that includes all the surrounding rural settlements, homesteads and villages within a 5 km radius from the site (**Figure 70**). The rural settlements are classified under one landscape type due to the near identical character. The settlements areas are partially vegetated and consist mostly of informal clusters of homes and informal farming activities.*

*'Bushland' is the combination of all the undeveloped vegetation in the study area (**Figure 70**). The vegetation is a complex mosaic of forest, thicket and grassland.*

Rural Settlements

Bushland

| | | |
|---|---|---|
| LANDSCAPE TYPES | Compiled for: NEMAI CONSULTING<br>Reference:NCW2012- LANDS TYPES-A4.cdr | AXIS LANDSCAPE ARCHITECTURE |
| PROPOSED NCWABENI OFF-CHANNEL STORAGE DAM | Date: 2012-06-18 | |

**Figure 70: Landscape types (Axis Landscape Architecture, 2012)**

*Visual character is based on human perception and the observer's response to the relationships between and composition of the landscape, the land uses and identifiable elements in the landscape. The description of the visual character also includes an assessment of the scenic attractiveness regarding those landscape attributes that have aesthetic value and contribute significantly to the visual quality of the views; vistas and/or viewpoints of the study area.*

*Visual quality is a qualitative evaluation of the composition of landscape components and their influence on scenic attractiveness. Many factors contribute to the visual quality of the landscape and are grouped under the three main categories listed in **Table 43**.*

**Table 43: Criteria of Visual Quality (Axis Landscape Architecture, 2012)**

| *INDICATOR* | *CRITERIA* |
|---|---|
| *Vividness* | *The memorability of the visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.* |
| *Intactness* | *The integrity of visual order in the natural and man-built landscape, and the extent to which the landscape is free from visual encroachment.* |
| *Unity* | *The degree to which the visual resources of the landscape join together to form a coherent, harmonious visual pattern. Unity refers to the compositional harmony of inter-compatibility between landscape elements.* |

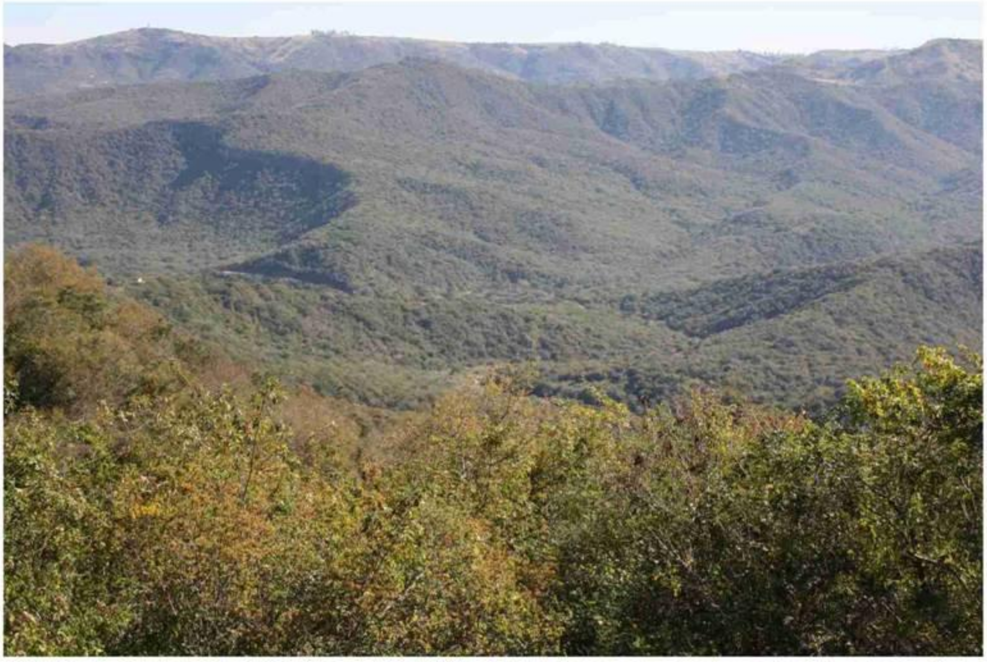
*The landscape is allocated a rating from an evaluation scale of 1 to 7 and divided by 3 to get an average. The evaluation scale is as follows: Very Low =1; Low =2; Moderately Low =3; Moderate =4; Moderately High =5; High =6; Very High =7*

*The study area is assessed against each indicator separately. All three indicators should be high to indicate high visual quality. The visual quality was individually assessed for the two landscape types, which includes the area within 5 km from the proposed site. The evaluation is summarised in **Table 44**.*

**Table 44: Visual Quality of the regional landscape (Axis Landscape Architecture, 2012)**

| *LANDSCAPE TYPE* | *VIVIDNESS* | *INTACTNESS* | *UNITY* | *VISUAL QUALITY* |
|---|---|---|---|---|
| *Rural Settlements* | *3* | *4* | *3* | *Moderately Low* |
| *Bushland* | *5* | *5* | *5* | *Moderately High* |

Simulations of the two OCS dams are shown in **Figures 71 – 72**.



Scheme D2: Current View

Scheme D2: Simulation View

| | | |
|---|---|---|
| **SIMULATION OF SCHEME D2**<br>PROPOSED NCWABENI OFF-CHANNEL STORAGE DAM | Compiled for:<br>NEMAI CONSULTING<br>Reference:NCW2012- LANDS TYPES-A4.cdr<br>Date:<br>2012-06-18 | AXIS LANDSCAPE ARCHITECTURE |

**Figure 71: Photo simulation – Site D2 (Axis Landscape Architecture, 2012)**

Scheme D3A: Current View

Scheme D3A: Simulation View

| | | |
|---|---|---|
| **SIMULATION OF SCHEME D3A** | Compiled for:<br>NEMAI CONSULTING<br><br>Reference:NCW2012- LANDS TYPES-A4.cdr | LANDSCAPE ARCHITECTURE |
| PROPOSED NCWABENI OFF-CHANNEL STORAGE DAM | Date:<br>2012-06-18 | |

**Figure 72: Photo simulation – Site D3A (Axis Landscape Architecture, 2012)**

*The visual envelope demarcates the extent of visual influence and includes the area within which views to the development are expected to be of concern. The visual envelope is established at 5 km. The visual influence on the proposed development further than 5km is considered insignificant and visual impacts outside this zone is negligible. A visibility analysis was performed for the study area of the proposed development. A Digital Elevation Model (DEM) with a resolution of 90m was utilized together with a GIS – see cumulative analysis for each dam site contained in* ***Figures 73 - 74****. As a result, all areas that are visible from the viewpoints are mapped and highlighted in a shaded colour. Conversely, the areas that are shaded are expected to have views of the proposed dam. The visibility analysis considers the worst-case scenario, using line-of-sight based on topography alone. This assists the process of identifying possible affected viewers and extent of the effected environment.*

*The anticipated impacts are discussed under* ***Section 12.11*** *in terms of the following:*

- ***Landscape impacts*** *-*
  - *Loss of bushland;*
  - *Alteration to existing tributaries;*
  - *Change in surface cover;*
- ***Visual impacts*** *-*
  - *Residents;*
  - *Recreational users/Tourists; and*
  - *Motorists.*

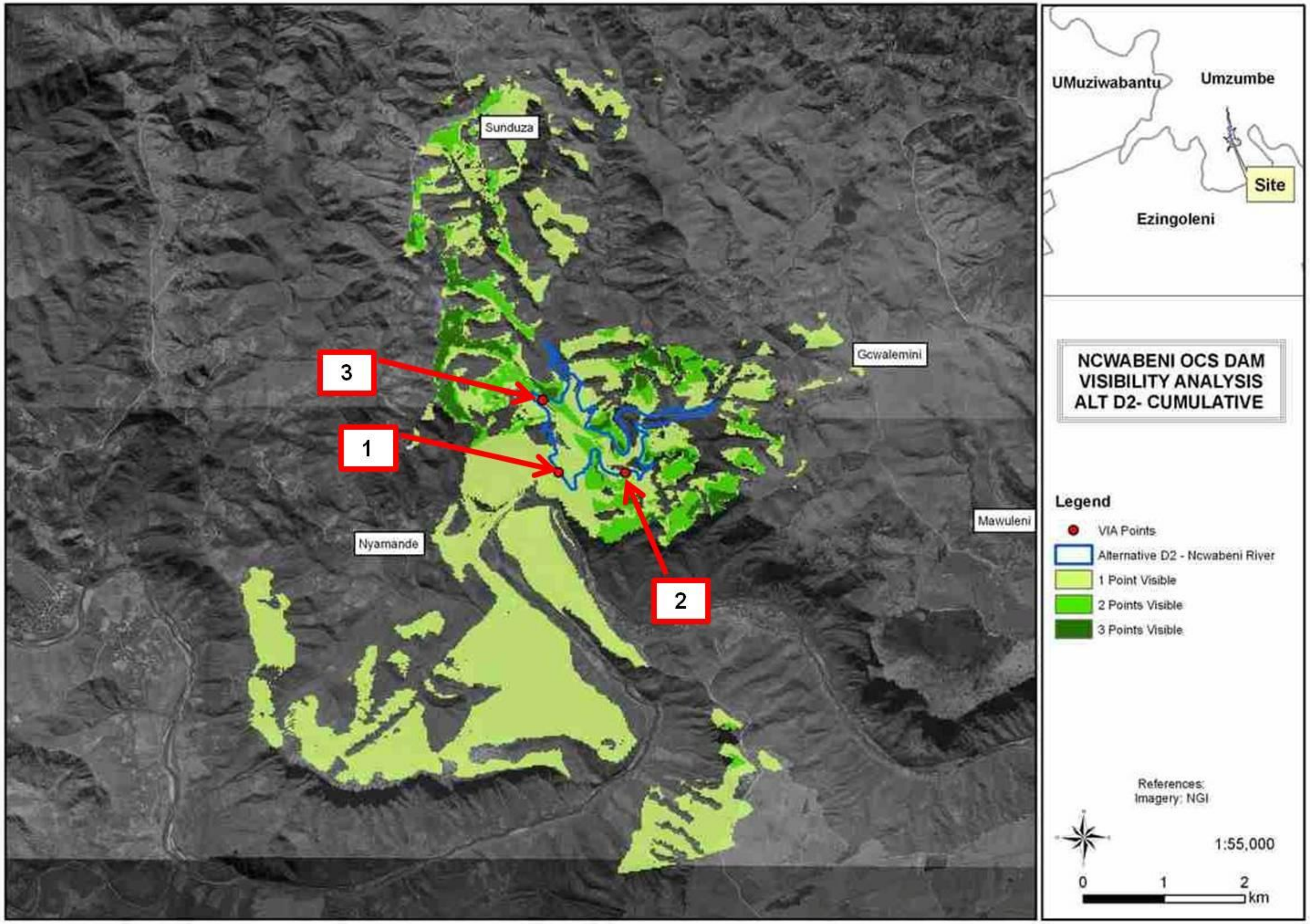



**Figure 73: Visibility Analysis of site D2 - Cumulative (Axis Landscape Architecture, 2012)**

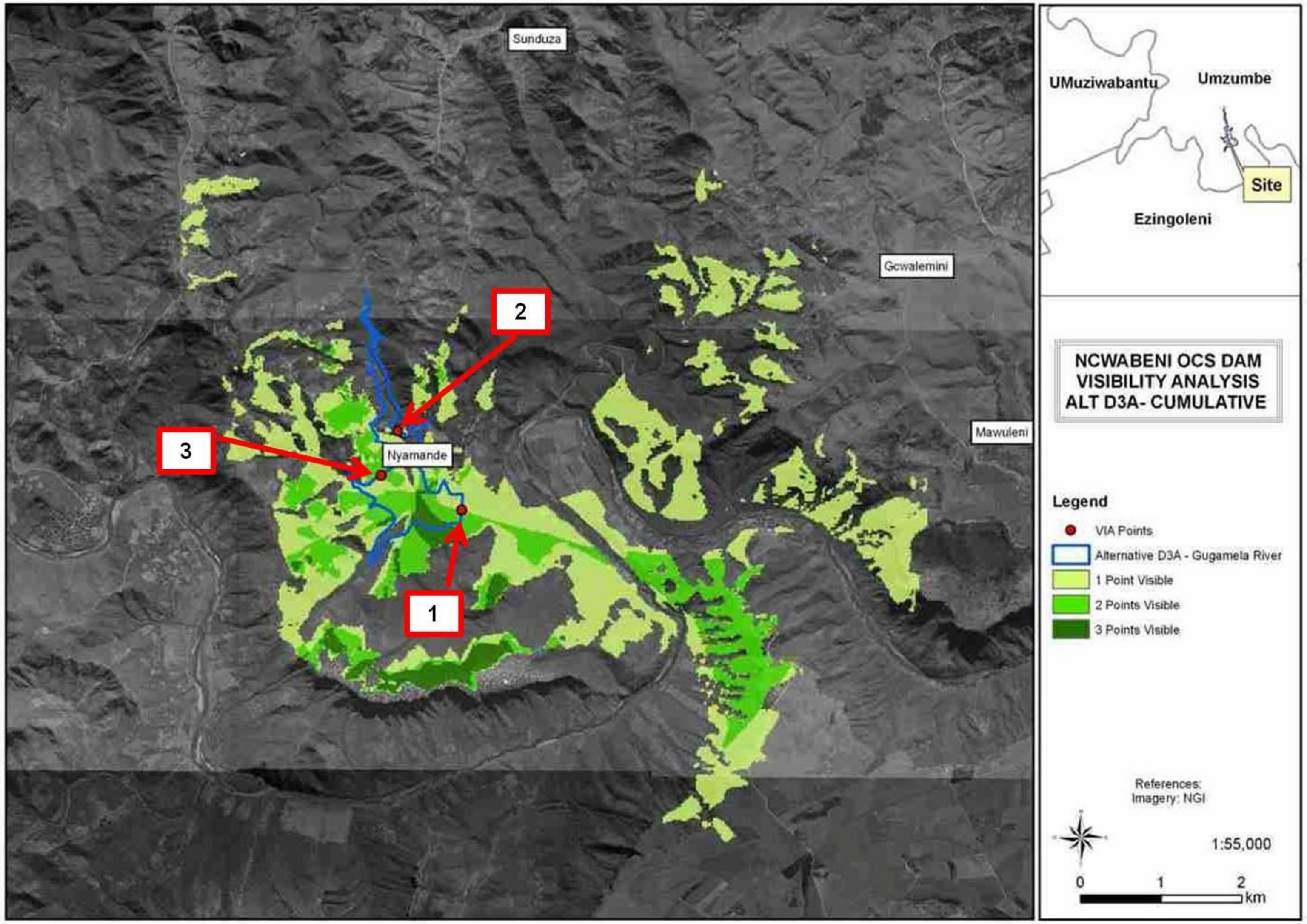



**Figure 74:** **Visibility Analysis of site D3A - Cumulative (Axis Landscape Architecture, 2012)**

## 11.8 Agricultural Study

The key issues and triggers identified during Scoping for the Agricultural Study include:

- Loss of fertile soil in inundation area; and
- Inundation of areas used for subsistence agriculture in D3A basin.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | Mzansi Agriculture |
| **Name:** | J.S. Phipson |
| **Qualifications:** | BA |
| **No. of years experience:** | More than 20 years experience in:<br>• Land Use and Land Capability Assessment;<br>• Veld and Indigenous Vegetation Assessment;<br>• Soil utilisation and Yield optimisation. Soil Conservation Measures;<br>• Crop Selection (subsistence and commercial crops);<br>• Strategic planning for agribusiness development initiatives; and<br>• Preservation and Utilisation of Natural Resources. |
| **Affiliation (if applicable):** | N/A |

A summary of the Agricultural and Agribusiness Status Quo Assessment (Mzansi Agriculture, 2012), as contained in **Appendix E7**, follows.

*The purpose of this study was to report on the status quo of agricultural development, vegetation and any other resources that might pertain to agricultural activity occurring within two sites selected as possible areas for the construction of an OCS dam. The study then determined to what extent agricultural or agribusiness considerations would impact on site selection.*

*Key findings include:*

***1. <u>Soils</u> -***

*The predominant soil parent material, a coarse-grained porphorytic granite has weathered down to the Shortlands Soil Form, resulting in this potentially high yielding soil being extensively encountered. Another potentially moderate to high yielding soil,* *the Oakleaf Soil Form, derived from well weathered alluvium is present in limited areas of the footslopes and valley bottoms. In the lower footslopes and valley bottoms it is clearly evident that where erosion has led to exposure of the oldest geological formations, Natal Group Sandstone, the result has been the agriculturally inhospitable Dresden Soil Form. This form is characterized by shallow sandy clay loams over hard plinthic rock. When quarried and crushed, this hard plinthite supplies excellent civil construction material.*

2. ***Land Capability Class -***
   *Apart from the few ha of footslope soils, the entire area falls into Land Class Capability Classes VII and VIII, suitable for livestock and game only, the most compelling determinant being excessively steep slopes.*
3. ***Topography -***
   *The terrain is rugged, broken, steep and inhospitable. On each of the sites there is one gently sloping area of a few ha each. With the exception of these two small sites, the topography precludes legitimate annual arable crops as the permissible limit is a maximum slope of 12 %. The overwhelming majority of slopes are in excess of 20 to 25 %.*
4. ***Climate*** *-*
   *The climate is hot, dry and hostile to agriculture. High summer temperatures preclude most crops. As is the case for most of the southern KZN coastal river valleys, successful production of most annual arable crops is limited to the cooler months.*
5. ***Irrigation water -***
   *Successful winter crop production would require irrigation. The small size of the two sufficiently level sites does not warrant the cost of installing irrigation systems.*
6. ***Livestock and Veld -***
   *The only livestock seen were a few goats and a few dozen donkeys. The goats, being browsers, were in good condition. The donkeys were in poor condition, probably attributable to the fact that under cover grasses have to compete against hardy acacia, broadleaf and euphorbicaean tree species for nutrients, soil moisture and sunlight. Grass cover is sparse.*

*There are no compelling agricultural or agribusiness reasons for giving one site preference over the other. Steep slopes in particular, and a hostile climate in general,* *mitigate against any arable crop activity. The irrigation of small portions of level land on both sites would not be economically viable.*

Based on the outcome of this study, it was not deemed necessary to assess the impact of the project on the agricultural potential in the project area further.

## 11.9 Invertebrate Survey

The key issues and triggers identified during Scoping for the Invertebrate Survey include:

- The KZN C-plan indicates that invertebrate species of conservation concern could potentially occur in the project area.

The details of the nominated specialist follow.

| Specialist | |
|---|---|
| **Organisation:** | |
| **Name:** | |
| **Qualifications:** | |
| **No. of years experience:** | • |
| **Affiliation (if applicable):** | |

A summary of the Invertebrate Survey (van der Merwe, 2012), as contained in **Appendix E9**, follows.

*Invertebrates were sampled using active and passive methods. Active methods entail collection by an individual using various kinds of equipment, while passive methods involve specialised types of traps at specific sites in the field, which are visited at given time intervals.*

*Two distinct vegetation units/invertebrate habitats are located on the Ncwabeni River and Gaugamela River sites, namely Eastern Valley Bushveld (Savanna Biome) and KwaZulu-Natal Coastal Belt (Indian Ocean Coastal Belt Biome). The conservation priority of each vegetation unit was determined by evaluating:*

- *The general condition of the vegetation unit -*

  - *How much natural vegetation remains;*
  - *The degree to which the it has been degraded by human activities or invasion by exotic species;*
- *The invertebrate species composition of the unit -*
  - *General species diversity;*
  - *Presence of species of conservation concern; and*
- *The conservation status of the vegetation type in KwaZulu-Natal.*

*A list of all identifiable insects and arachnids caught or seen on the site, as well as lists of invertebrate species of conservation concern that are known to occur in the vicinity of the two dam sites, were compiled.*

*A total of 43 insects, representing 14 families in 9 orders, were recorded during the survey period. Four arachnids were collected or observed, and diplopod presence was only confirmed by the presence of exoskeleton remains. Representation and numbers of the various arthropod classes caught might not compare favourably to other similar surveys completed in the same vegetation type. The vast majority of arthropods collected were insects. Hymenoptera was the most diverse (3 families) and abundant (14 specimens) order of insects, followed by the Coleoptera.*

*Neither Doratogonus infrangii nor Doratogonus montanus were observed during site visits. The survey was however carried out during a time of the year when millipede activity is greatly reduced. Although signs of millipede activity and some millipede remains were observed the presence or absence of these species in the two study areas was not established.*

*Much of the riverine area on the Gugamela River site is completely dominated by alien invasive species. Some more natural subtropical coastal forest was however present higher up on the slopes of the hilly areas. A concerted effort should be made to subject these isolated pockets of forest to as little disturbance as possible whilst construction is taking place.*

# 12 IMPACT ASSESSMENT

## 12.1 Overview

This section focuses on the pertinent environmental impacts that could potentially be caused by the proposed Ncwabeni OCS Dam during the pre-construction, construction and operation phases of the project. Note that an 'impact' refers to the change to the environment resulting from an environmental aspect (or activity), whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.

The impacts to the environmental features are linked to the project activities, which in broad terms relate to the physical infrastructure, inundation and the operation of the dam. Impacts were identified as follows:

- An appraisal of the project description and the receiving environment;
- Impacts associated with listed activities contained in GN No. R. 544, R. 545 and R. 546, for which authorisation has been applied for;
- Issues highlighted by environmental authorities;
- Findings from specialist studies; and
- Comments received during public participation.

### *12.1.1 Impacts associated with Listed Activities*

As mentioned, the project requires authorisation for certain activities listed in the EIA Regulations (2010), which serve as triggers for the environmental assessment process. The potential impacts associated with the key listed activities are broadly stated in **Table 45**.

**Table 45: Impacts associated with the key listed activities**

| GN No. R. 544 of 18 June 2010 | |
|---|---|
| **Listed Activities** | **Potential Impact Overview** |
| 9 The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water -<br>(i) with an internal diameter of 0,36 metres or more; or<br>(ii) with a peak throughput of 120 litres per second or more, excluding where:<br>a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or | • Impacts associated with the footprint of the physical infrastructure - conveyance system.<br>• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with installing the pipeline alongside the watercourse.<br>• Erosion on steep slopes. |

| GN No. R. 544 of 18 June 2010 | |
|---|---|
| **Listed Activities** | **Potential Impact Overview** |
| b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse. | • Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Visual impact. |
| 11 The construction of:<br>(xii) canals;<br>(xiii) channels;<br>(xiv) bridges;<br>(xv) dams;<br>(xvi) weirs;<br>(xvii) bulk storm water outlet structures;<br>(xviii) marinas;<br>(xix) jetties exceeding 50 square metres in size;<br>(xx) slipways exceeding 50 square metres in size;<br>(xxi) buildings exceeding 50 square metres in size; or<br>(xxii) infrastructure or structures covering 50 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. | • Impacts associated with the footprint of the physical infrastructure - off-channel storage dam, diversion weir, abstraction works, approach channel, stilling basin and pump station within 32 m of the watercourse.<br>• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourse.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Visual impact. |
| 12 The construction of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 19 of Notice 545 of 2010. | • Impacts associated with the footprint of the physical infrastructure – dam wall, spillway.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Socio-economic impacts associated with inundation of dam basin (e.g. relocation, movement patterns). |
| 13 The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres. | • Pollution of bio-physical environment through poor practices associated with onsite storage of dangerous goods. |
| 18 The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from a watercourse. | • Construction activities (including bulk earthworks) to be undertaken within a watercourse to construct off-channel storage dam and relevant components of abstraction works (e.g. diversion weir).<br>• Impacts associated with the earthworks within the watercourse to build the off-channel storage dam, diversion weir, abstraction works, approach channel, stilling basin and pump station.<br>• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourse. |
| 20 Any activity requiring a mining permit in terms of section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) or renewal thereof. | • Impacts associated with creating the borrow areas and hauling the material.<br>• Note – borrow areas are situated within the basin of the D2 site option, which will be inundated should this option be approved. |
| 22 The construction of a road, outside urban areas,<br>(i) with a reserve wider than 13,5 meters or,<br>(ii) where no reserve exists where the road is wider than 8 metres, or<br>(iii) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Notice 545 of 2010. | • Impacts associated with re-aligning the D859 and building the access road to the weir and abstraction works, and crossing of drainage lines.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species). |
| 23 The transformation of undeveloped, vacant or derelict land to –<br>(i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or<br>(ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares; -<br>except where such transformation takes place for linear activities. | • Impacts associated with the overall physical footprint of the project.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Socio-economic impacts associated with inundation of dam basin (e.g. relocation, movement patterns). |
| 24 The transformation of land bigger than 1000 square metres in size, to | |

| GN No. R. 544 of 18 June 2010 | | |
|---|---|---|
| | **Listed Activities** | **Potential Impact Overview** |
| | residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this Schedule such land was zoned open space, conservation or had an equivalent zoning. | |
| 26 | Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). | • Inundation of sensitive, threatened or protected ecosystems. |
| 47 | The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre -<br>(i) where the existing reserve is wider than 13,5 meters; or<br>(ii) where no reserve exists, where the existing road is wider than 8 metres – excluding widening or lengthening occurring inside urban areas. | • Widening or lengthening of D859 to allow for suitable access for construction and operational purposes. |

| GN No. R. 545 of 18 June 2010 | | |
|---|---|---|
| | **Listed Activities** | **Potential Impact Overview** |
| 3 | The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres. | • Pollution of bio-physical environment through poor practices associated with onsite storage of dangerous goods. |
| 10 | The construction of facilities or infrastructure for the transfer of 50 000 cubic metres or more water per day, from and to or between any combination of the following:<br>(i) water catchments,<br>(ii) water treatment works; or<br>(iii) impoundments,<br>excluding treatment works where water is to be treated for drinking purposes. | • Impacts associated with the overall physical footprint of the project and pumping water from the Mzimkhulu River to the OCS Dam. |
| 15 | Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more;<br>except where such physical alteration takes place for:<br>(i) linear development activities; or<br>(ii) agriculture or afforestation where activity 16 in this Schedule will apply. | • Impacts associated with the overall physical footprint of the project.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Socio-economic impacts associated with inundation of dam basin (e.g. relocation, movement patterns). |
| 18 | The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built for which routes have been determined before 03 July 2006 and which have not been authorised by a competent authority in terms of the Environmental Impact Assessment Regulations, 2006 or 2009, made under section 24(5) of the Act and published in Government Notice R385 of 2006 [if] –<br>(i) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act 7 of 1998);<br>(ii) it is a road administered by a provincial authority;<br>(iii) the road reserve is wider than 30 metres; or<br>(iv) the road will cater for more than one lane of traffic in both directions. | • Impacts associated with building the access road to the weir and abstraction works, re-alignment of D859 (administered by the KZN Department of Transport), and crossing of drainage lines. |
| 19 | The construction of a dam, where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of 10 hectares or more. | • Impacts associated with the footprint of the physical infrastructure – dam wall, spillway.<br>• Potential loss of sensitive environmental features (e.g. heritage resources, sensitive fauna and flora species).<br>• Socio-economic impacts associated with inundation of dam basin (e.g. relocation, movement patterns).<br>• Relocation of D859. |
| 20 | Any activity which requires a mining right or renewal thereof as contemplated in sections 22 and 24 respectively of the Mineral and Petroleum /resources Development Act, 2002 (Act 28 of 2002). | • Impacts associated with creating the borrow areas and hauling the material.<br>• Note – borrow areas are situated within the basin of the D2 site option, which will be inundated should this option be approved. |
| 21 | Any activity which requires an exploration right or renewal thereof as contemplated in sections 79 and 81 respectively of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002). | |
| 23 | Any activity which requires a reconnaissance permit as contemplated in section 74 of the Mineral Petroleum Resources Development Act, 2002 (Act 28 of 2002), excluding where such reconnaissance is conducted by means of a flyover. | |

| GN No. R. 546 of 18 June 2010 | | |
|---|---|---|
| | **Listed Activities** | **Potential Impact Overview** |
| 4 | The construction of a road wider than 4 metres with a reserve less than 13,5 metres. | • Impacts associated with building access roads and re-aligning the D859 to sensitive, threatened or protected ecosystems. |
| 10 | The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres. | • Pollution of sensitive, threatened or protected ecosystems through poor practices associated with onsite storage of dangerous goods. |
| 12 | The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. | • The clearance or inundation of large tracts of indigenous vegetation. |
| 13 | The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:<br>(1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list.<br>(2) the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No 544 of 2010. | |
| 14 | The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for:<br>(1) purposes of agriculture or afforestation inside areas identified in spatial instruments adopted by the competent authority for agriculture or afforestation purposes;<br>(2) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the activity is regarded to be excluded from this list;<br>(3) the undertaking of a linear activity falling below the thresholds in Notice 544 of 2010. | |
| 16 | The construction of:<br>(i) jetties exceeding 10 square metres in size;<br>(ii) slipways exceeding 10 square metres in size;<br>(iii) buildings with a footprint exceeding 10 square metres in size; or<br>(iv) infrastructure covering 10 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. | • Impacts associated with the footprint of the physical infrastructure (off-channel storage dam, diversion weir, abstraction works, approach channel, stilling basin and pump station), situated within 32 m of the watercourse, to sensitive, threatened or protected ecosystems.<br>• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourse. |
| 19 | The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. | • Impacts of re-aligning the D859 to sensitive, threatened or protected ecosystems. |
| 24 | The expansion of<br>(a) jetties where the jetty will be expanded by 10 square metres in size or more;<br>(b) slipways where the slipway will be expanded by 10 square metres or more;<br>(c) buildings where the buildings will be expanded by 10 square metres or more in size; or<br>(d) infrastructure where the infrastructure will be expanded by 10 square metres or more<br>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. | • Impacts associated with the footprint of the physical infrastructure (off-channel storage dam, diversion weir, abstraction works, approach channel, stilling basin and pump station), situated within 32 m of the watercourse, to sensitive, threatened or protected ecosystems.<br>• Effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) associated with working in-stream and alongside the watercourse. |

### 12.1.2 *Issues raised by Environmental Authorities*

The issues highlighted by authorities (both regulatory and commentary) during meetings and contained in correspondence received (refer to **Appendix G**) are captured in the table to follow.

## Table 46: Issues raised by Regulatory and Commentary Authorities

| Authority | Issues Raised | Response / Proposed Resolution |
|---|---|---|
| **DEA Pre-Application Consultation Meeting - 22 August 2011** | | |
| **DEA** | Need to engage with occupiers and land users, and not just with landowners. | Ground-truthing conducted of affected dwellings in two dam basins, with assistance from the Ugu District Municipality and iNduna Ngwazi from the Cele K Tribe. Interviews were also held with the occupants of the affected dwellings (only relevant to D3A option) to share more information regarding the project and to record their concerns (see **Section 10.10.3**). |
| | Amafa would need to be notified if any heritage resources are to be affected. | A Phase 1 Heritage Impact Assessment was conducted, in accordance with the KZN Heritage Act (Act No. 04 of 2008), by an Amafa accredited specialist for the entire project footprint.<br><br>A Needs and Desirability Application Form was completed and submitted to Amafa. |
| **Environmental Authorities Meeting - 15 September 2011** | | |
| **DEA** | Is the dam size sufficient to cater for demands in order to prevent future increase to the dam's capacity? | The sizing requirements, which are based on demand scenarios, were considered in Feasibility Study. |
| | Dam's life expectancy with specific reference to siltation. | The dam will be designed for 30 – 50 years. Pumping regime will be determined by silt levels in river. No pumping will take place during major floods when siltation risks are high. It is thus beneficial to have an off-channel storage dam in this regard. Silt management is addressed in Feasibility Study. |
| | The specialist studies should not just focus on the preferred option, but should also investigate the alternatives. | Specialists assessed all alternatives and recommended a preferred option that was integrated into the comparative analysis. |
| | Need to consider energy conservation measures, such as a hydro-electric scheme. | An alternative option of utilising hydropower that is already being generated at the Camro Estates farm for pumping purposes has been identified and the feasibility of this option will be evaluated further. Pumping could be energy neutral if hydropower is utilised. However, it must be noted that pumping will only be required during high flows, over relatively short periods. |
| **Amafa / Heritage KZN** | • All heritage and cultural resources need to be considered;<br>• An Amafa Needs and Desirability Application Form will need to be completed;<br>• An Amafa Accredited CRM Specialist will need to be used to conduct the Heritage Impact Assessment;<br>• The Heritage Impact Assessment will need to consider the borrow areas; and<br>• The KZN Heritage Act (Act No. 04 of 2008) needs to be complied with and added to the legal framework. | A Phase 1 Heritage Impact Assessment was conducted, in accordance with the KZN Heritage Act (Act No. 04 of 2008), by an Amafa accredited specialist for the entire project footprint.<br><br>A Needs and Desirability Application Form was completed and submitted to Amafa. |
| **Ezemvelo KZN Wildlife** | • Both sites for the OCS Dam fall within a proposed stewardship site in terms of the National Protected Area Expansion Strategy.<br>• Endangered plants could occur in | Data for EIA and specialist studies received via Information Management at Ezemvelo KZN Wildlife.<br><br>Sensitive nature of receiving environment and the implications of the project considered in the Terrestrial Fauna and Flora |

| Authority | Issues Raised | Response / Proposed Resolution |
|---|---|---|
| | the study area.<br>• The study area is earmarked for conservation in terms of freshwater resources.<br>• The study area is significant in terms of the River Disturbance Index.<br>• The study area falls within a Critical Biodiversity Area, however no biodiversity sector plan has been developed as yet.<br>• The site forms parts of Environmental Atlas Site.<br>• Suggested that the Ezemvelo Handbook should be used to guide the terms of reference for specialist studies. | Study and Aquatic and Riverine Assessment (amongst others).<br><br>According to DWA (2011b), dam sites on tributaries were found to have much less of an impact on the ecosystem than for those sites on the main stem of the Mzimkhulu River. It is acknowledged that the undammed nature of the Mzimkhulu River has been recognised by the National Freshwater Ecosystem Priority Areas programme and the river is ranked as one of the most important for conservation in the region. Avoiding dams on the main stem would support the aforementioned conservation initiative. |
| **Correspondence (06 February 2012)** | | |
| **KZN Department of Transport** | • Maintenance of the Provincial roads during the construction phase.<br>• Site D2 (Ncwabeni river) has the least impact on the Provincial road network. Site D3A (Gugamela river) requires a significant length of road construction and will result in an increased maintenance burden on the Department.<br>• Any work carried out on the Provincial road network will require written approval. | The selection of a preferred option for the dam site is undertaken through a comparative analysis of the alternatives, through technical and environmental considerations. Associated impacts on the D859 were assessed and mitigated and provided.<br><br>Relevant approval from the KZN Department of Transport to be obtained. |
| **Correspondence (09 March 2012)** | | |
| **KZN DAEA, Ugu District** | Recommended that a Noise Impact Assessment be conducted. | During construction, localised increases in noise will be caused by blasting, activities at the borrow area, operations at the batching plant and crusher area, vehicles on haul roads and access roads, and general construction activities on site. The pump station will be a source of noise during the operational phase of the project. However, the noise impacts need to be considered in terms of the remote nature of the dam sites, and the absence of sensitive receptors is proximity to these sites. Noise-related impacts associated with the project are addressed through targeted mitigation measures and best practices in the EMPrs. A Noise Impact Assessment was thus not deemed necessary. |
| | Proof that the community that lives within 100 m of the activity has been notified. | During the Scoping phase, the affected community was consulted via the formal communication channels that exist with the Cele K Tribal Authority. This included formal landowner notification (proof contained in the Scoping Report), two meetings held with the Tribal Authority and a meeting held with Camro Estates (minutes included in the Scoping Report).<br><br>During the EIA phase, the occupants of the homesteads within the D3A dam basin were directly engaged with to share more information regarding the project and to record their concerns (see **Section 10.10.3**).<br><br>Another meeting will also be held with the Cele K Tribal Authority to present the findings of the EIA phase. |

| Authority | Issues Raised | Response / Proposed Resolution |
| --- | --- | --- |
| | Correspondence from the relevant service provider (Eskom) that confirms available capacity to cater for the proposed development. | Discussions have been held between the technical team and Eskom. A separate EIA will be conducted to seek approval for the new high voltage power line. |
| **Correspondence (13 April 2012)** | | |
| **DAFF** | The proposed dam construction will have many implications on the ecosystem, making it less supportive of the wildlife and extinction of some tree species. | These comments were based on the review of the Scoping Report. The impacts of the project to flora were assessed as part of the Terrestrial Ecological Assessment, which formed part of the EIA phase.<br><br>The environmental and technical considerations associated with the various alternatives were assessed during the EIA phase through a comparative analysis to eventually distil the Best Practicable Environmental Option.<br><br>The comparative analysis showed that site D2 on the Ncwabeni River is preferred over site D3A on the Gugamela River by the majority of the specialists and taking into consideration the impacts to sensitive environmental features. Where site D3A was more favourable, the residual impacts associated with site D2 following the recruitment of mitigation were not regarded as sufficiently significant or overriding to sway the ultimate selection towards site D3A.<br><br>One of the key factors that further promoted the selection of site D2 as the preferred option related to the possible absence of suitable material for the building of the CFR Dam at site D3A that would have necessitated the establishment of quarries at site D2. |
| | Though there is a wide existing gravel road and the footpath towards the eastern part of D2, the activity necessitates building of other roads to accommodate various machineries to utilise during the process. These will directly reduce the forest cover and lead to fragmentation of the landscape. | |
| | The first site (D2) is a sensitive area hence the species richness and no vegetation specialist report have on the scoping report. It is thus crucial to consider the type of vegetation occurring there and estimate the extent to which the damage is expected. However, the site is a no go area based on the information outlined above. | |
| | The vegetation described on the report (pg. 84), including pictures attached is based on the findings from Gugamela River (D3 and D3A) where the ecosystem has changed due to anthropogenic activities as it is a post settlement site, as opposed to Ncwabeni River. | |
| | Additionally, the information reference (D2 and D2A) is for 1996 and might be biased hence the area is showing dense mosaic. | |
| | The latter proposed site (D3 & D3A) is disturbed and thus constitutes less vegetation in terms of trees/forest cover. Therefore, it is recommended for the construction of the dam. However, consultation should be made with affected parties. | |

### *12.1.3 Impacts Identified by I&APs*

The main issues raised by I&APs to date during the execution of the EIA, as contained in the Comments and Response Report (**Appendix H**), are listed in the table to follow.

**Table 47: Issues raised to date by I&APs**

| Issue Category | Response / Proposed Resolution |
|---|---|
| **Construction Phase** | |
| Relocation of graves | Management of related impacts attended to trough best practices and mitigation measures contained in the EMPrs. |
| Job opportunities associated with the project | |
| Use of local goods and services | |
| Water quality impacts during construction phase | |
| Re-alignment of road | |
| Visual impact as a result of the borrow areas outside of the basin | |
| **Operational Phase** | |
| Water supply from dam to local community | Ugu District Municipality, as the WSA, to make provision for supplying water from the OCS dam directly to the local community. |
| Flooding of land on Camro Estates behind weir | To be determined as part of backwater calculations. |
| Payment by irrigators for water released from dam | Existing allocations considered during the planning of the OCS dam. Additional water would need to be purchased. |
| Confirmation that the high flows in the river will be frequent enough to supply the OCS dam | The substantial Mean Annual Runoff from the Mzimkhulu River allows for sufficient time to pump. The OCS dam will also be filled by contributions from its own incremental catchment. |
| If water is pumped out of the Mzimkhulu River the estuary's level could be jeopardised | The yield analysis considered the EWR. The proposed OCS dam will assist the levels in the estuary during times of low flow. Refer to findings of specialist study in **Section 11.3** |
| Need to consider energy conservation measures, such as a hydro-electric scheme | Existing hydro-electric scheme at Camro Estates is being investigated further as a possible source of power during the operational phase. |
| According to the Council of Geoscience, a fault line runs in the study area | Evaluated as part of the geotechnical study. |

### *12.1.4 Project Activities and Environmental Aspects*

The main project components include the following:

1. OCS dam on either the Ncwabeni River (site D2) or Gugamela River (site D3A);
2. Abstraction / gauging weir on the Mzimkhulu River;
3. Abstraction works with a mechanism to remove silt;
4. Pump station and pipeline to deliver water to the dam; and
5. Outlet infrastructure to make measured releases back to the Mzimkhulu River.

In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project life-cycle, as shown below (as listed in **Section 6.5**):

**Table 48: Activities associated with the Ncwabeni OCS Dam Project Life-Cycle**

| Pre-construction |
|---|
| **Project Activities** |
| • *Detailed engineering design* |
| • *Negotiations and agreements with the landowners (Cele K Tribal Authority, Camro Estates)* |
| • *Land acquisition* |
| • *Detailed geotechnical investigations* |
| • *Geophysical investigations* |
| • *Fencing off of construction domain* |
| • *Survey and map topography for post-construction landscape, rehabilitation and shaping* |
| • *Procurement process for Contractors* |
| • *Selective improvements of access road D859, to facilitate delivery of construction plant and materials* |
| • *Arrangements for accommodation of construction workers* |
| • *The building of a site office and ablution facilities* |
| • *Barricading of sensitive environmental features (e.g. graves)* |
| • *Development of resettlement plans* |
| • *Relocation of affected inhabitants of basin* |
| • *The harvesting of timber that will be inundated* |
| • *Search, rescue and relocation of red data, protected and endangered species, medicinal plants, heritage resources and graves* |
| • *Obtain permits if protected trees are to be cut, disturbed, damaged, destroyed or removed* |
| • *Obtain permits and relocate heritage resources and graves* |

| Construction |
|---|
| **Project Activities** |
| • *Site establishment* |
| • *Grading and building of new access road* |
| • *Clearing of new D859 alignment* |
| • *Temporary accommodation of traffic* |
| • *Site clearing at tie-in point of riverbanks for abstraction weir, at abstraction works and pump station* |
| • *Clearing along pipeline route* |
| • *Relocation of infrastructure* |
| • *Temporary and permanent access roads and haul routes* |
| • *Temporary river crossing(s)* |
| • *Install culvert at drainage line crossings* |
| • *Delivery of construction material* |
| • *Transportation of equipment, materials and personnel* |
| • *Storage and handling of material* |
| • *Bulk fuel storage* |
| • *Site and basin clearing* |
| • *Excavation and trenching* |
| • *Blasting* |
| • *River diversion for building of dam wall* |

| |
|---|
| • *River diversion for sourcing rock from quarries* |
| • *River diversion for abstraction weir* |
| • *Establishment of and operations at crusher* |
| • *Establishment of and operations at batching plant* |
| • *Establishment of and operations at materials testing laboratory* |
| • *Create quarry and borrow areas* |
| • *Source and transport material from borrow area* |
| • *Construction of embankment* |
| • *Concrete Works* |
| • *Steel works* |
| • *Construction of abstraction weir, pump station and sediment exclusion works* |
| • *Construction of rising main* |
| • *Construct valve and access chambers* |
| • *Installation of pumps* |
| • *Build pump house* |
| • *Mechanical and Electrical Works* |
| • *Electrical supply* |
| • *Cut and cover activities* |
| • *Stockpiling (sand, crushed stone, aggregate, etc.)* |
| • *Waste and wastewater management* |
| • *Relocation of dwellings, graves, protected species* |
| • *Reinstatement and rehabilitation of construction domain (outside of inundation area, as necessary)* |

| **Operation** |
|---|
| **Project Activities** |
| • *Maintenance of infrastructure* |
| • *Operation facilities (offices and accommodation)* |
| • *Operation of dam (including controlled releases)* |
| • *On-going consultation with directly affected parties* |
| • *Develop Resource Management Plan* |

Environmental aspects are regarded as those components of an organisation's activities, products and services that are likely to interact with the environment and cause an impact. The following environmental aspects have been identified for the proposed Ncwabeni OCS Dam, which are linked to the project activities (note that only high-level aspects are provided):

**Table 49: Environmental Aspects associated with the Ncwabeni OCS Dam Project Life-Cycle**

| **Pre-construction** |
|---|
| **Environmental Aspects** |
| • *Poor construction site planning and layout* |
| • *Land occupancy by temporary buildings, provisional on-site facilities and storage areas* |

| |
|---|
| • *Inaccurate pre-construction environmental survey (including search and rescue)* |
| • *Absence of relevant permits (e.g. for protected trees, heritage resources)* |
| • *Inadequate consultation with landowners* |
| • *Lack of barricading of sensitive environmental features* |
| • *Poor waste management* |
| • *Absence of ablution facilities* |

| **Construction** |
|---|
| **Environmental Aspects** |
| • *Lack of environmental awareness creation* |
| • *Poor consultation with affected parties* |
| • *Indiscriminate site clearing* |
| • *Poor site establishment* |
| • *Poor management of access and use of access roads* |
| • *Inadequate provisions for working on steep slopes* |
| • *Poor transportation practices* |
| • *Poor fencing arrangements* |
| • *Erosion* |
| • *Disruptions to existing services* |
| • *Disturbance of topsoil* |
| • *Poor management of excavations* |
| • *Inadequate storage and handling of material* |
| • *Inadequate storage and handling of hazardous material* |
| • *Poor maintenance of equipment and plant* |
| • *Poor management of labour force* |
| • *Pollution from ablution facilities* |
| • *Inadequate management of construction camp* |
| • *Poor waste management practices – hazardous and general solid, liquid* |
| • *Wastage of water* |
| • *Disturbance to landowners* |
| • *Poor management of pollution generation potential* |
| • *Damage to significant flora* |
| • *Damage to significant fauna* |
| • *Influence to the Mzimkhulu and Ncwabeni / Gugamela River from river diversion, in-stream works and activities in the riparian zone (and a buffer area of 50m)* |
| • *Environmental damage where drainage lines are crossed* |
| • *Environmental damage of sensitive areas* |
| • *Disruption of archaeological and cultural features* |
| • *Poor reinstatement and rehabilitation* |

| **Operation** |
|---|
| **Environmental Aspects** |
| • *Inadequate management of access, routine maintenance and maintenance works* |
| • *Inadequate management of vegetation* |
| • *Release of poor quality water* |
| • *Downstream erosion* |
| • *Inadequate RMP development process* |

### *12.1.5 Potential Significant Environmental Impacts*

Note that it is not the intention of the impact assessment to evaluate all potential environmental impacts associated by the project's environmental aspects, but rather to focus on the potentially **significant** direct and indirect impacts identified during the Scoping phase and any additional issues uncovered during the EIA stage. The potential significant environmental impacts associated with the Ncwabeni OCS Dam, as listed in **Table 50**, were identified through an appraisal of the following:

- The risks identified during the Environmental Screening Investigation, undertaken by BKS (2011) (see **Section 13.2**);
- Project-related components and infrastructure (see **Section 6.2**);
- Activities associated with the project life-cycle (i.e. pre-construction, construction and operation) (see **Section 6.5**);
- Proposed alternatives with regards to the OCS dam (see **Section 13**);
- Nature and profile of the receiving environment and potential sensitive environmental features and attributes (see **Section 10**);
- Findings from specialist studies (see **Section 11**);
- Understanding of direct impacts upstream and downstream of the dam wall, and indirect effects of the project as a whole;
- Input received during public participation from authorities and I&APs (see **Section 14.3**); and
- Legal and policy context (see **Section 7**).

**Table 50: Potential significant environmental impacts associated with the project**

| CONSTRUCTION PHASE | |
|---|---|
| **Feature** | **Potential Impact** |
| Geology and Soil | • Impacts associated with the sourcing of construction material from borrow areas<br>• Soil erosion (land clearance, construction activities on steep slopes)<br>• Blasting-related impacts |
| Topography | • Visual impacts (river valley, steep slopes and low mountains)<br>• Erosion of affected areas on steep slopes |
| Surface Water | • Adverse effects to resource quality (i.e. flow, in-stream and riparian habitat, aquatic biota and water quality) of the Mzimkhulu River and the tributary (Ncwabeni / Gugamela River) associated with working in-stream and alongside the watercourse. |
| Flora | • Loss of vegetation of conservation significance<br>• Proliferation of exotic vegetation in disturbed areas<br>• Loss of medicinal plants<br>• Loss of firewood |
| Fauna | • Damage / clearance of habitat of conservation importance<br>• Loss of fauna species of conservation significance |
| Socio-economic | • Relocation of access road<br>• Nuisance from dust and noise<br>• Influx of people seeking employment and associated impacts<br>• Relocation of occupied dwellings at site D3A<br>• Damage to property, including structures, livestock, etc.<br>• Job opportunities*<br>• Use of local goods and services*<br>• Skills transfer*<br>• Stimulus to local economy* |
| Air Quality | • Excessive dust levels |
| Noise | • Excessive noise levels |
| Archaeological and Cultural Features | • Damage to heritage resources |
| Infrastructure | • Damage to infrastructure |
| Transportation | • Re-alignment of D859<br>• Construction-related traffic on D859<br>• Safety risks to pedestrians and existing road users<br>• Slipping of heavy vehicles on steep slopes<br>• Dangerous access onto D859 from P68-2 Main Road<br>• Improvements to the D859 and provision of stormwater system* |
| Aesthetics | • Reduction in visual quality of area<br>• Visual impacts from borrow area outside basin |

| OPERATIONAL PHASE | |
|---|---|
| **Feature** | **Potential Impact** |
| Geology and Soil | • Soil erosion on steep slopes (e.g. re-aligned access road, pipeline route)<br>• Risks posed by faults and lineaments on the stability of the dams |
| Topography | • Visual impacts (river valley, steep slopes and low mountains)<br>• Erosion of affected areas on steep slopes |

| Feature | Potential Impact |
|---|---|
| Surface Water | • Impacts to downstream water users due to abstraction<br>• Reduction in water quality in basin<br>• Possible temperature and dissolved oxygen stratification in basin<br>• Shoreline and downstream streambank erosion<br>• Changes to the seasonal flow patterns in the affected tributary<br>• Alteration of the flow regime in the Mzimkhulu River<br>• Prevention of up- and downstream movement of aquatic biota<br>• Fragmentation of the tributary from the main stem<br>• Loss of habitat for aquatic biota within the inundation zone<br>• Loss of riparian habitat within inundated area<br>• Impacts to aquatic ecosystem and Mzimkhulu Estuary due to flow alterations and sediment loads<br>• Proliferation of aquatic weeds |
| Flora | • Inundation of natural areas of conservation importance<br>• Loss of vegetation of conservation significance<br>• Proliferation of exotic vegetation in disturbed areas<br>• Loss of medicinal plants |
| Fauna | • Inundation of habitat of conservation importance<br>• Loss of fauna species of conservation significance<br>• Habitat fragmentation |
| Socio-economic | • Loss of land through inundation and project infrastructure;<br>• Resettlement of occupied dwellings at site D3A<br>• Health-related impacts (water-sourced illnesses – e.g. bilharzia)<br>• Meet water demands of the Umzimkhulu RWSS*<br>• Provision of water to local community directly from OCS Dam* |
| Agricultural Potential | • Loss of fertile soil in inundation area<br>• Inundation of areas used for subsistence agriculture in D3A basin |
| Archaeological and Cultural Features | • Inundation of heritage resources |
| Infrastructure | • Inundation of infrastructure<br>• Influence to the hydro-power plant at Camro Estates<br>• Use of alternative energy |
| Aesthetics | • Visual impacts from borrow area outside basin – relevant to D3A option<br>• Unsightly draw-down zone during periods of low water levels |

*: *Positive impacts*

The cumulative impacts are discussed in **Sections 12.12**.

The findings of the specialists are of particular importance in terms of understanding the impacts of the project and managing the adverse implications of the project life-cycle, as these studies focused on the significant environmental issues identified during the execution of the EIA. As can be seen from the various impact assessments performed by the specialists, there are a host of cross-cutting impacts that are addressed in a number of these studies, with particular reference to the visual, social and economic effects of the proposed OCS dam. The mitigation measures proposed by the specialists for these similar types of impacts are not regarded as contradictory but rather complementary, as they are aligned with best practices and principles.

### 12.1.6 *Impact Assessment Methodology*

The impacts and the proposed management thereof are first discussed on a qualitative level and thereafter quantitatively assessed by evaluating the nature, extent, magnitude, duration, probability and ultimately the significance of the impacts (refer to methodology provided in **Table 51**). Where applicable, the impact assessments and significance ratings provided by the respective specialists are included.

**Table 51: Quantitative Impact Assessment Methodology**

| | |
|---|---|
| **Nature (/Status)** | The project could have the following impacts to the environment:<br>• Positive;<br>• Negative; or<br>• Neutral. |
| **Extent** | • Local - extend to the site and its immediate surroundings.<br>• Regional - impact on the region but within the province.<br>• National - impact on an interprovincial scale.<br>• International - impact outside of South Africa. |
| **Magnitude** | Degree to which impact may cause irreplaceable loss of resources.<br>• Low - natural and social functions and processes are not affected or minimally affected.<br>• Medium - affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.<br>• High - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease. |
| **Duration** | • Short term - 0-5 years.<br>• Medium term - 5-11 years.<br>• Long term - impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.<br>• Permanent - mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient. |
| **Probability** | • Almost certain - the event is expected to occur in most circumstances.<br>• Likely - the event will probably occur in most circumstances.<br>• Moderate - the event should occur at some time.<br>• Unlikely - the event could occur at some time.<br>• Rare/Remote - the event may occur only in exceptional circumstances. |
| **Significance** | Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-<br>0 - Impact will not affect the environment. No mitigation necessary.<br>1- No impact after mitigation.<br>2- Residual impact after mitigation / some loss of populations and habitats of non-threatened species.<br>3- Impact cannot be mitigated / exceeds legal or regulatory standard / increases level of risk to public health / extinction of biological species, loss of genetic diversity, rare or endangered species, critical habitat. |

In the case of the specialist studies, some of the impact assessment methodologies deviated from the approach shown in **Table 51**. However, the quantitative basis for these specialist evaluations of the impacts to specific environmental features still satisfied the intention of the EIA.

### *12.1.7 Impact Mitigation*

#### 12.1.7.1 Mitigation Hierarchy

Impacts are to be managed by assigning suitable mitigation measures. According to DEAT (2006), the objectives of mitigation are to:

- Find more environmentally sound ways of executing an activity;
- Enhance the environmental benefits of a proposed activity;
- Avoid, minimise or remedy negative impacts; and
- Ensure that residual negative impacts are within acceptable levels.

Mitigation should strive to abide by the following hierarchy – (1) prevent; (2) reduce; (3) rehabilitate (or remediate); and/or (4) compensate for the environmental impacts.

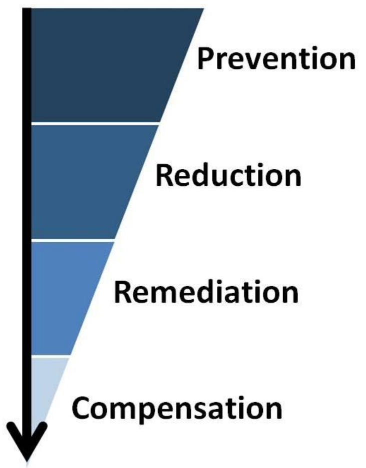


Figure 75: Mitigation Hierarchy

The proposed mitigation of the impacts associated with the Ncwabeni OCS Dam includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices.

Note that the mitigation measures in the subsequent sections are not intended to be exhaustive, but rather focus on the potentially significant impacts identified.

The EMPrs (contained in **Appendix F**) provide a comprehensive list of mitigation measures for specific elements of the project, which extends beyond the impacts evaluated in the body of the EIA Report.

#### 12.1.7.2 EMPr Framework

An EMPr represents a detailed plan of action prepared to ensure that recommendations for enhancing positive impacts and/or limiting or preventing negative environmental impacts are implemented during the life-cycle of a project.

| **Box 3:** | **Overview of an EMPr** |
|---|---|

The EMPrs aim to satisfy the requirements stipulated in Section 24N of NEMA and Regulation 33 of GN No. R. 543 (18 June 2010).

The scope of the Ncwabeni OCS Dam EMPrs are as follows:

- Establish management objectives during the project life-cycle in order to enhance benefits and minimise adverse environmental impacts;
- Provide targets for management objectives, in terms of desired performance;
- Describe actions required to achieve management objectives;
- Outline institutional structures and roles required to implement the EMPr;
- Provide legislative framework; and
- Description of requirements for record keeping, reporting, review, auditing and updating of the EMPr.

All liability for the implementation of the EMPrs (as well as the EIA findings and environmental authorisation) lies with the project proponent (i.e. DWA).

Due to the extent of the overall project, the suite of EMPrs (contained in ***Appendix F***) shown in **Table 52** were developed to deal with the various key components of the project. Note that the Operational EMPr will be developed in the future.

**Table 52: Suite of Project EMPrs**

| Project Life-cycle | Description | Responsibility for Implementation |
|---|---|---|
| **PRE-CONSTRUCTION EMPr** | | |
| Pre-construction phase | Managing of impacts associated with those activities (and related environmental aspects) that take place prior to construction of the project infrastructure. | DWA |
| **CONSTRUCTION EMPrs** | 1. OCS Dam<br>2. Re-alignment of D859<br>3. Abstraction weir, abstraction works, pipeline and access road | |
| Construction phase | Managing of impacts associated with those activities (and related environmental aspects) that take place as part of the construction of the project infrastructure. | DWA |

The following considerations and assumptions accompany the compilation of the EMPrs:

- The EMPrs are guided by the following principles (based on Lochner, 2005) –
    - **Continuous improvement -** The project proponent (or implementing organisation) should be committed to review and to continually improve environmental management, with the objective of improving overall environmental performance;
    - **Broad level of commitment -** A broad level of commitment is required from all levels of management as well as the workforce in order for the implementation of the EMPrs to be successful and effective;
    - **Flexible and responsive -** The implementation of the EMPrs needs to be responsive to new and changing circumstances. The EMPr report is a dynamic "living" document that will need to be updated regularly throughout the duration of the project life-cycle.
- Any changes to the EMPrs must be submitted to DEA for acceptance. In accordance with Regulation 37 of GN No. R. 543 (18 June 2010), the Environmental Authorisation (if granted) will specify the requirements for amending or updating the EMPrs.
- The EMPrs for the Ncwabeni OCS Dam provide the framework for the overarching environmental management requirements for the project life-cycle. Following detailed design and planning, the EMPrs may need to be revised to render the management actions more explicit and accurate to the final project specifications.
- The EMPrs will be linked to the project's overall Environmental Management System (EMS) (if applicable), where the EMS constitutes an iterative process that aims achieve continuous improvement and enhanced environmental performance.
- Although every effort has been made to ensure that the scope and level of detail of the EMPrs are tailored to the level of environmental risk (i.e. type and scale of activity and the sensitivity of the affected environment) and the project- and site-specific conditions, certain of the environmental management requirements within the EMPrs may be regarded as generic to make provision for activities that may take place as part of the overall project.

It is recommended that the following EMPrs be developed as further information becomes available:

1- Search, Rescue and Relocation Management Plan;

2- Ncwabeni OCS Dam Impoundment EMPr;
3- Rehabilitation Management Plan for disturbed areas outside of the dam inundation area; and
4- Operational EMPr.

## 12.2 Climate

The dam could contribute to greenhouse gas emissions, where inundated plant material that decays in an anaerobic environment will release methane and carbon dioxide. Some of the main parameters/factors affecting greenhouse gas production from dams include (http://www.hydropower.org/iha/development/ghg/faq.html):

- Shape of the reservoir;
- Water depth;
- Water temperature;
- Climate and weather conditions;
- How much carbon and/or plant life is in the water;
- The predominant soil types in the watershed;
- How long the water stays in the reservoir; and
- Age of the reservoir.

Conversely, dams can also sequester large volumes of carbon (Dean and Gorham, 1998), which is a positive contribution towards managing climate change.

As part of the Aquatic Ecology Study undertaken for the EIA for the De Hoop Dam (DWAF, 2005), it was suggested that the natural pre-impoundment carbon fluxes be quantified in order to establish the total contribution of the area to be inundated to potential climate change. The same applies for the proposed Ncwabeni OCS Dam, where the outcome of a similar assessment should guide the decision on removing all large trees within the basin. The basins for the two dam site options are densely vegetated (especially for site D2), which may result in a substantial tree-felling exercise, if deemed necessary.

To establish the net greenhouse gas footprint of the Ncwabeni OCS Dam, it is also recommended that the greenhouse gas emissions from the dam following impoundment be monitored to determine the difference between the emissions with and without the reservoir. This must be documented and the lessons learnt must provide guidance for managing greenhouse gas emissions for future DWA dams. It is suggested that these future studies be conducted by the Water Research Commission.

The dam could also cause potential changes in the micro-climate of the area surrounding the reservoir. Although, in the EIA conducted for the Mooi-Mgeni River Transfer Scheme Phase 2, specialists were of the opinion that the proposed Spring Grove Dam (surface area of approximately 10.3 $km^2$) would not likely have an impact on the microclimate of the area, except for an approximate band of 100 m around the dam, and localised impacts could include changing local wind patterns and nocturnal temperature inversions (DWAF, 2009). A Kariba Dam Case Study provides evidence that a dam the size of Kariba (maximum surface area 5 577 $km^2$) did not have a significant impact on either the local or the regional climate.

**Impact Assessment**

| **Environmental Feature** | **1. Climate** |
|---|---|
| **Relevant Alternatives & Activities** | **Both alternative dam sites; dam basin inundation** |
| **Project life-cycle** | **Operational phase** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Greenhouse gas emissions | 1.1. Quantify natural pre-impoundment carbon fluxes. Determine de-bushing requirements.<br>1.2. Monitoring of post-impoundment greenhouse gas emissions.<br>1.3. Employ the UNESCO *GHG Measurement Guidelines for Freshwater Reservoirs* (or other acceptable best practice) to determine the dam's greenhouse gas footprint. |

| | **+/- Impacts** | **Extent** | **Magnitude** | **Duration** | **Probability** | **Significance** |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | regional | unknown | medium-term | likely | unknown |
| **After Mitigation** | - | regional | unknown | medium-term | likely | unknown |

## 12.3 Geology and Soil

Construction material will need to be sourced from borrow areas near the OCS Dam sites. Such extraction could result in a variety of environmental impacts during the construction phase, including visual impacts, loss of habitat, noise and dust to local communities and wildlife. In the case of site D2, the borrow areas are situated within the dam basin to manage the permanent impacts. However, for site D3A the materials are most likely not all available within the basin and an external quarry (located at site D2) will need to be created, which will require adequate rehabilitation. Despite extensive rehabilitation efforts, a large area will be cleared of vegetation which will cause a significant impact to the aesthetics of the area. The overall footprint of site D3A will also be larger than that of site D2 in terms of its impact on sensitive environmental features.

Suitable mitigation measures are contained in the EMPr to manage the impacts associates with creating and operating the borrow areas. The borrow areas that fall within the dam basin and which will be inundated will not be rehabilitated. Excess material will also be spoilt within the dam basin.

Blasting will be required, based on geotechnical conditions encountered. All blasting will comply with the relevant legislation and SANS stipulations. Specific mitigation measures are contained in the EMPr, including the use of blast mats to safeguard against fly-rock, and the protection of property and accompanying monitoring practices.

During the construction phase large areas will be cleared of vegetation, which may lead to soil erosion. The terrain to be affected by the relocation of the D859, installation of the pipeline and new access road to the abstraction area, is characterised by a steep gradient. In these areas, erosion could take place in the absence of suitable stormwater management and stabilisation of the cut and fill areas. The EMPrs include suitable stormwater management measures to prevent the occurrence of erosion.

Soil may be polluted by poor storage of construction material, spillages and inadequate housekeeping practices. Specific mitigation measures are contained in the EMPr, where the primary objective is the effective and safe management of materials on site, in order to minimise the impact of these materials on the biophysical environment. The same objective applies to the correct management and handling of hazardous substances (e.g. fuel).

## Impact Assessment

| | |
|---|---|
| **Environmental Feature** | **2. Geology & Soil** |
| **Relevant Alternatives & Activities** | **Both alternative dam sites; abstraction works; pipelines; re-alignment of D859; access road, borrow pits** |
| **Project life-cycle** | **Construction & operational phases** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Soil erosion on steep slopes. | 2.1. Stabilisation of cleared areas to prevent and control erosion. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) will be selected according to the site specific conditions. Drainage management should also be implemented to ensure the minimization of potential erosion.<br>2.2. Acceptable reinstatement and rehabilitation or areas outside of FSL to prevent erosion during operation phase.<br>2.3. Install suitable buttressing to prevent future erosion of the river structure, if required.<br>2.4. Monitoring to be conducted to detect erosion (e.g. steep sections along the access road and pipeline, crossing of drainage lines, tie-ins at river banks, spillway, stilling basin). |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium-high | short-long | likely | 3 |
| **After Mitigation** | - | local | low | short-term | unlikely | 1 |

| | |
|---|---|
| **Environmental Feature** | **3. Geology & Soil** |
| **Relevant Alternatives & Activities** | **Both alternative dam sites – borrow areas** |
| **Project life-cycle** | **Construction phases** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Impacts associated with creating and operating borrow areas | 3.1. Remove, stockpile and preserve topsoil for re-use during rehabilitation.<br>3.2. Implement suitable stormwater management measures at borrow pits / quarries.<br>3.3. No direct discharge of sediment laden water without treatment.<br>3.4. Manage dangerous conditions (e.g. steep slopes, loose and unstable material).<br>3.5. All borrow pits and quarries situated outside of the dam basin to be created, operated and rehabilitated in accordance with the Environmental Management Plan, as authorised by the Department of Mineral Resources. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | high | short-term | almost certain | 3 |
| **After Mitigation** | - | local | low | short-term | moderate | 1 |

## 12.4 Surface Water

For the discussion to follow watercourses are considered as rivers, streams, natural channels (perennial and seasonal), wetlands and dams. Activities linked with the construction and operational phases can cause significant adverse impacts to the "resource quality" of the affected watercourses, which is defined by the National Water Act (Act No. 36 of 1998) as the following:

- Quantity, pattern, timing, water level and assurance of in-stream **flow**;
- **Water quality**, including physical, chemical and biological characteristics of the water;
- Character and condition of the in-stream and riparian **habitat**; and
- Characteristics, condition and distribution of the **aquatic biota**.

Water uses associated with the project include storing and taking water, impeding and diverting flow and altering the bed, banks, course and characteristics of the watercourse (associated with the construction activities that encroach upon the regulated area of a watercourse - i.e. 1:100 year floodline / delineated riparian or wetland habitats). Water Use Authorisation will be required for the aforementioned activities in terms of Section 21 of the National Water Act (Act No. 36 of 1998). In accordance with Section 27 of this Act, the following factors need to be taken into consideration by DWA before an authorisation may be issued:

1. Existing lawful water uses;
2. The need to redress the results of past racial and gender discrimination;
3. Efficient and beneficial use of water in the public interest;
4. The socio-economic impact of the water use or uses if authorised; or of the failure to authorise the water use or uses;
5. Any catchment management strategy applicable to the relevant water resource;
6. The likely effect of the water use to be authorised on the water resource and on other water users;
7. The class and the resource quality objectives of the water resource;
8. Investments already made and to be made by the water user in respect of the water use in question;
9. The strategic importance of the water use to be authorised;

10. The quality of water in the water resource which may be required for the Reserve and for meeting international obligations; and
11. The probable duration of any undertaking for which a water use is to be authorised.

Impacts associated with specific surface water attributes are explored further in the subsections to follow.

#### *12.4.1 Water Users*

The abstraction of water to fill the dam is to occur in the summer months when flows are greater than the sum of the requirements of the Umzimkhulu Regional Water Supply Scheme, lawful downstream users and the Ecological Reserve. Releases of water back into the Mzimkhulu River in the winter months are to be made if the flows are less than the requirements of the Umzimkhulu Regional Water Supply Scheme after providing for the Ecological Reserve and lawful downstream users. Detailed volumes need to be determined once the Reserve has been finalised through the classification process, in terms of the requirements of the National Water Act (Act No. 36 of 1998).

The OCS dam may affect water availability to the local community. Households reliant on water abstraction directly from the watercourse that is to be impounded may need to walk further to access water. It is anticipated that this impact may be of greater relevance to the Gugamela River, where human habitation in this catchment far exceeds that of the Ncwabeni River's catchment. The dam could however also improve water availability to other households in the immediate vicinity of the dam, and make it easier to access (DWAF, 2007c), depending on the future management of the reservoir and the adjoining land use. Access to the dam will receive detailed attention as part of the RMP development process, which will include public participation and direct engagement with the Cele K Tribal Authority. The need to take water directly from the rivers should be negated with the supply of potable water to the area by the UDM, where the water requirements of the Umzumbe area will be jointly met by the Mhlabatshane Scheme and proposed Ncwabeni OCS Dam (refer to **Section 3.2**).

**Impact Assessment**

| Environmental Feature | 4. Surface Water - Water Users |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; water abstraction from Mzimkhulu; measured water releases |
| Project life-cycle | Operational phase |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Impacts to lawfully entitled water users as a result of water abstraction from the Mzimkhulu River | 4.1. Abstractions based on DWA operating rules - abstraction only to take place during peak or high flow periods. Existing water use entitlements not to be affected.<br>4.2. Existing water use entitlements to be unaffected.<br>4.3. Compliance with the conditions of the Reserve, as determined and administered under the National Water Act (No. 36 of 1998). |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | regional | medium-high | short-term | likely | 3 |
| **After Mitigation** | neutral | - | - | - | - | - |

### *12.4.2 Water Quality*

During the construction phase, water quality impacts to the Mzimkhulu and Ncwabeni / Gugamela Rivers may include:

- Sedimentation from working within and alongside the watercourse;
- Diffuse pollution from spillages, silt-laden runoff from disturbed areas, and improper practices (e.g. poor management of waste water, inadequate storage and housekeeping practices, and inadequate disposal of solid waste); and
- Dewatering without filtering of sediments.

During the operational phase, potential impacts to water quality could result due to the physical, chemical and biological processes, sediments and nutrients being trapped in the dam basin and algal growth. Possible temperature and dissolved oxygen stratification could also take place. This will impact on the downstream water quality, depending on the time and manner of release. With the filling of the reservoir, the decomposition of submerged vegetation and soils can deplete the level of oxygen in the water. Other potential water quality issues related to the operation and maintenance of dams include sedimentation from shoreline or streambank erosion.

According to Enviross (2012), the storage of the water will effectively change the system from a flowing (lotic) system to a still (lentic) system. This means that the water will not be subject to mixing that would otherwise occur within a shallow, flowing system. Temperature stratification (layering) will occur within the stored water, with the cooler water being located at the deepest points of the dam. The water located within the deeper areas of the dam can be considerably cooler than the upper layers of the dam. A thermocline will develop, with the consequence that only the upper layers (epilimnion) will mix. This will be largely driven by wind and cyclic (daily) heating and cooling of the water and is the layer that retains gaseous exchange with the atmosphere. The lower layer (hypolimnion) will not mix across the thermocline and therefore never comes into contact with the atmosphere for gaseous exchange, with the result that it will become depleted of oxygen (anoxic). The hypolimnion also tends to have a higher pH and higher TDS than the epilimnion. Release of this water into the receiving aquatic ecosystem would be detrimental to the aquatic biodiversity. The significance of the impact emanating from releasing water that has been stored for a relatively long time (during the summer, high-flow period) will be determined by the depth of the intake for the release. Releasing water from the hypolimnion will mean that the colder, oxygen-poor water will impact on the characteristics of the receiving water. Having the intake within the hypolimnion would be an effective way of releasing sediments from the storage dam, but the altering of the characteristics of the receiving waters will have a significant impact on the species community structures of the receiving waters. It is proposed that only water from the epilimnion (the layer above the thermocline that has a temperature governed largely by ambient temperature, wind and radiant energy) should be released or pumped into the watercourse. This will ensure that the characteristics of the water within the Mzimkhulu River are not significantly altered and will therefore not impact the species community structures of the system. Note that to address the above issues, the dam will have a multiple level off-take tower to ensure good quality water is release to the downstream environment.

The OCS dam wall will trap sediment contributions from the tributary to the main stem. A lack of sediment in the water may result in increased scouring and erosion of river beds and banks downstream. The fact that the proposed storage dam is off-channel and that the Mzimkhulu River contains high silt loads will significantly reduce this impact. It is noted that an off-channel dam has the benefit of controlling sedimentation within the impoundment by managing the pumping schedule to produce the optimal water quality from the primary stream. Sedimentation exclusions works will also control the sediment discharged into the OCS dam. According to BKS (2012), it is anticipated that the flushing of sediment from the abstraction works will have a low impact on the river ecology because it is done during small floods or at the end of large floods, never under low flow conditions and therefore the base flow water quality is not affected. The estimated flushing duration for the gravel trap is less than 30 minutes

A water quality assessment was conducted as part of the Ncwabeni Off-channel Storage Dam Feasibility Study: Module 1: Technical Study (BKS, 2012a) to guide the design and planning of the proposed Ncwabeni impoundment and its operation to optimise water quality. The findings of the Water Quality Assessment of the proposed Ncwabeni impoundment are as follows:

- **Predicted Impacts** –
    - Algal counts are predicted to be low – moderate and blooms of nuisance algal species are unlikely to occur;
    - Stratification of the proposed impoundment is likely to result in anoxic water at a depth of 5 - 15 m from the surface during the hottest summer months;
- In-dam processes such as sedimentation of suspended material and bacteriological removal are likely to significantly improve surface water quality between the inflow and the wall of the proposed impoundments.
- **Management of Proposed Impoundments to Optimise Water Quality** -
    - Scouring (as opposed to spilling) is the recommended release mechanism during low rainfall and low inflow conditions when algal numbers are high to avoid release of algal-laden water into the downstream riverine ecosystems;
    - It is recommended that spill-abstraction-scour releases be managed to minimise the impact on aquatic life; and
    - From a water quality planning perspective, there appear to be no significant water quality problems that preclude the construction of the proposed Ncwabeni impoundment.

The operation of the dam needs to ensure that the Reserve, which includes water quality requirements, will be satisfied.

## Impact Assessment

| Environmental Feature | 5. Surface Water - Water Quality |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; activities undertaken in-stream, alongside rivers and within the construction domain |
| Project life-cycle | Construction phase |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Contamination of surface water through sedimentation from in-stream works, silt-laden runoff from disturbed areas, and improper practices (e.g. poor management of waste water and disposal of solid waste). | 5.1. Conduct water quality monitoring (baseline and during construction) at suitable up- and downstream sites on the Ncwabeni and Mzimkhulu Rivers.<br>5.2. All diffuse pollution sources to be managed to prevent pollution of the watercourses in the project area.<br>5.3. Storage area and ablution facilities to be located 50m from edge of riparian habitat.<br>5.4. Where necessary, install in-stream silt traps during construction within the watercourse channel and along the riparian habitat. In-stream silt traps are to be maintained and serviced on a regular basis. The style of silt trap will depend on materials used and the water movement patterns.<br>5.5. Implement suitable stormwater measures during construction to manage ingress of runoff into watercourses.<br>5.6. Ensure proper storage of material (including fuel, paint) that could cause water pollution. Ensure proper storage and careful handling of hazardous substances with spill prevention materials at hand.<br>5.7. Reduce sediment loads in water from dewatering operations. All dewatering should be done through temporary sediment traps (e.g. constructed out of geo-textiles and hay bales). These are to be serviced regularly and removed when no longer in use. Materials can be re-used. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Before Mitigation | - | local | medium-high | short-term | likely | 3 |
| After Mitigation | - | local | low | short-term | moderate | 1 |

| Environmental Feature | 6. Surface Water - Water Quality |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; measured water releases |
| Project life-cycle | Operational phase |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Impacts to water quality in the Mzimkhulu River due to releases from the OCS dam. | 6.1. Releases based on DWA operating rules – ensure that optimal water quality is achieved during releases from the OCS dam.<br>6.2. The dam will have a multiple level off-take tower to ensure good quality water is release to the downstream environment.<br>6.3. Compliance with the conditions of the Reserve, as determined and administered under the National Water Act (No. 36 of 1998).<br>6.4. Conduct water quality monitoring to determine the impacts to the Mzimkhulu River as a result of water releases from the OCS Dam.<br>6.5. Manage disposal of sediment from abstraction works. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Before Mitigation | - | local | medium-high | short-term | likely | 3 |
| After Mitigation | - | local | low | short-term | moderate | 1 |

### *12.4.3 Hydrology*

During the construction phase, the flow in the Mzimkhulu River and in the tributary to be affected by the OCS dam (Ncwabeni / Gugamela River) will be primarily affected by diversions and temporary river crossings for access purposes. The following temporary river diversions will be required (refer to **Section 6.6**):

- River diversion for building of dam wall;
- River diversion for sourcing rock from quarries; and
- River diversion for construction of abstraction weir.

The Contractor will prepare detailed method statements on how the river diversions will be undertaken. Best practices to manage the flow of the rivers to be affected by the diversions are included in the Construction EMPrs.

In the operational phase, the watercourse selected for the OCS Dam will be changed from a flowing (lotic) to a still (lentic) system. The river reach between the dam wall and the confluence with the main stem (Mzimkhulu River) will no longer be fed from the tributary's catchment, as water from the OCS dam will be released into the Mzimkhulu River. According to DWAF (2007c), the river reach downstream of the dam wall will have a reversed flow scenario (i.e. higher winter flows and lower summer flows) as a result of storage and release of water from the OCS dam.

Water abstraction and releases from the OCS dam may also alter the flow regime in the Mzimkhulu River. The nature of the impact to the flow in the affected watercourse will depend on the design, purpose and operating regime of the dam and the size of the reservoir. The water volumes in the Mzimkhulu River will be supplemented during low-flow conditions by measured releases from the OCS dam, which will improve the current situation. Water released from the proposed OCS dam will need to comply with the requirements of the Ecological Reserve for both the Mzimkhulu River and Estuary. By meeting the EWR, it is expected that the flow regime will benefit from releases. Abstracting during high-flow conditions will minimise the negative influence to the flow regime.

**Impact Assessment**

| Environmental Feature | 7. Surface Water - Hydrology |
|---|---|
| Relevant Alternatives & Activities | **Both alternative dam sites; quarry at site D2; abstraction weir** |
| Project life-cycle | **Construction phase** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Impacts to rivers from temporary diversions. | 7.1. Minimise influence to downstream flow regime when diverting and impeding flow for cofferdams, temporary river crossings or for any other purposes.<br>7.2. Prevent possible erosion caused by temporary in-stream diversion. Install suitable buttressing / stabilisation structures to prevent future erosion, if required.<br>7.3. Select most appropriate crossing point based on geotechnical conditions, sensitivity of riparian habitat (e.g. protected trees, large trees that afford bank stabilisation) and in-stream habitat, depending on technical feasibility. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | high | short-term | almost certain | 3 |
| **After Mitigation** | - | local | low | short-term | moderate | 1 |

| Environmental Feature | 8. Surface Water - Hydrology |
|---|---|
| Relevant Alternatives & Activities | **Abstraction from Mzimkhulu River; measured water releases** |
| Project life-cycle | **Operational phase** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| Impacts to flow regime for the operation of the OCS Dam. | 8.1. Operating rules to incorporate EWR.<br>8.2. Dam to be operated to ensure optimum abstraction and release, without significant impact to the flow regime. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | regional | high | short-term | almost certain | 3 |
| **After Mitigation** | - | regional | medium | short-term | moderate | 1 |

### *12.4.4 Aquatic Biota*

#### 12.4.4.1 Loss of River Ecosystem

According to Enviross (2012), the establishment of a dam wall on a river will completely alter the characteristics of the system and profoundly impact the organisms that inhabit it. Rivers such as the Ncwabeni and Gugamela Rivers are non-perennial in nature, meaning that they flow seasonally in accordance to the rainfall received within their respective catchment areas. They also receive water sources through groundwater discharge, which is also rainfall-dependent. Even during the low-flow periods, the systems provide habitat by the retention of surface waters within isolated pools. During high-flow periods, flow within these tributaries is restored, opening up access recruitment of species from the main channel, and many fish and invertebrate species utilise these tributary channels for a variety of reasons. These include refuge from the main channel during flood conditions, exploitation of the habitat for inhabitation or feeding, increased breeding habitat and provision of nursery areas. Damming a river will remove this. The dam could provide permanent habitat for invertebrates and fish (if stocked), but the genetic dispersal of these populations would largely be lost to the system. Only a few of the riverine species would flourish within a dam environment as well, which will drastically alter the species community structures on a local catchment scale.

In looking at the local catchments associated with the Mzimkhulu River within the region, it was found that the Gugamela and the Ncwabeni River local catchments were not unique and that numerous catchment areas of similar size and state of ecological integrity are associated with the system that could provide alternative habitat opportunities. **Figure 76** presents other local catchment areas within the region that could be alternatively utilised for habitat exploitation.

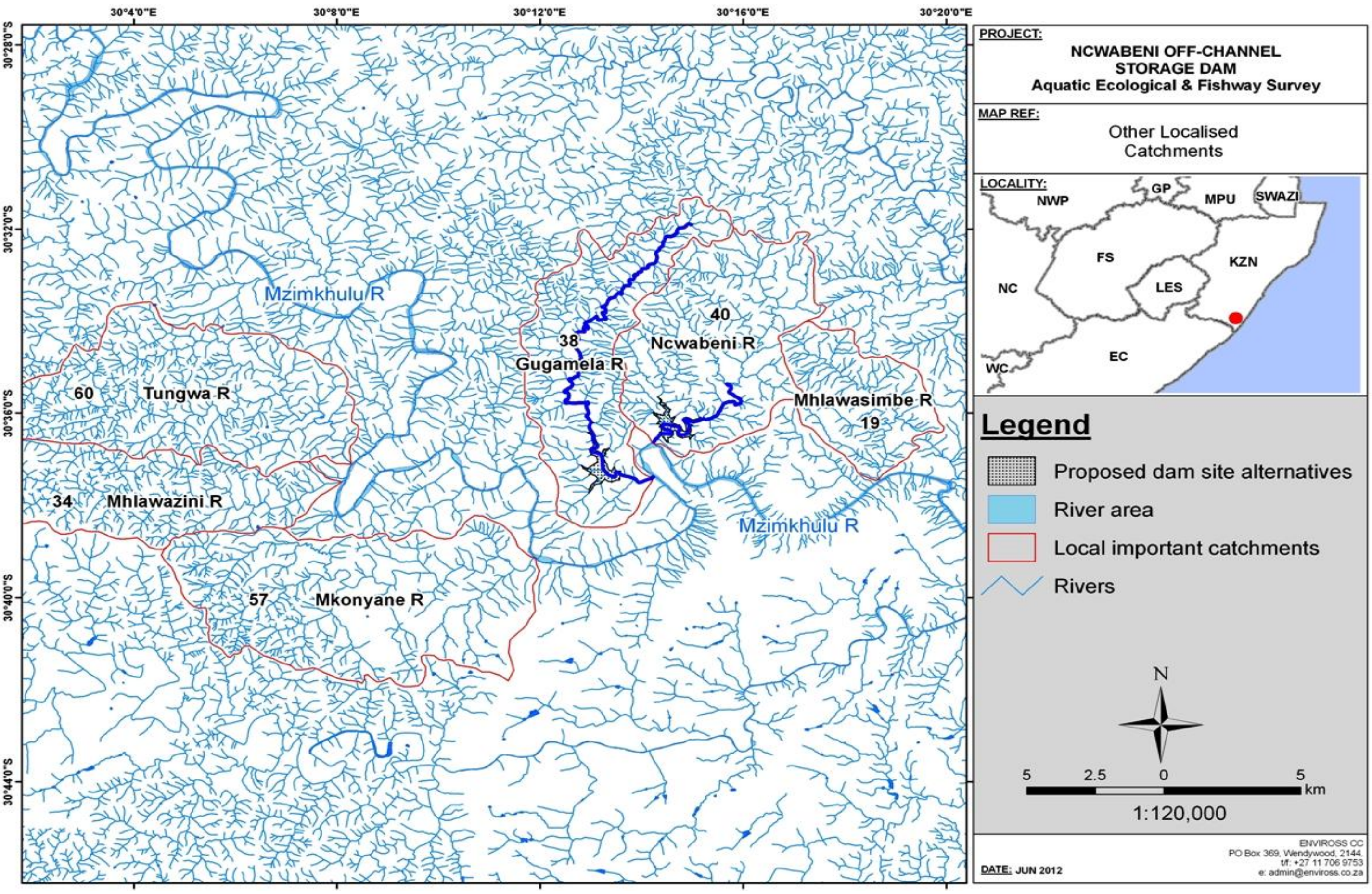



**Figure 76: Other local catchment areas of similar PES (Enviross, 2012)**

## Impact Assessment

| Environmental Feature | 9. Surface Water – Aquatic Biota |
|---|---|
| Relevant Alternatives & Activities | OCS dam on the Ncwabeni River |
| Project life-cycle | Operational phase |
| Potential Impact | Proposed Management Objectives / Mitigation Measures |
| Permanent barrier to migration of aquatic biota caused by the dam wall at the Ncwabeni River | 9.1. Should the Ncwabeni River be selected as the preferred site for the OCS dam, further investigations are required into improving the current low-level bridge on the Gugamela River which is acting as a manmade barrier to migration and upstream recruitment. This will serve as a form of compensation to aquatic biota for the permanent barrier on Ncwabeni River.<br>9.2. *Note - numerous catchment areas of similar size and state of ecological integrity are associated with the system that could provide alternative habitat opportunities*. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | high | long-term | almost certain | 3 |
| **After Mitigation** | - | local | medium | long-term | almost certain | 2 |

### 12.4.4.2 Impediment to Migration of Aquatic Biota

According to Enviross (2012), the construction of the abstraction weir that spans across the Mzimkhulu River will pose a migratory barrier to any aquatic biota requiring up and downstream migratory freedom along the watercourse. Aquatic biota require migratory freedom for various reasons, including seasonally-cyclic spawning migrations, genetic dispersal, habitat exploitation, feeding migrations and avoidance of unfavourable conditions. The relatively close proximity to the coast means that the Mzimkhulu River forms an important conduit to inland waters for catadromous Anguillid species (eels). These species include *Anguilla bicolor bicolor, Anguilla benghalensis, Anguilla mossambica* and *Anguilla marmorata* (threatened) – all of which have been recorded from the system. These species breed in the marine environment (at sea) and the planktonic larvae drift with the coastal currents and then migrate into estuaries, where they undergo a stage of maturity and migrate up the rivers along the east coast into freshwater systems as glass eels, where they develop into elvers. These elvers measure 40-60mm. At this stage these elvers are not capable of strong swimming movement and are therefore particularly vulnerable to the impacts of artificial in-stream barriers. These eels are capable, however, of leaving the main water column and crawling up wetted edges (splash zones) of channels, provided a roughened surface is available to aid in grip. A further catadromous species that has been recorded from within

5km of the site is *Mugil cephalus* (Freshwater mullet), which breeds at sea and recruits into freshwater environments as juveniles (typically 20-50mm in length) during late winter. Research has indicated that these juvenile individuals can only attain maximum burst speeds of approximately 1.0 to 1.3m/s (Bok *et al*., 2007). It is therefore recommended that the mean maximum velocities through a fishway structure not exceed these values.

Limited data is available on the macro-invertebrate species community structures specific to the lower Mzimkhulu River. The given list of recorded aquatic fish, crustaceans and molluscs provided by BKS (2011) includes a variety of macro-invertebrate species that would require free passage across the barrier to complete a stage in their respective lifecycles (successful larval development), habitat exploitation and genetic dispersal. Adults and juveniles would then migrate downstream toward the estuaries again (Bok, *et al.,* 2007). The main genera of crustaceans that would require migratory freedom include *Macrobrachium, Varuna* and *Brachipodopsis*. Another species of freshwater shrimp identified through the Scoping Report from Ezemvelo KZN Wildlife's Strategic Environmental Assessment Plan is *Atyoida serrata*. Provision should therefore be made to mitigate the effects of migratory inhibition on macro-invertebrates emanating from the construction of the weir in the Mzimkhulu River.

An extract from the Aquatic and Riverine Assessment (Enviross, 2012) pertaining to the potential impacts to the aquatic biota follows.

## Impact Assessment

| | |
|---|---|
| **Environmental Feature** | **10. Surface Water – Aquatic Biota** |
| **Relevant Alternatives & Activities** | **Abstraction weir** |
| **Project life-cycle** | **Operational phase** |

| Potential environmental impact | Project activity or issue | Environmental significance *before* mitigation | | | | | | | | Environmental significance *after* mitigation as per EMPr | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S | D | I | E | R | P | Conf | SP | S | D | I | E | R | P | Conf | SP |
| Riverine biodiversity impacts | Establishment of a migratory barrier will dramatically alter the community structure of obligatory migratory species; Long-term isolation of populations will lead to speciation. | 5 | 5 | 5 | 5 | 2 | 5 | | 90 | 1 | 1 | 1 | 1 | 4 | 1 | | 0 |

*[Significance of Environmental Impact (SP) = Consequence x Probability (P), where Consequence = Spatial extent (S) + Duration (D) + Intensity (I) + Effects on important ecosystems (E)) - Reversibility (R). SP ratings: 0-33 (Low), 34-74 (Medium), 75-100 (High)*

| Environmental Impacts | Mitigation Measures |
|---|---|
| • Establishment of a migratory barrier | 10.1. Provision to be made for a fishway which will allow migratory freedom over seasons and periods when required by the various species groups inhabiting the system.<br>10.2. Routine monitoring to assess the functionality of the fishway should be undertaken;<br>10.3. Routine maintenance of the fishway should be undertaken to ensure functionality (debris removal, sediment flushing, etc). |

#### 12.4.4.3 Construction-related Impacts to Aquatic Biota

Construction activities in close proximity to watercourses and in-stream works will increase the turbidity in the affected rivers. This could adversely affect aquatic fauna by inhibiting spawning and predation, and result in the clogging of gills. Silt deposition could alter micro-habitats. It is anticipated that less-resilient fish and macro-invertebrate species will move away from the affected reaches of the watercourses where the construction activities are taking place. The Construction EMPrs include mitigation measures to manage stormwater and water quality impacts.

**Impact Assessment**

| Environmental Feature | 11. Surface Water – Aquatic Biota |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; activities undertaken in-stream and alongside rivers |
| Project life-cycle | Construction phase |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Clogging of gills from increased silt loads;<br>• Alteration of habitat;<br>• Disturbance to migration patterns;<br>• Poaching / illegal fishing. | 11.1. Management of water quality and flow - repeat mitigation measures 5.1 – 5.7 and 7.1 – 7.3.<br>11.2. Temporary diversion to allow for movement of aquatic biota, as far as possible.<br>11.3. Environmental induction of all construction workers and implementation of disciplinary procedures for non-compliance. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium | short-term | likely | 2 |
| **After Mitigation** | - | local | low-medium | short-term | moderate | 1 |

### *12.4.5 Riparian Habitat & Morphology*

The riparian zone on the tributary where the OCS dam will be situated will be inundated behind the dam wall, with a complete loss of riparian habitat. The riparian zone in the river reach from the dam wall to the confluence with the main stem will also be influenced, as this section will no longer receive water from the upstream catchment.

During construction, the riparian habitat will be damaged at the sites for the dam wall, abstraction weir and abstraction works. The EMPrs make provision for the reinstatement and rehabilitation of areas disturbed by construction activities that are located outside of the dam basin and that will not become inundated.

The Index of Habitat Integrity, which was completed as part of the Aquatic and Riverine Assessment, found the Gugamela and Ncwabeni Rivers at the survey sites do not suffer from habitat modification and have largely retained ecological integrity and functionality ("A" integrity class).

**Impact Assessment**

| Environmental Feature | 12. Surface Water – Riparian Habitat & Morphology |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; activities undertaken in-stream and alongside rivers; measured water releases |
| Project life-cycle | Construction & operational phases |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Destabilisation of morphology (i.e. river structure);<br>• Damage to / loss of riparian habitat within / adjacent to the works area. | 12.1. Select most appropriate crossing points based on sensitivity of riparian habitat (e.g. protected trees, large trees that afford bank stabilisation) and in-stream habitat, depending on technical feasibility.<br>12.2. Reinstate (shaping) and rehabilitate (indigenous riparian vegetation) affected areas outside dam basin. Install suitable buttressing to prevent future erosion, if required.<br>12.3. Measures to be implemented to dissipate energy of water released from spillway into stilling basin. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium | permanent | likely | 2 |
| **After Mitigation** | - | local | low-medium | short-term | moderate | 1 |

## 12.5 Flora

The majority of the land that will be inundated constitutes natural or semi natural areas. Vegetation will primarily be lost within the reservoir through inundation, building the infrastructure associated with the OCS dam and abstraction works and re-aligning the D859. The potential loss of significant flora species (e.g. *Celtis africana*) may also occur. Where technically feasible, the final pipeline route, re-alignment of the D859 and new access road to the abstraction works will attempt to avoid protected trees.

The vegetation types associated with the two OCS dam sites are shown in **Figure 77**. The majority of the infrastructure associated with the OCS dam, as well as the basin, will be located within Eastern Valley Bushveld which has a status of ‘least threatened’. Portions of the dam basins at D2 and D3A, as well as components of the OCS dam for the D3A option (namely sections of the re-aligned D859 and pipeline route, and the northern part of the dam wall and spillway) fall within the KwaZulu-Natal Coastal Belt, which is recognised as ‘endangered’.

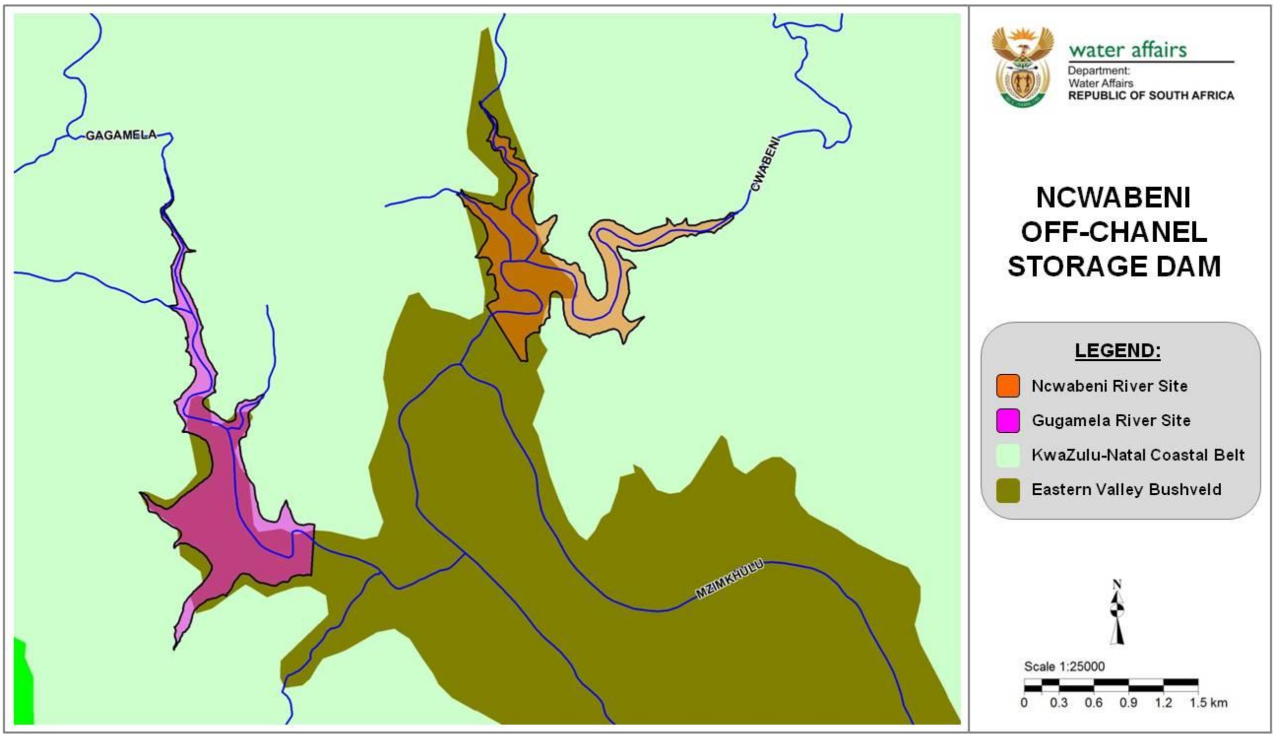



**Figure 77: Vegetation Types in project area**

Portions of the basins for both dam sites fall within SANBI’s CBA 2 zones (see **Figure 52**), which include areas of significantly high biodiversity value. In addition, SANBI’s CBA 1 zones also occur close to the northern part of the dam basins. The future management of the OCS dam and the surrounding land needs to take cognisance of the proximity of portions of the dam footprint to the CBA 1 zones. This needs to be considered further during the development of the RMP.

Clearing of vegetation for construction purposes will result in the proliferation of exotic vegetation, which could spread beyond the construction domain. In addition, exotic vegetation may also grow in the dam's draw-down area. These potential impacts will be managed through suitable rehabilitation and eradication methods contained in the EMPrs.

Trees felled as part of construction activities should be made available to the Cele K Tribe. If the basin is to be cleared of all large trees, this may result in a large quantity of timber. Following the search, rescue and relocation activities and during pre-impoundment, the community should be allowed to access the basin to fell trees. Depending on the feasibility of supplying all the wood to the community, the excess plant material may be buried in the basin. Medicinal plants, which are of great value to the rural population, could also be lost though the activities associated with the project. An agreement needs to be reached with the tribal authority with regards to the harvesting of medicinal plants and firewood.

Consideration must be given whether the dam basin will be selectively de-bushed up to a predetermined level below the FSL, based on the following criteria (DWAF, 2008):

- Viability of commercial harvesting;
- Need of tribal authority and rural dwellers to harvest medicinal plants, firewood, etc.;
- Potential adverse impacts to water quality (including levels of dissolved oxygen) due to the decomposition of flooded vegetation; and
- Potential future use of impoundment, where the existing vegetation will pose dangerous obstacles.

As part of the future management plans to be developed for the project, a Search, Rescue and Relocation Plan is recommended that takes into consideration red data, protected and endangered flora and fauna species, medicinal plants, heritage resources and graves. For flora species, the following factors need to be considered (amongst others) as part of this plan:

1. Detailed plan of action (including timeframes, methodology and costs);
2. Site investigations;
3. Consultation with authorities, stakeholders and the Cele k Tribe;
4. Marking of species to be relocated;
5. Seeking of permits;
6. Identification of suitable areas for relocation;

7. Aftercare; and
8. Monitoring (including targets and indicators to measure success).

The following permits may need to be acquired:

- Permit from the Department of Agriculture, Forestry and Fisheries under the National Forests Act (No. 84 of 1998) if protected trees are to be cut, disturbed, damaged, destroyed or removed; and
- Permit from Ezemvelo KZN Wildlife for the relocation of species protected under the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and Natal Nature Conservation Ordinance (15 of 1974).

## Impact Assessment

| Environmental Feature | 13. Flora |
|---|---|
| Relevant Alternatives & Activities | **Both alternative dam sites; all activities within the construction domain; inundation of dam basin** |
| Project life-cycle | **Construction & operational phases** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Loss of vegetation of conservation significance through construction activities or inundation. | 13.1. Search, rescue and relocation plan to be developed for sensitive flora species within the construction domain and dam basin. Plan to be implemented in accordance with the project programme to ensure that these sensitive environmental features are rescued prior to potential impact occurrence. Ezemvelo KZN Wildlife to be consulted to ensure that the plan incorporates all these authority' requirements.<br>13.2. All relevant approvals to be obtained prior to relocation of red data, protected and endangered flora species and medicinal plants.<br>13.3. Any protected plants or trees in proximity to construction areas that will remain, should be clearly marked and must not be disturbed.<br>13.4. Adequate reinstatement and rehabilitation of areas disturbed by the construction activities – relevant to disturbed areas outside of dam basin and areas to be utilised for operational purposes.<br>**13.5.** RMP to investigate the establishment of a formal protected area around the OCS dam, which incorporates CBA zones. Possible community conservation areas to be explored in consultation with stakeholders. |
| • Proliferation of exotic vegetation in disturbed areas | 13.6. Control of alien invasive species and noxious weeds for areas disturbed by the construction activities, in accordance with the requirements of the Conservation of Agricultural Resources Act (No. 43 of 1983). Eradication method to be approved by the Project Manager.<br>13.7. Implement a monitoring programme for eradication of alien invasive plants and noxious weeds. |
| • Loss of medicinal plants<br>• Loss of firewood | 13.8. Search, rescue and relocation plan to include medicinal plants.<br>13.9. Trees felled should be made available to the Cele K Tribe and the local surrounding community, as far as practical.<br>13.10. No trees to be felled for fuel purposes. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | high | long-term | almost certain | 3 |
| **After Mitigation** | - | local | low | long-term | moderate | 1 |

## 12.6 Fauna

Permanent inundation caused by the reservoir will flood terrestrial habitat within the basin and the riparian zone, and will affected ecosystem connectivity. Depending on whether the basin will be de-bushed, certain slower moving animals may drown with the onset on inundation. Further ecosystem disruption may occur downstream of the dam wall along the tributary's banks (riparian area), which are usually associated with rich biodiversity.

Habitat will also be lost where clearing is done within the construction domain. Fauna could also be adversely affected through construction-related activities (noise, illegal poaching, and pollution of the biophysical environment). It is expected that sensitive fauna will move away from the area during the construction area phase.

Although isolated portions of the basins for both dam sites fall within SANBI's CBA 2 zones which are associated with high biodiversity, the majority of the inundated areas and footprint of the physical infrastructure are located within Eastern Valley Bushveld which has a status of 'least threatened'. It is expected that similar habitat as encountered within the dam basin is readily available in the greater area (characterised by a rural landscape) to allow for the habitation of relocated species, without resulting in competition with similar species for resources (depending on the conditions of the receiving habitat). The distribution ranges of those species found during the Terrestrial Ecology Assessment are also not restricted to the project area. In addition, the Aquatic and Riverine Assessment found that that the Gugamela and the Ncwabeni River local catchments were not unique and that numerous catchment areas of similar size and state of ecological integrity are associated with the system. It is assumed that these areas could provide alternative riparian habitat opportunities for those fauna species with a preference to riparian zones.

As mentioned, a Search, Rescue and Relocation Plan needs to be developed that takes into consideration red data, protected and endangered fauna species (amongst others). In this regard, attention will be given to the red data invertebrate species, namely the Strong black millipede (*Doratogonus infragili*) (Endangered) and Montane Black Millipede (*Doratogonus montanus*) (Least Concern). All relocations will need to comply with the requirements of Ezemvelo KZN Wildlife, in terms of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and Natal Nature Conservation Ordinance (15 of 1974).

In consultation with the relevant authorities, stakeholders and the Cele K Tribe, the future management of the dam will need to adequately consider the SANBI's CBA 1 and 2 zones in the northern part of the basin, and will need to promote connectivity between the up- and downstream ecosystems. The RMP could set aside an area that incorporates the CBAs (Ezemvelo KZN Wildlife and SANBI) for conservation purposes (e.g. a community conservation area), which could serve as a trade-off for the impacts associated with the impoundment, assuming that representative habitats occur within this earmarked area.

The EMPrs include measures to manage the potential adverse impacts to fauna associated with the construction activities.

**Impact Assessment**

| | |
|---|---|
| **Environmental Feature** | **14. Fauna** |
| **Relevant Alternatives & Activities** | **Both alternative dam sites; all activities within the construction domain; inundation of dam basin** |
| **Project life-cycle** | **Construction & operational phases** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Loss of habitat and animals of conservation significance through construction activities or inundation.<br>• Loss of livestock. | 14.1. Repeat mitigation measures 13.1 – 13.10<br>14.2. Search, rescue and relocation plan to be developed for sensitive fauna species within the construction domain and dam basin. Plan to be implemented in accordance with the project programme to ensure that these sensitive environmental features are rescued prior to potential impact occurrence. Ezemvelo KZN Wildlife to be consulted to ensure that the plan incorporates all these authority' requirements.<br>14.3. Proper access control to be maintained to prevent livestock from accessing construction areas.<br>14.4. Stringent and dedicated control of poaching. No fishing allowed. No wilful harm to any animals, unless a direct threat is posed to a worker's health or safety.<br>14.5. Captured animals to be safely released to a similar representative habitat. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | high | long-term | likely | 3 |
| **After Mitigation** | - | local | low | long-term | unlikely | 1 |

## 12.7 Air Quality

Dust will be generated during the construction period from various sources, including blasting, activities at the borrow areas, operations at the batching plant and crusher area, use of haul roads and access roads, and general construction activities on site.

The dam could contribute to greenhouse gas emissions, where inundated plant material that decays in an anaerobic environment will release methane and carbon dioxide.

No specialist air quality study was undertaken for the proposed Ncwabeni OCS Dam, as it was not deemed necessary for the type of activities associated with this project and considering the distance of sensitive receptors to the major construction activities, as well as the overall remoteness of the site. Mitigation measures are included in the EMPrs to ensure that the air quality impacts during the construction phase are suitably managed and that regulated thresholds are not exceeded.

**<u>Impact Assessment</u>**

| **Environmental Feature** | **15. Air Quality** |
|---|---|
| **Relevant Alternatives & Activities** | **Both alternative dam sites; all activities within the construction domain;** |
| **Project life-cycle** | **Construction phase** |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Excessive dust levels as a result of construction activities. | 15.1. Appropriate dust suppression measures or temporary stabilising mechanisms to be used when dust generation is unavoidable (e.g. dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Dust suppression to be undertaken for all bare areas, including construction area and access roads. Note that all dust suppression requirements should be based on the results from the dust monitoring and the proximity of sensitive receptors.<br>15.2. Speed limits to be strictly adhered to.<br>15.3. The Contractor will take preventative measures to minimise complaints regarding dust nuisances (e.g. screening, dust control, timing, pre-notification of affected parties).<br>15.4. Air quality to be monitored (baseline and during construction) for dust fallout and particulate matter. Sampling locations to consider major sources of dust and sensitive receptors. |

| | **+/- Impacts** | **Extent** | **Magnitude** | **Duration** | **Probability** | **Significance** |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium | short-term | likely | 2 |
| **After Mitigation** | - | local | low | short-term | unlikely | 1 |

## 12.8 Noise

During construction, localised increases in noise and vibration will be caused by the following:

- Operation of motorised vehicles for transportation of personnel, materials, and equipment to, from, and within the project site;
- Drilling and blasting operations;
- Operation of mobile and stationary motorised equipment within the project boundary (e.g. haul trucks, excavators, bulldozers, loaders, drill rigs, aggregate crushers, conveyor systems and generators);
- Operation of various auditory safety signals, alarms, or sirens (e.g., vehicle backup alarms and blast warning); and
- General construction activities on site

Sensitive receptors to noise include rural dwellings within the dam basin and to the east of the dam at site D3A. The staff quarters and farmhouse at Camro Estates are in excess of 1.5 km from the dam walls and abstraction works of both dam sites.

For option D3A the pipeline from the abstraction works will run past dwellings. Blasting and general construction activities during the installation of the pipeline may pose a nuisance to these nearby residents.

The pump station will be a source of noise during the operational phase of the project. However, the noise impacts need to be considered in terms of the remote nature of the dam sites.

Project personnel working on the construction site will experience the greatest potential exposure to the highest levels of noise and vibration. Workplace noise and vibration issues will be managed as part of the Occupational Health and Safety Management System to be employed on site, which will include specific measures aimed at preventing hearing loss and other deleterious health impacts.

Noise that emanates from construction activities are addressed through targeted best practices for noise management in the EMPrs.

**Impact Assessment**

| Environmental Feature | 16. Noise |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; all activities within the construction domain; |
| Project life-cycle | Construction phase |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Excessive noise levels as a result of construction activities. | 16.1. The provisions of SABS 1200A will apply to all areas within audible distance of residents.<br>16.2. Working hours to be agreed upon with Project Manager, so as to minimise disturbance to landowners and community members.<br>16.3. Construction activities generating output levels of 85 dB or more will be confined to normal working hours.<br>16.4. Noise preventative measures (e.g. screening, muffling, timing, pre-notification of affected parties) to be employed.<br>16.5. Blasting operations to be controlled to ensure sound pressure levels are kept below the generally accepted 'no damage' level of 140 decibels.<br>16.6. Noise to be monitored (baseline and during construction). Sampling locations to consider major noise sources and sensitive receptors. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium | short-term | likely | 2 |
| **After Mitigation** | - | local | low | short-term | unlikely | 1 |

## 12.9 Social Environment

The possible impacts of the project to the socio-economic environment during the construction phase include (amongst others):

- Relocation of D859 and increase in use of the D859 by construction vehicles;
- Nuisance from dust and noise;
- Safety of people and animals may be at risk during construction;
- Risk of STDs, HIV and AIDS infection due to an influx of workers and work seekers;
- Effects of job seekers and workers on existing social structures (e.g. increase in prostitution, unplanned and unwanted pregnancies, increase in alcohol and drug related incidents, pressure on local services, increase in local prices and the cost of living, cultural conflicts);
- Increased risk of criminal activity due to an influx of workers and activities during construction;
- An increase in the risk of fires due to construction and maintenance activities;

- The need to resettle households at site D3A due to the construction of the dam and infrastructure, and for the safe operation of the dam;
- Direct opportunities for Small Medium and Micro Enterprise (SMMEs);

The following impacts may occur during the operational phase of the project:

- The reservoir could become a breeding ground for various water-related diseases and water-related insect vectors such as snails and mosquitoes;
- The construction of the dam and the flooding of the reservoir are likely to disrupt routine farming operations at site D3A;
- Risk to people and livestock from drowning; and
- Restriction of access to the dam for desired use.

Adequate provision is made in the impact assessment to follow and in the EMPrs for managing the social impacts of the project.

Any development on sites D2 or D3A, which includes the project infrastructure and appurtenant works, would be subject to the consent of the Traditional Authority and the Ngonyama Trust Board. The landowners would need to be appropriately compensated for the acquisition of the land. Compensation would also be required for the relocation of graves, including exhumation and reburial.

Based on prior engagement with the tribal authority, the following measures are highlighted as important requirements and forms of landowner involvement:

- Local leaders should assist with the identification of possible graves, areas of cultural and religious significance as well as medicinal plants used by local traditional healers;
- All trees cleared for construction purposes must be harvested and provided to the villagers to use as firewood; and
- Local residents should benefit from any job opportunities granted by the project, where possible.

Land close to watercourses in the project area is valued from an agricultural perspective, for irrigation purposes. In this regard, damming of the Gugamela River at the D3A site will result in the loss of a number of areas currently used for subsistence farming. Many local households keep cattle and goats. Livestock currently have access to the rivers for drinking purposes. If the dam is to be fenced, then alternative watering points would need to be established for livestock. The need to take water directly from the rivers or the future dam for domestic use or livestock watering should be negated with the supply of potable water to the area by the UDM, where the water requirements of the Umzumbe area will be jointly met by the Mhlabatshane Scheme and proposed Ncwabeni OCS Dam.

On a positive note, employment opportunities will be created during the construction phase, with accompanying skills transfer. Where possible, goods and services will also be sourced locally during construction, and the local economy will be stimulated.

The RMP should, through public participation, understand and incorporate the needs of the local community with regards to the future use of the dam and the surrounding land.

An extract from the Social Impact Assessment (Dr Neville Bews & Associates, 2012) pertaining to the potential impacts to the social environment follows. Note that due to the overlap with the findings of the Socio-Economic Study, the impact assessment for this study is not repeated within the body of the EIA Report.

**Impact Assessment**

| Environmental Feature | 17. Social Environment - Access |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; re-alignment of D859 |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| **D2** | Negative | Local | Low | Short term | Almost certain | 1 |
| **D3A** | Negative | Local | Medium | Short term | Almost certain | 2 |

| Mitigation Measures |
|---|
| 17.1. Provide strategically distributed crossing points to secure existing routes currently used by both farmers and local communities;<br>17.2. Consult with property owners, local authorities and communities to ensure that all affected parties are informed of the timing and extent of any disruptions;<br>17.3. Ensure that service nodes such as schools, clinics, water sources, places of worship, etc. remain easily and safely accessible at all times; |

| Environmental Feature | 18. Social Environment – Crime & Security |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| D2 | Negative | Local | Low | Short term | Almost certain | 2 |
| D3A | Negative | Local | Low | Short term | Almost certain | 2 |
| Operational Phase | | | | | | |
| D2 | Negative | Local | Medium | Medium term | Almost certain | 2 |
| D3A | Negative | Local | Medium | Medium term | Almost certain | 2 |

**Mitigation Measures**

18.1. Where appropriate establish liaison structures with local police and communities to monitor changes during the construction phase;
18.2. Where necessary additional security should be provided;
18.3. Workers should be provided with identity cards and should wear identifiable clothing.

| Environmental Feature | 19. Social Environment – Fire Risk |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| D2 | Negative | Local | Medium | Short term | Almost certain | 2 |
| D3A | Negative | Local | Medium | Short term | Almost certain | 2 |

**Mitigation Measures**

19.1. Ensure that both construction and maintenance personnel are made aware of the risks and dangers of veld fires and that they behave in a manner so as to reduce the risk of fire.
19.2. Consider the viability of close co-operation between landowners and construction and maintenance teams to ensure an effective fire management strategy.

| Environmental Feature | 20. Social Environment – Health Issues |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Operational Phase | | | | | | |
| D2 | Negative | Local | Low | Long term | Moderate | 1 |
| D3A | Negative | Local | Low | Long term | Moderate | 1 |

**Mitigation Measures**

20.1. Follow mitigation measures recommended in the appropriate specialist report/s;
20.2. Put in place a system to monitor health risks throughout the life of the project;
20.3. Ensure that there is broad based representation, capable of serving all interests, in respect of the monitoring facility referred to above.

| Environmental Feature | 21. Social Environment – Subsistence Farming |
|---|---|
| Relevant Alternatives & Activities | Site D3A |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Operational Phase | | | | | | |
| D2 | Neutral | - | - | - | - | - |
| D3A | Negative | Local | Medium | Short term | Almost certain | 2 |

**Mitigation Measures**

21.1. Liaise with the tribal authority, farmers and, if appropriate, farmer associations with the aim of finding solutions to any disruptions that may threaten farming activities;
21.2. The introduction of measures to manage water quality during the construction phase.

| Environmental Feature | 22. Social Environment - Safety hazard (people and animals) |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| D2 | Negative | Local | Medium | Short term | Almost certain | 2 |
| D3A | Negative | Local | Medium | Short term | Almost certain | 2 |
| Operational Phase | | | | | | |
| D2 | Negative | Local | Low | Permanent | Almost certain | 2 |
| D3A | Negative | Local | Low | Permanent | Almost certain | 2 |

**Mitigation Measures**

22.1. Ensure that all equipment is maintained to the required safety standards;
22.2. Ensure that the appropriate safety procedures are in place and followed at all times during both construction and maintenance;
22.3. Fence off all construction sites to prevent people and animals from straying onto the site;
22.4. Install adequate warning signs warning of any imminent dangers.
22.5. Where feasible and in places of high risk consideration should be given to fencing these areas to prevent drowning;
22.6. Consider the viability of educating the population, especially children, in the vicinity of the dam as to the risk of drowning.

| Environmental Feature | 23. Social Environment – Job Creation |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| D2 | Positive | Local | Medium | Short term | Almost certain | 2 |
| D3A | Positive | Local | Medium | Short term | Almost certain | 2 |

**Mitigation Measures**

23.1. Use local labour as far as possible;
23.2. Create opportunities for the employment of women;
23.3. Where possible use labour-intensive methods of construction;
23.4. Where feasible introduce a programme to transfer skills particularly during the construction phase of the project

| | |
|---|---|
| **Environmental Feature** | **24. Social Environment – Resettlement** |
| **Relevant Alternatives & Activities** | **Site D3A** |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Construction Phase** | | | | | | |
| **D2** | Negative | Local | Low | Short term | Almost certain | 1 |
| **D3A** | Negative | Local | Medium | Short term | Almost certain | 2 |

**Mitigation Measures**

24.1. Consider the viability of engaging a specialist resettlement consultant to oversee the process;
24.2. Follow a recognised and acceptable relocation protocol;
24.3. Involve the affected communities and appropriate tribal authorities in the resettlement plan from commencement

| | |
|---|---|
| **Environmental Feature** | **25. Social Environment - Sense of place** |
| **Relevant Alternatives & Activities** | **Both alternative dam sites** |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Construction Phase** | | | | | | |
| **D2** | Negative | Local | High | Short term | Almost certain | 2 |
| **D3A** | Negative | Local | High | Short term | Almost certain | 2 |
| **Operational Phase** | | | | | | |
| **D2** | Neutral | Local | Low | Long term | Almost certain | 2 |
| **D3A** | Neutral | Local | Low | Long term | Almost certain | 2 |

**Mitigation Measures**

25.1. Consult with affected communities in an effort to identify and address issues relating to the visual impact and sense of place;
25.2. Reinstate the natural environment as swiftly as possible;
25.3. Where feasible, follow the recommendations of the biodiversity, conservation and visual impact specialist;
25.4. Consider the viability of the dam becoming a recreational facility.

| | |
|---|---|
| **Environmental Feature** | **26. Social Environment - STDs, HIV and AIDS risk** |
| **Relevant Alternatives & Activities** | **Both alternative dam sites** |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Construction Phase** | | | | | | |
| **D2** | Negative | National | Medium | Short term | Almost certain | 2 |
| **D3A** | Negative | National | Medium | Short term | Almost certain | 2 |

**Mitigation Measures**

26.1. The contractor should, in consultation with local HIV/AIDS organisations and government structures, design and implement a STD, HIV and AIDS awareness and prevention campaign for employees. This campaign should use various common practice methodologies in order to ensure social and cultural sensitivity.
26.2. The contractor should make STD, HIV and AIDS awareness and prevention programmes a condition of contract for all suppliers and sub-contractors.

| |
|---|
| 26.3. The contractor should provide an adequate supply of free condoms to all workers. Condoms should be located in the bathrooms and other communal areas on the construction site and at the construction camps.<br>26.4. If viable, a voluntary counselling and testing programme should be introduced during the construction phase. This should be undertaken in conjunction with the existing VCT programmes within the region. |

| Environmental Feature | 27. Social Environment – Social Stability |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites |

| Site | Nature/status | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| Construction Phase | | | | | | |
| D2 | Negative | Local | Medium | Short term | Almost certain | 2 |
| D3A | Negative | Local | Medium | Short term | Almost certain | 2 |

| Mitigation Measures |
|---|
| 27.1. Communication channels must be maintained between the contractor and local community structures in an effort to maximise the employment of local labour.<br>27.2. Make condoms readily accessible to workers.<br>27.3. Liaise with the South African Police Services and community structures to ensure that the workforce is controlled.<br>27.4. Where appropriate, workers from other area should be provided with adequate on-site temporary accommodation and amenities.<br>27.5. On completion of the work all temporary accommodation must be dismantled and removed to prevent the development of informal settlements |

## 12.10 Traffic & Access Roads

The D859 constitutes the main access route to Ward 1, which is used as a public transport route by the local community leading to the D922 and to the dwellings located within the D3A basin and beyond. Sections of the D859 fall within the basins of both OCS dam sites. The sections that will become inundated will be re-aligned, as shown in the layout contained in **Appendix B1**.

During the construction period there will be a significant increase in traffic on the main and district roads leading to the site, due to the delivery of plant and material, transportation of staff and normal construction traffic. This impact will be exacerbated if construction material is to be obtained from a commercial source, which is not anticipated. Haul roads and access roads will also be created on site, within the construction domain.

Despite the remote nature of the project area and relative low traffic volumes on the D859, the impacts to traffic and local access roads during the construction phase include the following:

- Current road condition inadequate to cater for construction traffic;
- Disruptions to traffic due to re-alignment and upgrading of the D859 (increases in significance during periods when road usage increases, such as funeral processions, church services, etc.);
- Slipping off heavy vehicles on steep gradients during wet conditions;
- Safety risks to existing road users and pedestrians using the D859 (e.g. blind rises, sharp bends);
- Increase in dust generated from the dirt roads; and
- Dangerous access onto D859 from P68-2 Main Road (St Faiths Road) (sharp bend, steep slope, poor road condition) (see **Figure 78**).

The EMPrs include mitigation measures associated with the re-alignment and use of the D859 and the establishment and use of access roads during the construction phase. This includes measures to address the safety, accommodation of existing traffic, access to homesteads, dust suppression and engagement with the local community. Local residents will also benefit from the proposed upgrade of the D859.


**Figure 78: Access from P68-2 Main Road onto D859 (Google Earth image)**

**Impact Assessment**

| **Environmental Feature** | **29. Traffic & Access Roads** |
|---|---|
| **Relevant Alternatives & Activities** | **Both alternative dam sites; all activities within the construction domain; re-alignment of the D859** |
| **Project life-cycle** | **Construction phase** |

| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
|---|---|
| • Inadequate road conditions;<br>• Disruptions to existing road users;<br>• Safety risks;<br>• Increase in dust levels;<br>• Dangerous access from P68-2 Main Road. | 29.1. Undertake negotiations and confirm arrangements with the Cele K Tribe regarding the use of the D859 and traffic arrangements.<br>29.2. Determine and document the road conditions of the D859.<br>29.3. Selective upgrade of the D859 to ensure that it is capable of accommodating the type of vehicles and/or mechanical plant using the road.<br>29.4. Any clearing for access or haul roads outside the demarcated works area shall only be undertaken after approval from the Project Manager.<br>29.5. Temporary access roads outside of dam basin to be suitably rehabilitated.<br>29.6. Ensure temporary accommodation of traffic, where the D859 is being worked on.<br>29.7. Make provision for community members to access their homesteads.<br>29.8. Speed limit of 40km/h on public and other roads within the project area to be adhered to.<br>29.9. Permission required from the Project Manager for the movement of any vehicles and/or personnel outside of designated working areas.<br>29.10. Access roads to be maintained in a suitable condition.<br>29.11. Suitable erosion protective measures to be implemented for access roads during the construction phase.<br>29.12. Traffic safety measures (e.g. traffic warning signs, flagmen) to be implemented.<br>29.13. Clearly demarcate all access roads. Clearly mark pedestrian-safe access routes.<br>29.14. Ensure that service nodes such as schools, clinics, places of worship, etc. remain easily and safely accessible at all times.<br>29.15. Ensure safe access onto the D859 from the P68-2 Main Road (including suitable signage and road condition).<br>29.16. Implement measures (e.g. water tanker) to manage dust from access roads, as necessary. |

| | **+/- Impacts** | **Extent** | **Magnitude** | **Duration** | **Probability** | **Significance** |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium-high | short-term | almost certain | 3 |
| **After Mitigation** | - | local | low | short-term | moderate | 1 |

## 12.11 Visual Quality & Tourism

### *12.11.1 General*

A substantial area will be cleared within the construction domain to build the physical infrastructure associated with the project and to accommodate the construction camp, workshop, batching plant, storage areas and access roads. The construction EMPrs provide mitigation measures to address these impacts.

There is a possibility that the large construction workforce may need to be accommodated on site, as suitable facilities may not be available in the surrounding rural area and travelling distance to nearby towns may not be favourable. Should this be the case, a separate EMPr should be developed to manage the impacts linked to providing accommodation facilities.

Linear disturbance associated with the project, namely the pipeline, re-aligned D859 and new access road to the abstraction works, will cause scarring and visual impacts. The infrastructure that is situated outside of the dam basin (abstraction weir, abstraction works, pump station, offices) will also serve as visual intrusions in the landscape. Through adequate reinstatement and rehabilitation, and considering the general absence of sensitive visual receptors, these impacts can be mitigated to such an extent that the residual impacts are rendered as insignificant.

For site D3A, construction material for the rockfill dam will most likely not all be available within the basin and the quarry that has been identified within the D2 basin will need to be established. This will create a visual impact external to the basin, which will not be inundated and will require rehabilitation. The benefit of site D2 is that all construction material will be source from within the basin.

The labour camps for both sites D2 and D3A are located outside of the dam basin (see **Figures 15 – 16**). The camps will be screened to a certain extend by the natural topography. The construction EMPr for the OCS Dam includes mitigation measures to address the various impacts associated with the onsite accommodation of labour. It is anticipated that the permanent site offices will be built within the same area that has been earmarked for the labour camp.

Although the dam will alter the rural terrestrial landscape, the large water body can contribute to the visual quality of the area. Dams are also popular sites for tourists to visit. Measures can also be employed to lessen the visual impact of the main embankment (e.g. allowing for vegetation growth, staining of concrete to more natural colours), as shown in the example in **Figure 79**. If the dam and the surrounding land are suitably managed, the overall impact on the visual quality will not be regarded as significant and the tourism potential of the project could possibly be leveraged through the RMP.

**Figure 79: Screening of embankment with vegetation – Berg River Dam (picture courtesy of TCTA)**

During periods of low water levels the draw down zone along the shoreline of the dam will present a visual impact. Releases from the dam will occur in the winter months when river flows are low, which is primarily from June/July to October. This implies that the draw down zone could be visible for a period of 3 – 4 months, depending of the climatic conditions and water requirements. The Ncwabeni site (D2) is more remote and less visible than the Gugamela site (D3A) which has more human habitation in the surrounding area.

An extract from the Visual Impact Assessment (Axis Landscape Architecture, 2012) pertaining to the impacts to the visual quality of the project area follows.

### *12.11.2 Landscape Impacts*

#### 12.11.2.1 Loss of bushland during construction

The proposed development will cover large areas of bushland in order to accommodate the proposed dam. Due to the sloping topography, vegetation and existing land-use the area has a high Visual Absorption Capacity (VAC).

#### 12.11.2.2 Alteration to existing tributaries

The existing tributaries and rivers are currently in a moderately good state. During construction, the earthworks will expose soil that will visually contrast in colour with the vegetated areas surrounding it. The water diversion structures and earthworks equipment will permanently detract from the existing character. Due to the high VAC of the area the permanent character change will only be experienced on a local level.

#### 12.11.2.3 Change in surface cover

The site preparation and construction stage will cause high levels of visual contrast. Portions of the vegetated surface cover will be cleared to make way for the new proposed development. The exposed soil and the presence of construction equipment, material stockpiles, site offices and construction camps will contrast in colour and form with the receiving environment. The high VAC of the receiving environment will minimise the exposure of the construction activity.

The construction areas will cause a moderately high character change due to greater visual contrast that will be visible between the construction site and the receiving environment.

### *12.11.3 Visual Impacts*

Severity of visual impact refers to the magnitude of change to specific visual receptor's views. Severity of visual impact is influenced by the following factors:

- The viewer's exposure to the development;
- Distance of observers from the proposed development;
- The visibility of the proposed development;

- Number of affected viewers;
- Duration of views to development experienced affected viewers; and
- Degree of visual intrusion created by the development.

#### 12.11.3.1 Residents

The residents of the surrounding villages will be affected by the construction of the proposed dam due to their proximity to the site. This is especially applicable to the residents within the catchment area of the dam. The visibility of the construction activity will be high especially when construction occurs near the boundary of the site, which is closest to the affected receptors. The active operation of construction equipment may generate dust clouds and noise that will increase resident's awareness of the operation. The construction activity will cause unsightly views as the soils are exposed and the disorganised arrangement of stockpiles, site offices and construction equipment dominate the scene.

Visual intrusion will increase as the project nears completion and the site is cleared of construction elements.

Residents outside the 2 km radius zone will not experience the full extent of the development and may only be exposed to fragmented views of the construction phase and completed development due to the topography that screens most of the site. The visual intrusion is considered to be minimal and the distance between the observers and the proposed development is in itself a mitigating factor. The severity of visual impact for both stages of the development will be *low*.

#### 12.11.3.2 Recreational Users and Tourists

Only tourists travelling on the local district gravel road will experience views of the site and the construction activity. The visual intrusion, caused by the exposed soil and the construction operation will be low.

The visual exposure will be relatively low considering the number of tourists travelling these roads. Their duration of views of the construction activities will be short, only lasting for a few minutes. The severity of visual impact is low.

#### 12.11.3.3 Motorists

During construction, traffic delays may occur due to construction on the road verges or heavy vehicle circulation on the roads. The traffic delays increase motorist's awareness and increase the duration of their exposure to views of the construction activity. The severity of visual impact will be *moderate* during the construction stage and will decrease to *low* severity once the development is completed.

**Impact Assessment**

| Environmental Feature | 30. Visual Quality |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; all activities within the construction domain |
| Project life-cycle | Construction and operational phases |
| **Potential Impact** | **Proposed Management Objectives / Mitigation Measures** |
| • Reduction in visual quality due to construction activities.<br>• Visual impacts associated with the operation of the dam. | 30.1. On-going housekeeping to maintain a tidy construction area.<br>30.2. The site will be shielded / screened to minimise the visual impact, where practicable.<br>30.3. Where practicable, development designs to compliment the natural surroundings in order to preserve a sense of place.<br>30.4. In general, no slopes steeper than 1(V):3(H) are permitted in cut-and-fill areas (outside dam basin), unless otherwise specified by the Project Manager. Steeper slopes require protection. New slopes must mimic the natural slopes and topography, where possible.<br>30.5. All borrow pits and quarries situated outside of the dam basin to be created, operated and rehabilitated in accordance with the EMPR, as authorised by the Department of Mineral Resources.<br>30.6. After the construction phase, the areas disturbed that are located outside of the dam basin and that are not earmarked for operational purposes must be rehabilitated by appropriate landscaping, levelling, topsoil dressing, land preparation, alien plant eradication and vegetation establishment.<br>30.7. Monitor the re-growth of invasive vegetative material (outside of the dam basin).<br>30.8. Manage encroachment of exotic vegetation in the dam draw down zone, as necessary. |

| | +/- Impacts | Extent | Magnitude | Duration | Probability | Significance |
|---|---|---|---|---|---|---|
| **Before Mitigation** | - | local | medium-high | short - medium-term | almost certain | 2 |
| **After Mitigation** | - | local | medium | short-term | likely | 1 |

The impacts assessment for the visual quality and associated attributes is supplemented by the following evaluation conducted as part of the Visual Impact Assessment (Axis Landscape Architecture, 2012).

| Environmental Feature | 31. Visual Quality – Landscape Impact & Visual Impacts |
|---|---|
| Relevant Alternatives & Activities | Both alternative dam sites; all activities within the construction domain |

| LANDSCAPE IMPACT – LOSS OF BUSHLAND DURING CONSTRUCTION | | | | | | | |
|---|---|---|---|---|---|---|---|
| Activity | Nature of Impact | Extent of impact | Duration of impact | Severity of impact | Probability of impact | Significance | |
| | | | | | | Without Mitigtion (WOM) | With Mitigation (WM) |
| Removal of bushland during construction phase. | Negative – Removing landscape elements that are fundamental in establishing a valued landscape character | Regional | Permanent | High | Highly probable | High | Moderate |

| LANDSCAPE IMPACT – ALTERATION TO EXISTING TRIBUTARIES AND RIVERS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Activity | Nature of Impact | Extent of impact | Duration of impact | Severity of impact | Probability of impact | Significance | |
| | | | | | | WOM | WM |
| Alteration to existing tributaries and rivers – construction phase | Negative – Removing and altering landscape elements that contribute to the local character of the area. | Local | Permanent | Moderate | Definite | Moderate | Low |
| Upgrading and maintaining the tributaries to a high standard – operational phase | Positive – Re-configuration and maintaining a high quality landscape feature with visual appeal | Local | Permanent | Moderate | Definite | Low | N/A |

| LANDSCAPE IMPACT – CHANGE IN SURFACE COVER | | | | | | | |
|---|---|---|---|---|---|---|---|
| Activity | Nature of Impact | Extent of impact | Duration of impact | Severity of impact | Probability of impact | Significance | |
| | | | | | | WOM | WM |
| Completed development in 5 years time | Negative – Adding additional land uses that alter the bushland character of the site and cause a loss of open space. | Regional | Permanent | Moderate | Definite | Moderate | Low |

| **Nature:** Potential impact on villages and settlements | |
|---|---|
| **Extent** | Local (2) |
| **Duration** | Permanent (5) |
| **Magnitude** | High (4) |
| **Probability** | Definite (5) |
| **Significance** | Moderate (55) |
| **Status (positive or negative)** | Negative |
| **Reversibility** | Irreversible |
| **Irreplaceable loss of resources?** | Yes |
| **Can impacts be mitigated?** | Minimally |
| **Cumulative impacts** | Limited cumulative visual impacts are expected |
| **Residual Impacts** | N/A |

| **Nature:** Potential impact on local and international tourists | |
|---|---|
| **Extent** | Local (2) |
| **Duration** | Short term (1) |
| **Magnitude** | Moderate (3) |
| **Probability** | Medium Probability (3) |
| **Significance** | Low (18) |
| **Status (positive or negative)** | Negative |
| **Reversibility** | Irreversible |
| **Irreplaceable loss of resources?** | Yes |
| **Can impacts be mitigated?** | Minimally |
| **Cumulative impacts** | Limited cumulative visual impacts are expected |
| **Residual Impacts** | N/A |

| **Nature:** Potential impact on motorists using local and major routes | |
|---|---|
| **Extent** | Local (2) |
| **Duration** | Short term (1) |
| **Magnitude** | Low (3) |
| **Probability** | Medium Probability (3) |
| **Significance** | Low (18) |
| **Status (positive or negative)** | Negative |
| **Reversibility** | Irreversible |
| **Irreplaceable loss of resources?** | Yes |
| **Can impacts be mitigated?** | Minimally |
| **Cumulative impacts:** | Limited cumulative visual impacts are expected |
| **Residual Impacts** | N/A |

| **Mitigation Measures** | |
|---|---|
| 31.1. | If practically possible, locate construction camps in areas that are already disturbed or where it isn't necessary to remove established vegetation like for example, naturally bare areas; |
| 31.2. | Keep the construction sites and camps neat, clean and organised in order to portray a tidy appearance; |
| 31.3. | Remove rubble and other building rubbish off site as soon as possible or place it in a container in order to keep the construction site free from additional unsightly elements; |
| 31.4. | Locate the construction camps and the material stockpiles outside of the visual field of sensitive visual receptors; |
| 31.5. | Rehabilitate or vegetate disturbed areas as soon as practically possible after construction. This should be done to restrict long stages of exposed soil and possible erosion that will result in indirect landscape and visual impacts; |
| 31.6. | If construction is necessary during night time, direct light sources away from residential units and roads; |
| 31.7. | Dust suppression procedures should be implemented especially on windy days during earth works, as necessary; |
| 31.8. | Maintain the landscape to a high aesthetic standard to retain a high visual quality for visitors and |

| | |
|---|---|
| | observers; |
| 31.9. | All declared weeds and alien vegetation growing in the site reserve must be removed and controlled; |
| 31.10. | An ecological approach to rehabilitation measures, as opposed a horticultural approach to landscaping should be adopted wherever possible. For example communities of indigenous, preferable endemic, plants enhance bio-diversity and blend well with existing vegetation. This ecological approach costs significantly less to maintain than conventional landscaping methods and is more sustainable in the long term. |

## 12.12 'No-Go' Impacts

The no-go alternative, which implies maintaining the status quo, provides the baseline against which the impacts of the other project options are compared.

An Economic Study (contained in **Appendix E10**) was conducted for the proposed Ncwabeni OCS Dam to determine *inter alia* the socio-economic benefits/losses for the region if the project is not implemented. An Economic Cost Benefit Analysis was performed and the Net Present Value and the Economical Internal Rate of Return were determined. An interpretation of the calculations was made, including the social, economic and environmental benefits and disbenefits of the project. The full spectrum of opportunity costs (shadow prices) was estimated where applicable and applied in the econometric model.

This study found that in terms of the of the construction phase the impact to the Provincial Gross Domestic Product (GDP) will amount to approximately R 485 million (in constant, 2012 prices), of which the direct impact is estimated at R 313 million. The impact of the total average annual GDP, during the operational phase, on the Provincial GDP is estimated to amount to approximately R 4.82 million (in constant, 2012 prices), of which the direct impact is estimated at R 1.92million. This emphasises the importance of the so-called multiplier effects which the water supply will have on the South African economy.

The Cost Benefit Analysis concluded that the project is economically feasible, which is further emphasised by interpreting the results of the analysis in the context of the socio-political imperative to supply water to the population (Conningarth Economists, 2012).

The implications of the 'no go' option are as follows:

- Disadvantages -
    - The water deficit in the Mzimkhulu River, particularly with the implementation of the Reserve, will mean that the water requirements of the supply area are at risk of not being met during low flow conditions;
    - Water supply shortfalls could adversely affect the various water user sectors, and could suppress development with related socio-economic implications;
    - Over-utilisation of water resources will adversely affect the ecological functioning of the Mzimkhulu Estuary;
    - The optimal beneficial use of water in the Mzimkhulu River will not be achieved; and
    - The unnecessary loss of surplus water that could be stored for later release will continue.
- Advantages –
    - The environmental issues associated with the project would be irrelevant and the local receiving environment would not be affected by the project-related activities; and
    - The rural nature of the land will remain unchanged, with the primary use entailing dispersed settlements, subsistence farming and natural areas.

Through the mitigation of the identified impacts associated with the various phases of the project life-cycle, and considering the nett benefits that accompany the OCS Dam (as opposed to maintaining the status quo), it is concluded that the no-go option should be rejected in order for the objectives of the project to be met.

## 12.13 Cumulative Impacts

| Box 4: | What is a "Cumulative Impact"? |
| --- | --- |
| According to GN No. R543 (18 June 2010), a ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area. | |

Cumulative impacts can be identified by combining the potential environmental implications of the proposed Ncwabeni OCS Dam with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area.

### *12.13.1 Water Resource Management*

The design of the OCS dam made provision for the 2035 planning horizon. As the flow in the Mzimkhulu is currently un-regulated, with no other impoundments in the system, the OCS dam will not contribute to a cumulative impact in this regard.

The Aquatic and Riverine Assessment found that the Gugamela and the Ncwabeni River local catchments were not unique and that numerous catchment areas of similar size and state of ecological integrity are associated with the Mzimkhulu River system that could provide alternative habitat opportunities for aquatic biota. It should be noted that the significance of this impact is dependent on the cumulative impact of developments of this nature. The OCS dam is regarded as an isolated development within a catchment area that does not suffer significantly from this impact. Cumulative impacts associated with possible future impoundments within the Mzimkhulu River catchment area will have to be carefully evaluated during the environmental assessments for these new dams.

The reported Mhlabatshana dam project may have an impact on the Ncwabeni dam design. According to the design phase of the Mhlabatshane Dam, the Mzimkhulu River will possibly augment the water supply of the Mhlabashane Dam. The cumulative impact of both dams abstracting water from the Mzimkhulu River must be managed to ensure that the Reserve, as protected in terms of the National Water Act (Act No. 36 of 1998), is not compromised.

The Mzimkhulu River is known for heavy silt loads. Construction activities within or alongside the watercourses and run-off from bare areas could contribute to the siltation of the main stem. Suitable provision for stormwater management and mitigating water quality impacts are included in the EMPrs.

### *12.13.2 Socio-Economic Environment*

The project was initiated to meet the water demands in the Umzimkhulu RWSS. The water deficit in the Mzimkhulu River, particularly with the implementation of the Reserve, will mean that the water requirements of the supply area are at risk of not being met during low flow conditions. The proposed Ncwabeni OCS Dam together with other interventions (e.g. WC/WDM) will allow the UDM to cater for the water demands within the specific supply scheme on a sustained basis. In turn, this will have a positive impact on the macro socio-economic environment.

If the UDM provides water to the surrounding community from the OCS Dam, more people may relocate to the area that is to be serviced in order to gain access to water. The settlement on this tribal land is managed by the Cele K Tribe. However, the UDM and the Department for Cooperative Governance and Traditional Affairs may need to intervene where settlement conflict could arise over the provision of water services.

### *12.13.3 Transportation Network*

The construction period will be associated with traffic-related impacts to the local road network (notably the D859 from P68-2). However, no other large-scale developments are known to be earmarked for the greater area, and there is thus no cumulative impact to the transportation network. The traffic generated by the NPC-Cimpor Simuma Facility and commercial farming practices, which are all situated on the opposite side of the Mzimkhulu River, makes use of a different main road (P262) as the one used to access the OCS dam site.

### *12.13.4 Air Quality*

The Simuma Facility, which is a source of particulate matter in the district, is situated approximately 10 km to the south-east of site D2. The dust pollution from site should thus not create a cumulative impact with the activities of the cement production plant.

#### *12.13.5 <u>Biodiversity</u>*

Exotic vegetation is encountered in the project area and is mostly associated with grazing and disturbances linked to subsistence livelihoods. Large areas will be cleared during the construction phase of the project and all disturbed areas outside of the dam basin will need to be appropriately rehabilitated to ensure that a cumulative impact is not caused in this regard.

Through the Search, Rescue and Relocation Plan a concerted effort will be made to prevent the loss of red data, protected and endangered fauna and flora species that will be affected by the project. With the relocation of these species to suitable habitat, and the potential to use the RMP as a mechanism for the establishment of a formal protected area around the OCS dam which incorporates the CBA zones (Ezemvelo KZN Wildlife and SANBI), the cumulative impact to biodiversity could be adequately managed.

#### *12.13.6 <u>Visual Quality</u>*

In order to provide for the water requirements of the surrounding community, the UDM will need to build the necessary infrastructure to purify the water from the OCS dam and to reticulate to water to the users / standpipes. Additional disturbances caused by these construction activities and the physical infrastructure could result in a cumulative impact to the visual quality of the area. The RMP must include measures to rehabilitate all areas that have been disturbed by the infrastructure associated with the building and operation of the OCS dam.

# 13 ANALYSIS OF ALTERNATIVES

Alternatives are the different ways in which the project can be executed to ultimately achieve its objectives. Examples could include carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the project.

The section provides an appraisal of all the environmental and technical considerations associated with the various alternatives through a comparative analysis to eventually distil the Best Practicable Environmental Option (BPEO). Münster (2005) defines the BPEO as the alternative that "*provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term*".

## 13.1 OCS Scheme Alternatives

A number of phases and iterations of identifying, comparing and selecting alternative options to meet the growing water demands of the Umzimkhulu RWSS have been conducted (see screened alternatives discussed under **Section 6.1**). The construction of an OCS dam as part of a larger scheme of upgrading the current infrastructure and linking it to other existing systems was found to be the preferred alternative. Only alternatives pertaining to the location of the OCS dam were taken forward into the EIA comparative analysis, as the other project options were rejected for technical reasons, as shown in **Table 53** (refer to project description contained in **Section 6**).

**Table 53: Summary of Alternatives**

| Feature | Alternatives | Preferred | Technical Reasons |
|---|---|---|---|
| 1. OCS Dam Location | a) Ncwabeni River - D2 & D2A<br>b) Gugamela River - D3 & D3A | (i) Ncwabeni River – D2<br>(ii) Gugamela River – D3A | Topography, hydrology, geotechnical conditions, environmental screening |
| 2. Dam Type | a) RCC gravity dam<br>b) Zoned earthfill embankment dam<br>c) CFR dam | CFR dam | Costs and availability of construction material |
| 3. Abstraction Weir location | a) Gugamela Site<br>b) Upper Site<br>c) Lower Site | Lower Site | Hydraulics, hydrology, geotechnical conditions |

## 13.2 Environmental Screening Investigation

The Ncwabeni: Off-Channel Storage Dam Feasibility Study: Module 1: Technical Study: Environmental Screening Investigation (BKS, 2011), was undertaken to identify potential environmental (biophysical, socio-economic and enviro-legal) issues of concern pertaining to the two alternative dam sites.

The screening assessment was undertaken using a rating approach, where the possible risks associated with each environmental issue were rated using the following rating system:

- Favourable (rated at 4 points);
- Uncertain (rated at 3 points) – there is uncertainty regarding the nature and extent of the impact primarily due to a lack of information on site-specific conditions;
- Not Favourable (rated at 2 point); and
- Fatal flaw (rated at 1 point) – where there could be an impact that cannot be mitigated.

**Table 54** presents a summary of the risk assessment and the numbers reflect the **sums** of the abovementioned ratings allocated to all risks associated with each environmental issue. For example, the overall risk rating with regards to the 'Fauna/Flora' is rated 6 at site D2 and 8 at site D3A where the lower score reflects a less favourable option based on the potential impact to the environmental feature.

The risk assessment did not identify any fatal flaws. However, it noted that the environment is sensitive and requires proper assessment and management. Alternative D2 is more sensitive in terms of the ecological aspects, while Alternative D3A is more sensitive in terms of social aspects (BKS, 2011).

**Table 54: Risk Assessment Summary from Environmental Screening Investigation (BKS, 2011)**

| Environmental issue | Site D2 | Site D3A |
|---|---|---|
| **Biophysical** | | |
| Geology | 7 | 7 |
| Soil | 3 | 4 |
| Fauna/Flora | 6 | 8 |
| Riverine ecosystem | 14 | 15 |
| Water quality | 13 | 13 |
| Hydrology | 8 | 8 |
| **Social** | | |
| Agricultural | 10 | 10 |
| Heritage | 3 | 3 |
| Displacement of persons | 10 | 6 |
| Health & safety | 8 | 8 |
| Access route | 10 | 9 |
| Visual | 4 | 4 |
| Infrastructural development | 16 | 16 |
| **Economic** | | |
| Loss of local income due to project | 9 | 7 |
| Employment creation | 8 | 8 |
| **Enviro-legal** | | |
| Enviro-legal | 3 | 3 |
| Public Participation | 6 | 6 |
| **Total** | **139** | **135** |

## 13.3 "No Go" Option

As standard practice and to satisfy regulatory requirements, the option of not proceeding with the project is included in the evaluation of the alternatives.

Through a water balance analysis, the Southern KwaZulu-Natal Water Resources Pre-feasibility Study concluded that there will be no excess water to supply the requirements of the Lower South Coast Area once the Reserve is implemented and that there are already shortfalls in supply without taking into consideration the Reserve (DWAF, 2002).

Detailed investigations have been conducted to date to exhaust the various options to meet the water demands of the Lower South Coast Water Supply System, and to advance towards identifying the current feasible project alternatives.

The implications of the ‘no go’ option are discussed in **Section 12.12**. The ‘no go’ alternative is not supported, as failure to provide storage infrastructure in the form of the OCS dam on the Mzimkhulu River will jeopardise the ability of the Ugu District Municipality to cater for the water demands of the MWSS.

## 13.4 Specialist Studies

The sub-sections to follow present the findings of the various specialists in terms of their respective preferences for the alternative OCS dam site.

### *13.4.1 Terrestrial Ecology Assessment*

The table to follow compares the two proposed OCS dam sites based on factors associated with the terrestrial ecology.

**Table 55: Comparison of Alternatives from a Terrestrial Ecological Perspective (Nemai Consulting, 2012b)**

| Feature | D2: Ncwabeni | D3A: Gugamela |
|---|---|---|
| Existing human habitation | × Not preferred | × Preferred |
| Potential occurrence of the Red Data millipede species. | ✓ Preferred Site | × Not preferred |
| Re-alignment of D859 will cover a smaller area and the rehabilitation will be on a lesser scale | ✓ Preferred Site | × Not preferred |
| Abundant alien invasive plant species | × Not preferred | × Preferred |
| Mammal species of conservation importance recorded on sites (Cape clawless otter) | ✓ Preferred Site | × Not preferred |
| Natural state of the area | × Not preferred | × Preferred |
| A new quarry will need to be created at site D2 if D3A is selected, as the possibility exists that material is not available within the D3A basin | ✓ Preferred Site | × Not preferred |
| Destruction of habitat for green mamba and pythons | × Not preferred | × Preferred |
| Critical Biodiversity Area | ✓ Preferred Site | × Not preferred |
| **Preferred** | × **Not preferred** | ✓ **Preferred Site** |

### *13.4.2 Aquatic and Riverine Assessment*

This sub-section was extracted from the Aquatic and Riverine Assessment (Enviross, 2012).

The Ncwabeni and Gaugamela Rivers incorporate catchment areas of similar land use, drivers and impacts. From the ecological surveys of each river, it was found that the Ncwabeni River supported a far greater diversity and density of aquatic biota than what was supported by the Gugamela River. The most significant difference in habitat characteristics noted during the survey was the water temperature. The Gugamela River showed a water temperature between 8 and 10°C colder than that of the receiving Mzimkhulu River. The Ncwabeni River showed a similar temperature to the Mzimkhulu River. This means that aquatic biota would naturally seek refuge or naturally inhabit the Ncwabeni River, freely migrating between the two channels. This would not be true for the Gugamela River as the relatively large temperature difference would form a temperature barrier which would not readily be crossed through, making this channel less important to aquatic biota as a refuge or for habitat exploitation. This temperature difference is presumed to be purely as a function of the localised catchment characteristics. The Gugamela River passes through ravine habitat, where steep banks and the generally closed canopy of the riparian vegetation means that the water does not have chance to be heated by the sun. It is also a system that could be heavily supplemented by underground water, which is naturally colder than surface waters within the given landscape. A poorly-constructed bridge crossing on the Gugamela River also poses as a migratory barrier under all but considerable high flow conditions, further inhibiting upstream recruitment of aquatic biota within this system. This is an impact that can be readily mitigated though by relatively simple and cost-effective means.

The Ncwabeni River has a waterfall (shown in **Figure 66**) that poses a natural migratory barrier approximately 4 km upstream of its confluence with the Mzimkhulu River. Therefore, even though a highly-productive section of river, the entire catchment area is not open to upstream recruitment by fish and many invertebrate species. This greatly decreases the significance of the impact of establishment of the impoundment on this river. This feature is not present on the Gugamela River, potentially making the Gugamela River catchment a far bigger catchment area open to exploitation by migrating aquatic biota. Therefore, placing the off-channel storage dam on the Ncwabeni River will not impact on the extent of the catchment area open to fish and many invertebrates in relation to if it was to be placed on the Gugamela River.

It was found that the Gugamela and the Ncwabeni River local catchments were not unique and that numerous catchment areas of similar size and state of ecological integrity are associated with the system that could provide alternative habitat opportunities.

A quarrying area has been identified in association with the Ncwabeni River. In order to accommodate the quarrying processes, a localised diversion of the Ncwabeni River will also be required. This quarry is proposed within an area that would be inundated should the Ncwabeni option for the OCS dam be favoured. If this is the case, then the excavated area will merely add in creating a larger storage capacity for the dam. No disturbed soils will also not be subjected to scouring impacts of flowing water as there will be minimal to zero water velocity encountered within the impoundment. If the Ncwabeni option is found to be the preferred option, then the diversion of the river will also be reduced to a short-term impact that will only be imposed on the system during the construction phase and during the initial phases whilst the impoundment fills. If the Gugamela River option is found to be the preferred alternative, the quarrying activities along the Ncwabeni River and the permanent diversion of the watercourse will have a long-term impact on the system. Diverting a river will lead to disturbances of the soils and the aggravation of soil erosion. The diversion of the watercourse will also alter the natural hydrology of the localised area, which could further aggravate erosion. If allowed to remain unabated, this has the potential to completely transform the system over the long term. If this aspect is looked at in isolation, then the Ncwabeni alternative site would be the option with the least overall ecological impacts, which could also be more readily managed.

In looking at the impacting features above and the various factors that will drive the pressures on the watercourses and catchment areas, the preferred alternative is to construct the OCS dam on the Ncwabeni River. The overall impacting features associated with the proposed construction activities can be localised and the impact footprint minimised in this way. The overall ecological condition of the catchment area is considered a major driver for the good PES ratings of the associated watercourses. The ecological integrity of the watercourses can be retained if the catchment impacts can be contained and localised, which will be the case if the OCS dam together with the quarrying activities are located within the same foot print area.

**Table 56: Comparison between the key findings and overall ecological implications of constructing a dam on the Gugamela or Ncwabeni Rivers (Enviross, 2012)**

| River | PES Rating | Level of support to aquatic biota | | Quarry activities & river diversion | Impacts of infrastructure on other watercourses |
|---|---|---|---|---|---|
| | | Fish | Macro-invertebrates | | |
| Ncwabeni | A | Medium to High – an impassable waterfall occurs 4km upstream of the confluence with the main channel | High | Preferred Ncwabeni option: Short term impacts, but eventual inundation will negate long-term impacts. It will reduce the overall footprint of the impact within the catchment area – important for long-term conservation significance. | Minimal |
| Gugamela | A/B | Low | Medium-High | Preferred Gugamela option: Quarrying activities at the Ncwabeni River will necessitate river diversion over the long term. Open quarries will have high, long-term impacts on the system, which are not readily managed. | Minimal, but will require more than three times the length of infrastructure, which will increase the impact footprint. |

### 13.4.3 *Socio-Economic Study*

The table to follow summarises the socio-economic factors considered in the selection of the preferred alternative, as compiled as part of the Socio-Economic Study (Nemai Consulting, 2012a).

**Table 57: Comparison between the two OCS Dam sites based on socio-economic factors (Nemai Consulting, 2012a)**

| Feature | D2: Ncwabeni | D3A: Gugamela |
|---|---|---|
| Influx of workers | ○ No Preference | |
| Relocation and resettlement | ✓ Preferred Site | × Not preferred |
| SMME Opportunities | ○ No Preference | |
| Employment | ○ No Preference | |
| Access | ✓ Preferred Site | × Not preferred |
| Industry | ○ No Preference | |
| Access to water and Health | ○ No Preference | |
| Agriculture | ✓ Preferred Site | × Not preferred |
| Tourism and Recreation | ○ No Preference | |
| Property Values | ○ No Preference | |
| Education | ○ No Preference | |
| **Preferred** | ✓ **Preferred** | × **Not preferred** |

Another factor to consider in the evaluation of the alternatives is the following cost implications associated with each of the schemes, which render site D2 a more favourable option due to the higher costs of D3A:

- Road alignment -
    - Site D3A requires a far greater distance of road to be diverted to accommodate the new basin;
- Relocation –
    - Site D2 requires the removal of maximum six graves and abandoned homesteads;
    - Site D3A requires the resettlement of three households and relocation of over 10 abandoned homestead or graves;
- Borrow material –
    - Site D3A will require a greater hauling distances to transport materials to the construction site;
    - With the quarries for site D3A located outside of the dam basin, the rehabilitation costs linked to the option would be far greater when compared to site D2.

#### *13.4.4 <u>Social Impact Assessment</u>*

This sub-section was extracted from the Social Impact Assessment (Dr Neville Bews & Associates, 2012).

Having considered both site D2 and site D3A it is clear that, on a social basis, no obvious fatal flaw exists relating to either site. It is, however, also clear that site D2 emerges as the socially preferred site on the following basis:

1. Access and infrastructure requirements are less affected in respect of site D2 as site D3A requires a significant length of road construction resulting in significant burden for maintenance being placed on the KZN Department of Transport;
2. Although there are no areas in any of the alternative dam sites suitable for intensive grazing or cultivation, various subsistence farming activities do occur and have been identified in site D3A; and
3. A number of households have been identified in the dam basin of site D3A, these households will require resettlement. The Department of Water Affairs and Forestry (2007a) has also identified a very strong attachment to the land by local communities.

Notwithstanding this, however, it is quite possible that the social preference could be overridden by either technical and/or biodiversity requirements.

### *13.4.5 Heritage Impact Assessment*

The Heritage Impact Assessment (Beater, 2012) found that that the majority of homesteads and possible associated graves are found in site D3A (Gugamela River dam site). It is therefore the opinion of the consultant that site D2 (Ncwabeni River dam site) is the preferred site for the location of the OCS dam as the least amount of graves will need to be exhumed and relocated and the least amount of homesteads will be submerged by the development. No archaeological sites will be affected by the inundation of the river valley.

### *13.4.6 Agricultural Potential Study*

The following conclusions were drawn in the Agricultural and Agribusiness Status Quo Assessment (Mzansi Agriculture, 2012):

- In the case of site D3A, less than 2 ha of land being illegally cultivated at less than 10 % of yield potential will be inundated.
- In the case of site D2 no agricultural land will be inundated.

Site D3A will thus be more impacted on by the proposed OCS dam from an agricultural perspective.

### *13.4.7 Visual Impact Assessment*

This sub-section was extracted from the Visual Impact Assessment (Axis Landscape Architecture, 2012).

The two alternative schemes for the proposed OCS dam are rated according to preference by using a two-point rating system in **Table 58**, one (1) being the most preferred, to two (2) being the least preferred. The preference rating is informed by the impact assessment and the overall performance of each alternative with regards to the impact on the landscape character and the identified viewers.

**Table 58: Evaluation of alternative layouts (Axis Landscape Architecture, 2012)**

| Alternatives | Preference Rating |
|---|---|
| **D2** | 1 |
| **D3A** | 2 |

The visual receptors that will be mostly affected are the residents within a 2 km distance from the site. The visual impact will be moderately high during the construction of the developments when unsightly views of the construction activity will be visible. The residents will experience a high level of visual exposure due to their proximity and the exposed soil, construction equipment and material stockpiles will cause severe visual intrusion.

### *13.4.8 Summary*

A summary of the preferred alternatives, as recommended by the respective specialists, is tabulated below.

**Table 59: Summary of Preferred Option recommended by Specialists**

| Specialist Study | D2: Ncwabeni | D3A: Gugamela |
|---|---|---|
| Terrestrial Ecology Assessment | | ✓ |
| Heritage Impact Assessment | ✓ | |
| Aquatic and Riverine Assessment | ✓ | |
| Agricultural Impact Assessment | ✓ | |
| Visual Impact Assessment | ✓ | |
| Socio-Economic Study | ✓ | |
| Social Impact Assessment | ✓ | |

## 13.5 Comparative Impacts of Alternatives

The table to follow compares the project alternatives based on the receiving environment (**Section 10**) and the outcome of the impact assessment (**Section 12**).

**Table 60: Comparative Adverse Impacts of Project Alternatives**

(*Note: Highlighted blocks indicate the preferred option for each environmental feature; where no blocks are highlighted, no obvious preference exists*)

| Environmental Feature / Attribute | D2: Ncwabeni | D3A: Gugamela | No-Go Option |
|---|---|---|---|
| **Land Use** | • D2 will inundate land of approximately 0.95 km$^2$.<br>• Tribal land, not currently utilised, in a natural state. | • D3A will inundate land of approximately 0.98 km$^2$.<br>• Various homesteads with subsistence farming on the tribal land. | No impact. |
| **Climate** | Basin is densely vegetated. Greater contribution to greenhouse gas emissions, due to decomposition of inundated vegetation. | Basin not as densely vegetated, due to human habitation. Less greenhouse gas emissions expected. | No impact. |
| **Topography** | • Steep gradients encountered at re-aligned section of D859, pipeline, spillway chute, new access road to abstraction works.<br>• Materials confirmed to all be available within the dam basin for rockfill embankment dam. | • Steep gradients encountered at re-aligned section of D859, pipeline, spillway chute, new access road to abstraction works.<br>• Longer re-alignment of D859 and longer pipeline.<br>• Materials most likely not all available within the basin and external quarry needed at site D2.<br>• Greater area disturbed - more reinstatement and rehabilitation required. | No impact. |
| **Surface Water** | • Slightly larger incremental catchment.<br>• Highest ichthyofaunal diversity.<br>• Similar water quality as Mzimkhulu Rivers means that it would be more readily utilised as a refuge tributary.<br>• Better habitat diversity and quality.<br>• A natural barrier (waterfall) occurs approximately 4km upstream of confluence with the Mzimkhulu River, therefore available habitat is limited.<br>• Other tributaries of similar PES are available as refuge channels within nearby catchment areas. | • Less diversity and numbers of fish and macro-invertebrates than Ncwabeni River.<br>• Differing water quality aspects means that the channel is not readily utilised as a refuge tributary.<br>• Migratory barrier (low-level bridge) already exists that has impacted on species community structures – this can be readily and economically mitigated to improve longitudinal connectivity.<br>• External quarry and river diversion on the Ncwabeni River will require long-term rehabilitation and management.<br>• No natural migratory barriers occur within the channel within the area, making the tributary open to upstream recruitment and colonisation by fish over a far greater | Requirements of the Ecological Reserve not catered for during low flow conditions. |

| Environmental Feature / Attribute | D2: Ncwabeni | D3A: Gugamela | No-Go Option |
|---|---|---|---|
| | | extent. | |
| **Terrestrial Ecology** | ✓ This site is in a more natural state.<br>✓ Greater biodiversity to be lost by inundation. . | • More disturbed through human habitation, overgrazing, subsistence agriculture and alien invasive plants.<br>• Larger construction domain - more reinstatement and rehabilitation required.<br>• Potential occurrence of the Red Data millipede species.<br>• Re-alignment of D859 will affect a larger area.<br>• A new quarry will need to be created at site D2 if D3A is selected, as the possibility exists that material is not available within the D3A basin. | Potential to create a formal protected area as part of the RMP will not be realised. |
| **Agriculture** | • No agricultural activities within basin. Steep gradient does not support agriculture. | • Loss of areas used for subsistence agriculture adjacent to homestead.<br>• Steep gradient does not support agriculture. | No impact |
| **Heritage resources** | • Less than 10 homesteads and graves affected. | • Many homesteads + graves (± 20) will be submerged / relocated.<br>• At least 1 occupied homestead with grave will be submerged and grave relocated. | No impact |
| **Social aspects** | No occupied dwellings in basin. | • Resettlement of occupied homesteads. | • Water deficit in the Mzimkhulu River will remain. Water requirements of the Umzimkhulu RWSS will be at risk of not being met during low flow conditions.<br>• No water provision from OCS dam to local community. |
| **Economic aspects** | Lower pumping head and shorter pipeline will mean lower costs. | Longer pipeline required and high operating costs. Longer road diversion for the D859. | |
| **Road network** | Section of D859 to be re-aligned = ± 1 000 m. | Section of D859 to be re-aligned = ± 5 000 m. | No impact |
| **Visual quality** | Natural landscape less disturbed. | • Site in less of a natural state due to past human disturbance.<br>• Larger external footprint outside of dam basin in terms of the following:<br>○ Longer re-alignment of the access road;<br>○ Longer pipeline; and<br>○ Borrow material may not be available from the Gugamela basin which | No impact |

| Environmental Feature / Attribute | D2: Ncwabeni | D3A: Gugamela | No-Go Option |
|---|---|---|---|
| | | may lead to the sourcing of quarry material from the identified site at Ncwabeni. Although this will be rehabilitated, it will mean additional scarring of the land outside of the proposed inundation area. | |

## 13.6 BPEO Selection

Based on the recommendations of the specialists, technical considerations and the comparison of the impacts associated with the two options for the location of the OCS, the optimum OCS scheme selected was a CFR Dam at site D2 on the Ncwabeni River (FSL of 167.5 m.a.s.l.) with a broad crested side channel spillway and a diversion weir, abstraction works, pipeline and access road. A layout drawing of the selected scheme is included in **Figure 80**.

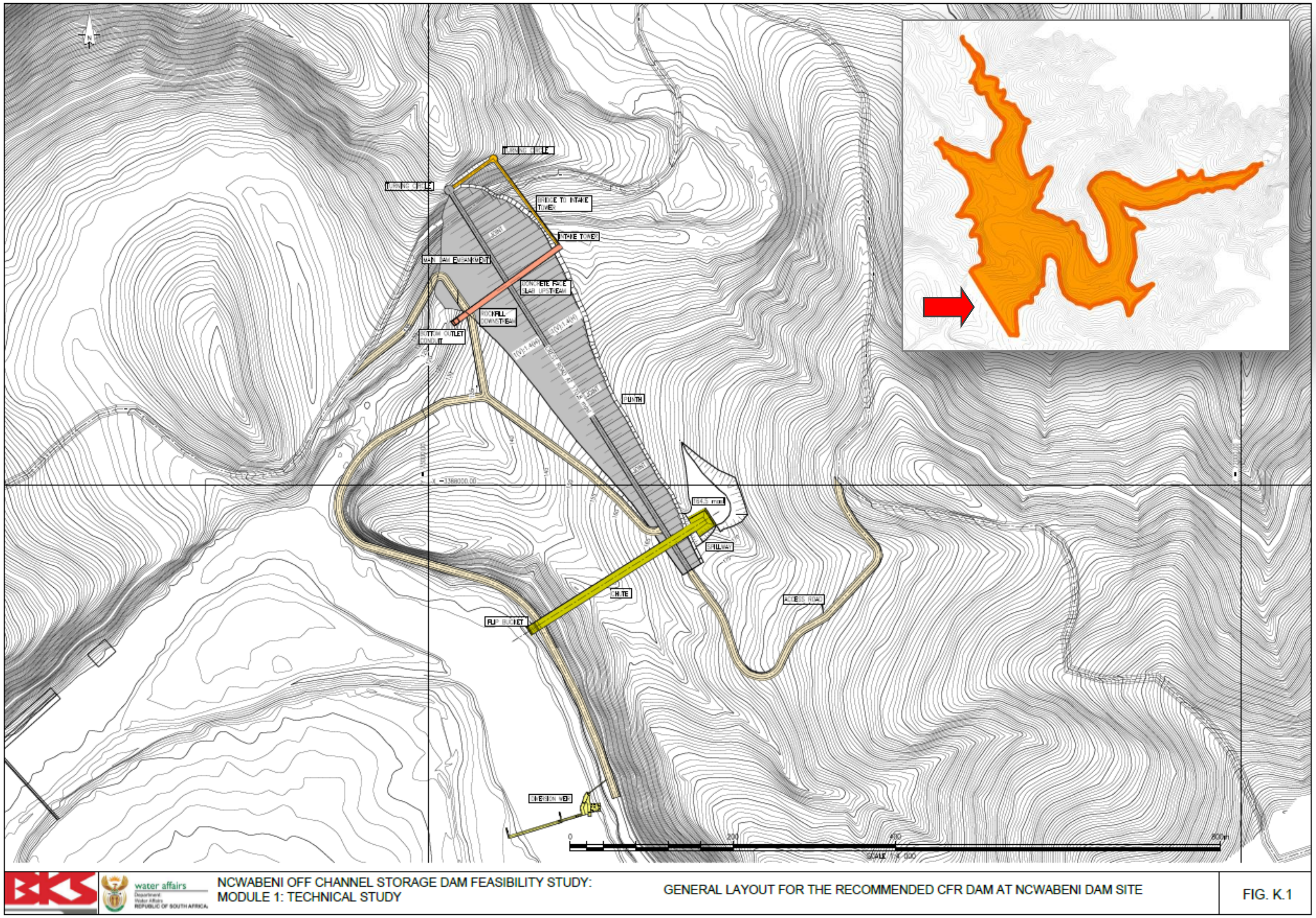



**Figure 80: General Layout for the BPEO at site D2**

# 14 PUBLIC PARTICIPATION – EIA PHASE

The purpose of public participation includes:

1. Providing I&APs with an opportunity to obtain information about the project;
2. Allowing I&APs to present their views, issues and concerns with regard to the project;
3. Granting I&APs an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
4. Enabling DWA and the project team to incorporate the needs, concerns and recommendations of I&APs into the project.

The public participation process that was followed for the proposed Ncwabeni OCS Dam is governed by NEMA and GN No. R. 543. **Figure 81** outlines the key milestones in the public participation process undertaken for the Scoping (completed) and EIA phases for the proposed Ncwabeni OCS Dam.


**Figure 81: Public Participation Process for the Ncwabeni OCS Dam**

The approved Plan of Study for the EIA (contained in the Scoping Report) stipulates the activities to be undertaken as part of the public participation for the project, in accordance with regulatory requirements, which forms the basis of the discussion to follow. Note that the public participation conducted for the Scoping phase will not receive attention in this section as it was comprehensively discussed in the Scoping Report. Emphases will thus primarily be placed on the EIA public participation process.

## 14.1 Maintenance of the I&AP Database

A database of I&APs (refer to **Appendix I**), which includes authorities, different spheres of government (national, provincial and local), parastatals, stakeholders, landowners, interest groups and members of the general public, was maintained during the EIA phase.

## 14.2 Notification – Approval of Scoping Report

Advertisements were placed in the following newspapers in November 2012 as notification that the Scoping Report had been approved by DEA:

- South Coast Fever (English);
- South Coast Herald (English); and
- Isolezwe (Zulu).

In addition, all I&APs on the database were notified of the approval of the Scoping Report via fax, email or registered mail.

## 14.3 Comments and Response Report

The EIA Comments and Response Report (contained in **Appendix H**) provides a comprehensive summary of comments, issues and queries received from I&APs to date (including the EIA phase). This Report also attempts to addresses the comments through input received from the project team.

All comments received following the public review of the Draft EIA Report were included in the EIA Comments and Response Report.

## 14.4 Review of Draft EIA Report

### *14.4.1 Notification*

I&APs were notified as follows of the opportunity to review the Draft EIA Report:

1. A notification letter of the Draft EIA Report was forwarded to I&APs; and
2. Advertisements were placed in the following newspapers in November 2012 (refer to copies of the newspaper advertisements contained in **Appendix J**):
   a) South Coast Fever (English);
   b) South Coast Herald (English); and
   c) Isolezwe (Zulu).

In addition, all I&APs on the database were also notified of the opportunity to review the Draft EIA Report via fax, email or registered mail.

### *14.4.2 Public Meeting*

The following public meeting was convened:

**Date:** 22 November 2012

**Time:** 14h00 – 16h00

**Venue:** Ugu District Municipality Offices, 96 Marine Drive, Oslo Beach, Port Shepstone

A meeting was also held with the Cele K Tribe on 22 November 2012.

The purpose of these meetings was as follows:

- To present the status of the EIA process;
- To present the project details;
- To present the findings of the specialist studies;
- To address key issues raised during the Scoping and EIA phases;
- To elaborate on the potentially significant environmental impacts, and the proposed mitigation of these impacts;

- To present the findings of the comparative analysis of the alternatives; and
- To allow for queries and concerns to be raised, and for the project team to respond.

The minutes of the above meetings are contained in **Appendix K**.

### *14.4.3 Regulatory & Commentary Authorities*

Copies of the Draft EIA Report were provided to the UDM and Umzumbe Local Municipality. Copies of the document were also provided to the following key regulatory and commentary authorities:

- KZN DAEA (Environmental Impact Assessment & Macro-Planning);
- Ezemvelo KZN Wildlife;
- DWA KZN Regional Office;
- DMR KZN Office;
- Amafa aKwaZulu-Natali;
- KZN Department of Agriculture, Forestry and Fisheries;
- KZN Department of Cooperative Governance and Traditional Affairs; and
- KZN Department of Transport.

### *14.4.4 Accessing the Draft EIA Report*

In accordance with Regulation 56 of GN No. R. 543 of 18 June 2010, registered I&APs were granted a 40-day review period for commenting on the Draft EIA Report. Copies of the report were placed at the locations provided in **Table 61**.

**Table 61: Locations for review of Draft EIA Report**

| Copy | Location | Address | Tel. No. |
|---|---|---|---|
| 1. | Port Shepstone Library | 10 Conner Street Port Shepstone | 039 688 2061 |
| 2. | Ugu District Municipality Offices | 96 Marine Drive, Oslo Beach, Port Shepstone | 039 688 5700 |
| 3. | Umzumbe Local Municipality | Mathulini Tribal Authority Sipofu Road | 039 972 0005 |

Copies of the Draft EIA Report were provided to the Cele K Tribe and to Camro Estates.

The Draft EIA Report could also be downloaded from the project website (www.ncwabeniocsdam.co.za).

### *14.4.5 Commenting on the Draft EIA Report*

A commenting period on the Draft EIA Report was granted from 19 November 2012 – 15 January 2013. In accordance with Regulation 57 of GN No. R. 543 of 18 June 2010, the comments received from I&APs (including correspondence and completed Comment Sheets) from the review of the Draft EIA Report were incorporated into the Comments and Response Report (contained in **Appendix H**). Copies of the comments are included in **Appendix G**.

### *14.4.6 Commenting on the Final EIA Report*

The Final EIA Report will be lodged in the public domain for a three week period. Any comments of the Final EIA Report must be submitted to the Department of Environmental Affairs (quote the Reference Number: NEAS Ref No: DEA/EIA/0000586/2011; DEA Ref. No: 12/12/20/2468) and must be copied to Nemai Consulting. The contact details are as follows:

*Department of Environmental Affairs*
*Mrs. Tebogo Mapinga*
*Tel: 012 395 1805*
*Fax: 012 322 2682*
*Postal Address: Private Bag X 447, PRETORIA, 0001*
*E-mail: TMapinga@environment.gov.za*

## 14.5 Notification of DEA Decision

All I&APs will be notified via email, fax or post within 10 days after having received written notice from DEA on the final decision for the Ncwabeni OCS Dam. Advertisements will also be placed in local and regional newspapers regarding the Department's decision. These notifications will include the appeal procedure to the decision and key reasons for the decision. A copy of the decision will also be provided to I&APs on request.

# 15 EIA CONCLUSIONS & RECOMMENDATIONS

## 15.1 Sensitive Environmental Features

Within the context of the project area, cognisance must be taken of the following sensitive environmental features, attributes and aspects, for which mitigation measures are included in the EIA Report and EMPrs:

1. All watercourses, which include natural drainage lines, are regarded as sensitive. The catchment areas of the major rivers (Mzimkhulu, Ncwabeni and Gugamela) in the area were found to have retained a high degree of functionality and overall integrity.
2. The project occurs within a low mountainous area, and steep slopes are encountered particularly in the river valleys and along sections of the D859 and the pipeline route (amongst others).
3. Red Data and protected fauna and flora species potentially occur in the project area, which need to be confirmed and safeguarded through a dedicated search, rescue and relocation exercise.
4. The sites are situated on communal tribal land that belongs to the Cele K Tribe. During the construction phase, a large labour force will be employed and a labour camp will be established on site, depending on the availability of accommodation in the greater area. The interaction between the labour force and the local community will need to be managed to avoid social instabilities.
5. Occupied homesteads with subsistence agricultural activities occur within the D3A site. A number of grave sites were identified within the D2 and D3A basins.
6. The Mzimkhulu River acts as a conduit for priority migratory species that require access to inland waters to complete their lifecycles.
7. The project area is afforded high aesthetic appeal through topographical features such as low mountains, valleys and watercourses. The area's natural state and dense vegetation further contribute to the visual quality encountered in the area.
8. The section of the D859 that will become inundated will need to be re-aligned.
9. Extensive areas need to be cleared as part of the construction activities. Proliferation of exotic vegetation could ensue in disturbed areas.

## 15.2 Environmental Impact Statement

Off the various alternatives considered to meet the water demands of the Umzimkhulu RWSS, an OCS dam at sites D2 or D3A were deemed to be the most suitable for various reasons, including factors related to the topography, hydrology, geotechnical conditions and the environment.

Dam sites on tributaries are known to have much less of an impact on the ecosystem than for those sites on the main stem. Avoiding dams on the main stem would support conservation initiatives, where the undammed nature of the Mzimkhulu River has been recognised by the National Freshwater Ecosystem Priority Areas programme and the river is ranked as one of the most important for conservation in the region.

The EWR determined as part of the Mzimkhulu River Catchment Water Resource Study were taken into account in both the yield analysis and technical design of the Ncwabeni OCS Dam. The water volumes in the Mzimkhulu River will be supplemented during low-flow conditions by measured releases from the OCS dam, which will improve the current situation in terms of the Reserve.

The Aquatic and Riverine Assessment found that the Gugamela and the Ncwabeni River local catchments were not unique and that numerous catchment areas of similar size and state of ecological integrity are associated with the Mzimkhulu River system that could provide alternative habitat opportunities for aquatic biota.

On a local level, the surrounding community will benefit directly from the OCS dam, as the UDM has committed to making water available from the dam. This was one of the major issues highlighted during meetings to date with the Cele K Tribal Authority.

The comparative analysis showed that site D2 on the Ncwabeni River is preferred over site D3A on the Gugamela River by the majority of the specialists and taking into consideration the impacts to sensitive environmental features. Where site D3A was more favourable, the residual impacts associated with site D2 following the recruitment of mitigation were not regarded as sufficiently significant or overriding to sway the ultimate selection towards site D3A.

One of the key factors that further promoted the selection of site D2 as the preferred option related to the possible absence of suitable material for the building of the CFR Dam at site D3A that would have necessitated the establishment of quarries at site D2. This will substantially enlarge the development footprint of site D3A and will involve the reinstatement and rehabilitation of the quarries, as they will be located outside of the eventual dam basin. Approval would also be required from DMR in terms of Section 106(2) of the MPRDA for sourcing material outside of the area to be impounded. The alternative would be to obtain material from another source, which would lead to considerable cost implications and impacts associated with the hauling of the material. In the case of site D2 this impact is negated, where the quarries fall within the dam basin.

With the selection of the BPEO for the location of the OCS dam, the adoption of the mitigation measures include in the EIA Report and the dedicated implementation of the suite of EMPrs, it is believed that the significant environmental aspects and impacts associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

## 15.3 Recommendations

The following key recommendations, which may also influence the conditions of the Environmental Authorisation (where relevant), accompany the EIA for the Ncwabeni OCS Dam:

1. The operating rules of the OCS dam will need to be based on the following requirements-
   a. Water to be abstracted for storage during the summer months once flows in the Mzimkhulu River are greater than that needed to satisfy downstream users, and to

be released back into the Mzimkhulu River in winter months to augment flows lower than that required by downstream users; and

b. The EWR of the Mzimkhulu River and Estuary need to be catered for.

2. Existing communication channels need to be duly respected and adhered to when engaging with the Cele K Tribe. Specific requirements highlighted by the tribal authority include –
   a. Tribal authority to be involved with the identification of graves and medicinal plants;
   b. Fire wood generated during site clearing activities to be made available to the community; and
   c. Local residents should benefit from any job opportunities granted by the project.
3. Apart from the abstraction weir, abstraction works, pump station, pipeline, spillway and permanent offices, the construction domain needs to be contained within the dam basin area as much as possible to avoid disturbance outside of the eventual impoundment footprint. All external areas that are not associated with permanent infrastructure and the operation of the dam need to be adequately rehabilitated.
4. It is recommended that the following EMPrs be developed as further information becomes available during the implementation of the project:
   a. Search, Rescue and Relocation Management Plan for red data, protected and endangered species, medicinal plants, heritage resources and graves;
   b. Ncwabeni OCS Dam Impoundment EMPr;
   c. Rehabilitation Management Plan for disturbed areas outside of the dam inundation area; and
   d. Operational EMPr.
5. As discussed in the EMPr, various forms of monitoring is required to ensure that the receiving environment at the Ncwabeni OCS Dam is suitably safeguarded against the identified potential impacts, and to ensure that the environmental management requirements are adequately implemented and adhered to during the execution of the project. The types of monitoring to be undertaken include –
   a. Baseline Monitoring needs to be undertaken to determine to the pre-construction state of the receiving environment, as serves as a reference to measure the residual impacts of the project by evaluating the deviation from the baseline conditions and the associated significance of the adverse effects;

   b. Environmental Monitoring - entails checking, at pre-determined frequencies, whether thresholds and baseline values for certain environmental parameters are being exceeded; and
   c. Compliance Monitoring and Auditing - The independent Environmental Control Officer (ECO) to monitor and audit compliance against the EMPrs and Environmental Authorisation.
6. It is suggested that the Water Research Commission undertakes future studies on the greenhouse gas footprint of the Ncwabeni OCS Dam.
7. Recommendations from the Aquatic and Riverine Assessment (Enviross, 2012) -
   a. It is recommended that the bridge crossing at the Gugamela River be improved so that it does not inhibit upstream migrations of aquatic biota. This will also compensate for the loss of the river ecosystem associated with the OCS dam on the Ncwabeni River; and
   b. A vertical slot fishway channel has been recommended to be incorporated into the weir design on the Mzimkhulu River. A follow-up monitoring programme is recommended to determine the overall functionality of the fishway.
8. Recommendations from the Heritage Impact Assessment (Beater, 2012) -
   a. A second phase Heritage Impact Assessment needs to be undertaken that systematically surveys the footprint of the proposed dam identifying all affected graves and homesteads. Depending on the results of this survey, the recommended mitigation measures regarding the removal of the directly affected graves need to be confirmed. Public advertising and detailed consultation with affected family and community to be carried out before relocation of the graves. Approval from the affected family and permission from Amafa must be received before the exhumation process begins.
   b. Prior to the construction of the abstraction weir in the Mzimkhulu River, the area on the right bank of the River must be surveyed by an archaeologist.
9. Considerations during the development of the RMP -
   a. Where feasible, ecosystem connectivity needs to be promoted between the upstream catchment and the system downstream of the dam wall;
   b. Investigate possibility of setting aside an area within the purchase line which includes the CBA and other sensitive features for conservation purposes, which could serve as a trade-off for the impacts associated with the impoundment;

c. Consider access to and utilisation of the OCS Dam by the surrounding rural community (e.g. stock watering);
d. In support of the Umzumbe Local Municipality SDF, which indicates that the dam sites are located in an area that has particular value in terms of tourism, the future use of the dam for recreational purposes needs to be adequately considered as well as the assigning of land use objectives that are commensurate with the tourism vision.
e. Include measures for the on-going rehabilitation and maintenance of vegetation in all the areas that have been disturbed by the infrastructure associated with the building and operation of the OCS dam.

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# APPENDIX A

AMENDED APPLICATION FORM

&

DEA APPROVAL OF SCOPING REPORT

# APPENDIX B

## LAYOUT DRAWINGS

## APPENDIX B1

*ALTERNATIVE LAYOUTS FOR THE TWO SCHEMES*

# APPENDIX B2

*TYPICAL CROSS-SECTION FOR A CFR DAM*

# APPENDIX B3

*MAIN EMBANKMENT AT SITE D2*

# APPENDIX B4

*SPILLWAY, CHUTE AND FLIP BUCKET*

# APPENDIX B5

*DIVERSION WEIR AND ABSTRACTION WORKS*

# APPENDIX B6

*PROPOSED QUARRY AREAS*

# APPENDIX B7

*LOCALITY MAP*

# APPENDIX C

CURRICULA VITAE OF EAPS

# APPENDIX D

CORRESPONDENCE FROM KZN DEA - GN NO. R. 546

# APPENDIX E

## SPECIALIST STUDIES

# APPENDIX E1

*AQUATIC AND RIVERINE ASSESSMENT*

# APPENDIX E2

*TERRESTRIAL ECOLOGY ASSESSMENT*

# APPENDIX E3

*HERITAGE IMPACT ASSESSMENT*

# APPENDIX E4

*SOCIO-ECONOMIC STUDY*

# APPENDIX E5

*SOCIAL IMPACT ASSESSMENT*

# APPENDIX E6

*VISUAL IMPACT ASSESSMENT*

# APPENDIX E7

*AGRICULTURAL AND AGRIBUSINESS STATUS QUO*

# APPENDIX E8

*ASSESSMENT OF POTENTIAL IMPACTS ON THE MZIMKHULU ESTUARY*

# APPENDIX E9

*INVERTEBRATE SURVEY*

# APPENDIX E10

*ECONOMIC STUDY*

# APPENDIX E11

*DECLARATIONS BY SPECIALISTS*

# APPENDIX F

ENVIRONMENTAL MANAGEMENT PROGRAMMES

(DRAFT)

# APPENDIX F1

*PRE-CONSTRUCTION EMPr*

# APPENDIX F2

*CONSTRUCTION EMPr - OCS DAM*

# APPENDIX F3

*CONSTRUCTION EMPr - RE-ALIGNMENT OF D859*

# APPENDIX F4

*CONSTRUCTION EMPr - ABSTRACTION WEIR, ABSTRACTION WORKS, PIPELINE AND ACCESS ROAD*

# APPENDIX G

## COMMENTS FROM I&APS – SCOPING & EIA PHASES

# APPENDIX G1

*SCOPING PHASE*

# APPENDIX G2

*EIA PHASE*

# APPENDIX H

COMMENTS AND RESPONSE REPORT

# APPENDIX I

## DATABASE OF I&APs

# APPENDIX J

COPIES OF NEWSPAPER ADVERTISEMENTS

# APPENDIX K

## MINUTES OF PUBLIC MEETINGS