water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

# RICHARDS BAY RECONCILIATION STRATEGY STUDY

## Interventions Workshop


Facilitated by:
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Aurecon


4 Feb 2015

# Programme

10H30: Welcome and Attendance
Tea/Coffee/Snacks

10H45: SESSION 1

13H15: LUNCH

13H45: SESSION 2
Remainder of evaluated interventions

15H30: Tea/Coffee/Snacks

15H45: SESSION 3
Remainder of evaluated interventions (if required)

16H30: CLOSURE

# Agenda

- Introduction
- Potential future shortfall
- Interventions Task
- Evaluated Interventions
- Scenario Planning
- Way Forward

# Introduction

# Purpose of Study

- Development of a strategy for interventions to meet possible water requirements in Richards Bay & surrounding towns up to 2040
- Determine potential options / groups of options – that form reconciliation scenarios – each of which could potentially be implemented
- Identify information needed & time frame to implement the strategy

# Strategy Area

- uMhlathuze Local Municipality area
- Extended to include:
  - RBM mining areas, Fairbreeze mine & some rural domestic supply areas
  - Intervention source areas
- For modelling purposes the entire Mhlatuze catchment, with water imports into and exports from the catchment is considered

# Workshop Objectives

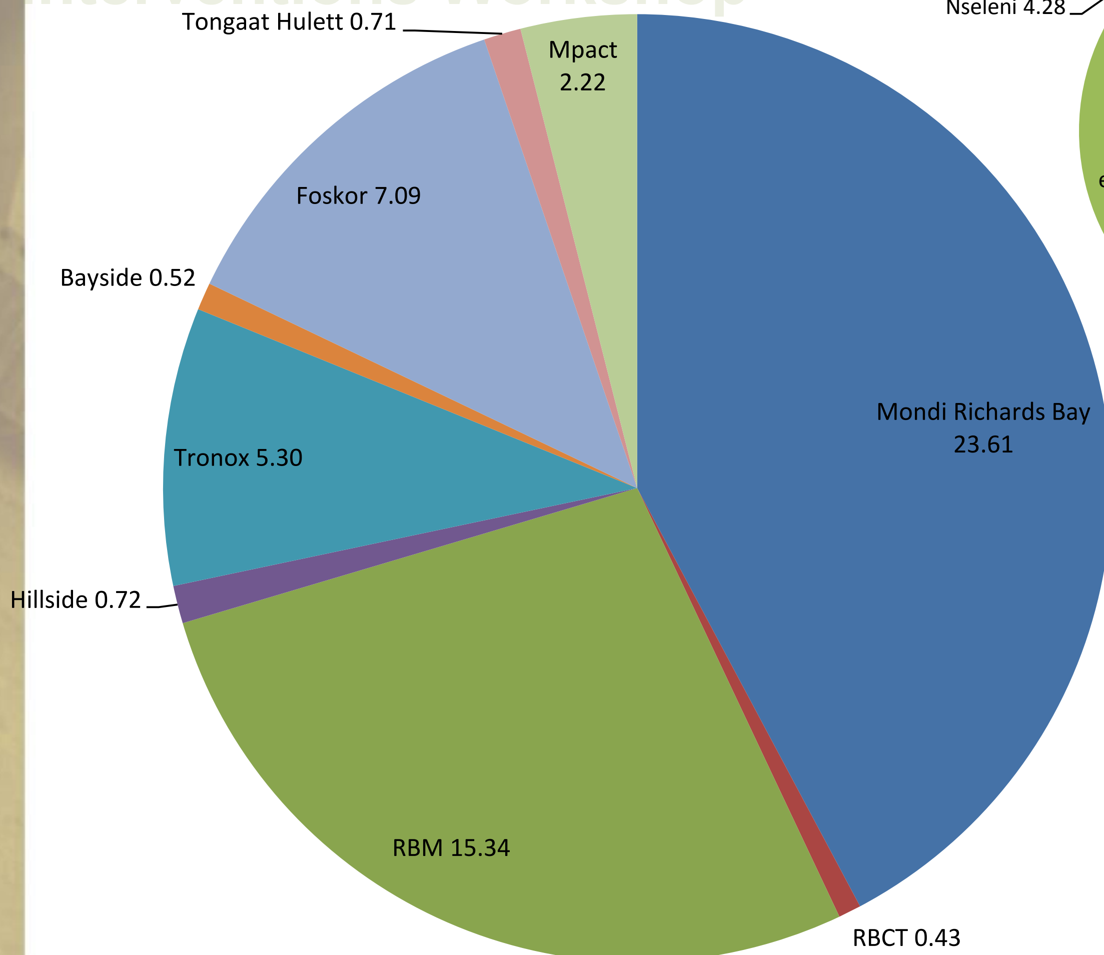
- Revisit interventions identification & shortlisting
- Present evaluations of short-listed interventions
- Invite comment on intervention features
- Recommend interventions to evaluate in the Scenario Planning

# Potential future shortfall

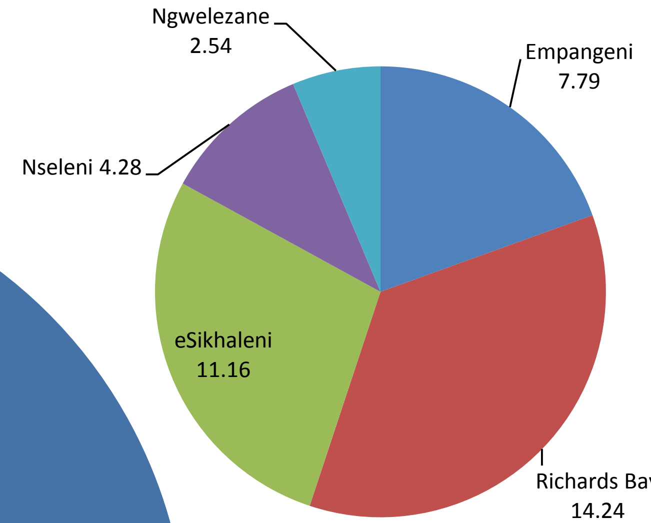
Interventions Workshop

## Current Industrial Usage (million m³/a)

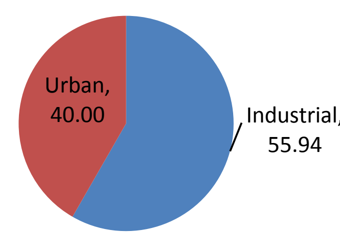
Interventions Workshop

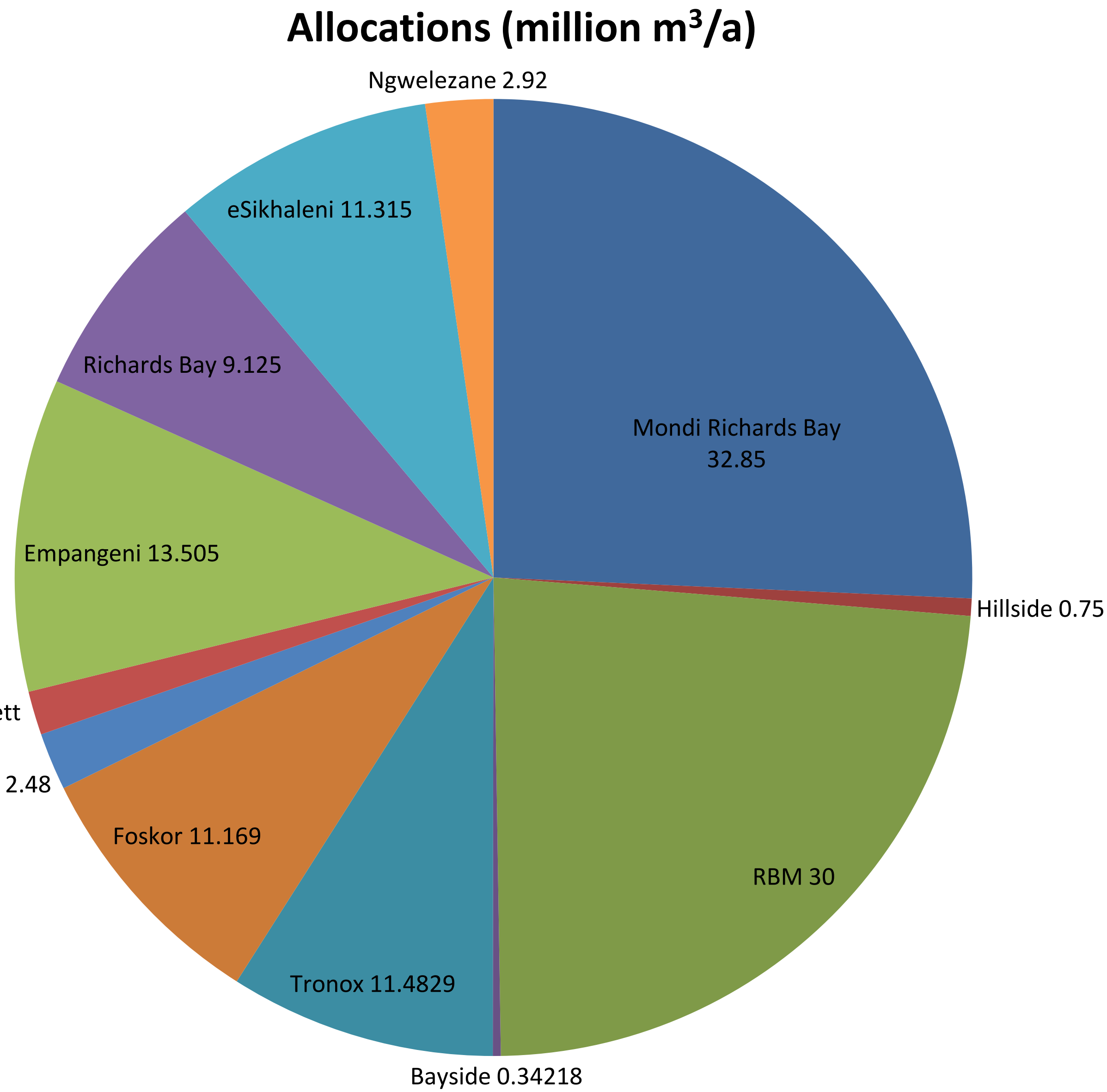



## Current Domestic Usage (million m³/a)

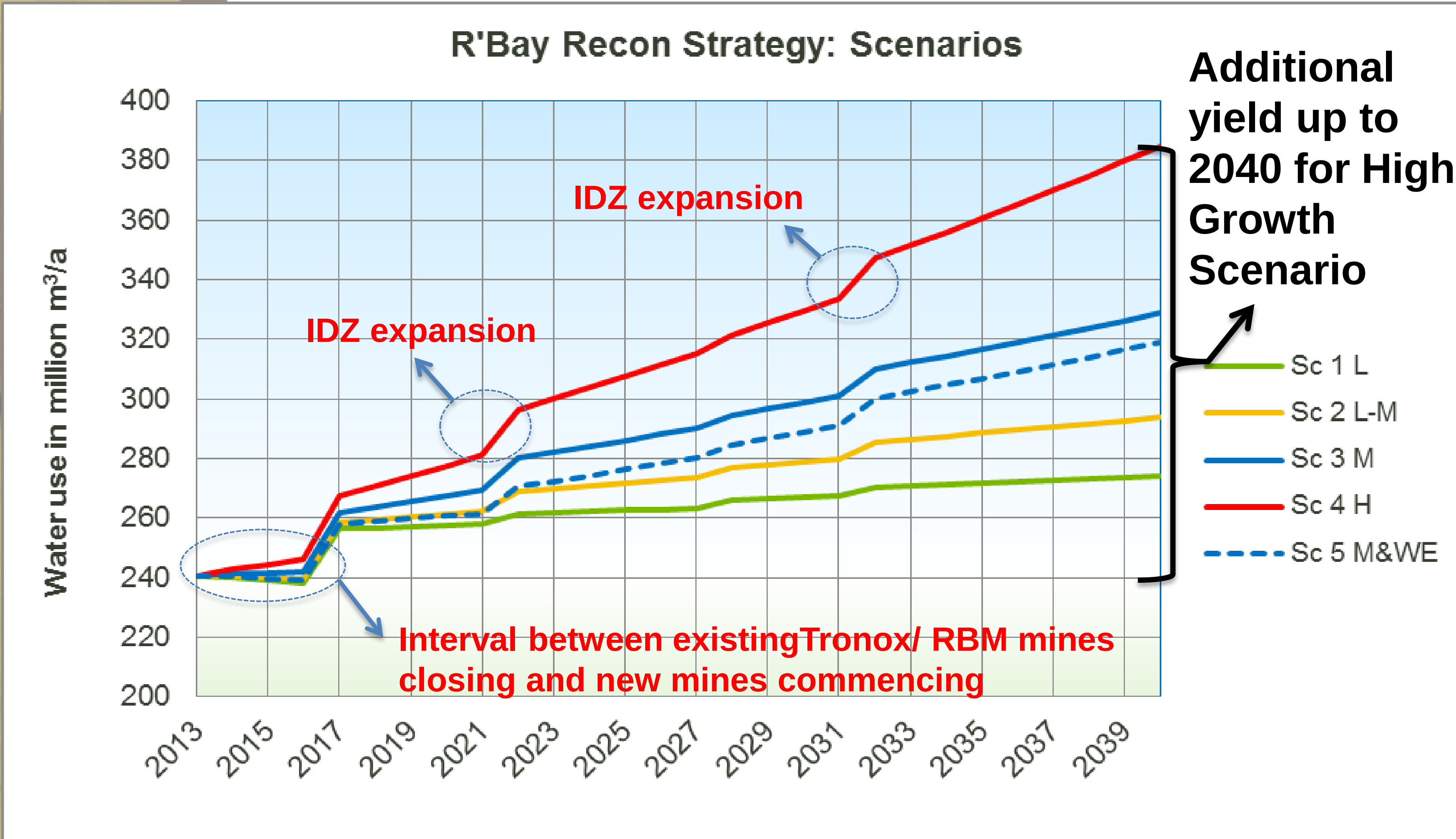



## Current Water Usage




Allocations (million m³/a)
Ngwelezane 2.92
eSikhaleni 11.315
Richards Bay 9.125
Mondi Richards Bay 32.85
Empangeni 13.505
Hillside 0.75
Tongaat Hulett 1.888
Mpact 2.48
Foskor 11.169
RBM 30
Tronox 11.4829
Bayside 0.34218

# Future requirements scenarios



# Interventions Task

# Intervention Options

- Identified long-list of intervention options
- Screened out some options based on expected feasibility & other factors (with stakeholders)
- Defined short-list of options to evaluate further
- Comparative evaluation of short-listed options at desktop level done:
  - Conceptual planning & evaluation of technical, financial, environmental, social & strategic features
  - Documented according to a standardised template

# Intervention Categories

- Improved water use efficiency (WC/WDM)
- Improved operation of the Richards Bay WSS
- Water reallocation
- Revisiting users' assurances of supply
- Land care
- Thukela River inter-basin transfer schemes
- Mfolozi River inter-basin transfer schemes
- Mhlathuze River dams
- Other surface water supply schemes
- Groundwater schemes
- Use of treated effluent
- Desalination
- Water supply infrastructure

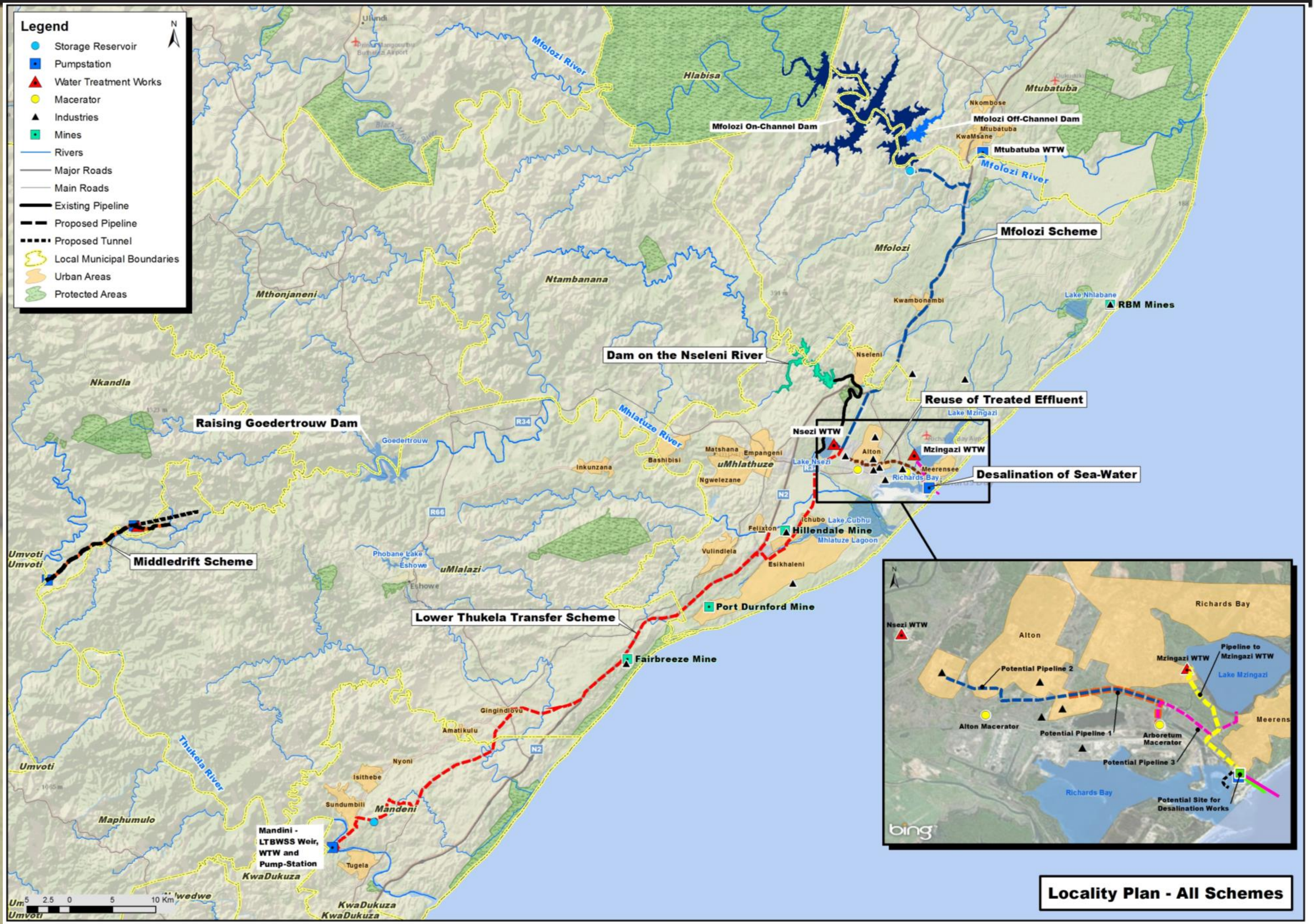
# Long List / Short List

- About 40 interventions identified
  - Some could be subdivided into further options
- Initial shortlist identified at previous Stakeholder Meeting
- *Raising of Goedertrouw Dam* added after meeting
- *Artificial recharge of WSS lakes* dropped for desktop evaluation after some investigation
- 13 Interventions further evaluated
  - Some with phases / variations

# Short Listed Interventions

- Bulk industrial WC/WDM
- Urban WC/WDM
- Rainwater harvesting
- Limiting supply from over-abstracted coastal lakes
- Thukela-Mhlathuze Transfer Scheme
- Coastal pipeline from the lower Thukela River
- Mfolozi River: Kwesibomvu Dam transfer scheme
- Mfolozi River off-channel dam transfer scheme
- Raising Goedertrouw Dam
- Dam on the Nseleni River
- Groundwater schemes
- Arboretum Effluent Reuse Scheme
- Desalination of seawater

# Evaluated Interventions


Legend
Storage Reservoir
Pumpstation
Water Treatment Works
Macerator
Industries
Mines
Rivers
Major Roads
Main Roads
Existing Pipeline
Proposed Pipeline
Proposed Tunnel
Local Municipal Boundaries
Urban Areas
Protected Areas
Mfolozi On-Channel Dam
Mfolozi Off-Channel Dam
Mtubatuba WTW
Mfolozi River
Mfolozi Scheme
Hlabisa
Mtubatuba
Mfolozi
Ntambanana
Mthonjaneni
RBM Mines
Dam on the Nseleni River
Reuse of Treated Effluent
Raising Goedertrouw Dam
Nsezi WTW
Mzingazi WTW
Desalination of Sea-Water
Mhlatuze River
uMhlathuze
Nkandla
Middledrift Scheme
Hillendale Mine
Port Durnford Mine
Lower Thukela Transfer Scheme
Fairbreeze Mine
uMlalazi
Thukela River
Maphumulo
Mandeni
Mandini - LTBWSS Weir, WTW and Pump-Station
KwaDukuza
Richards Bay
Alton
Nsezi WTW
Pipeline to Mzingazi WTW
Mzingazi WTW
Lake Mzingazi
Potential Pipeline 2
Alton Macerator
Potential Pipeline 1
Arboretum Macerator
Potential Pipeline 3
Potential Site for Desalination Works
Locality Plan - All Schemes

# Water Conservation/ Demand Management – Bulk Industrial

## Implementation of demand management by bulk industries

- Four bulk industrial users (Mondi Richards Bay, RBM, Tronox and Foskor) account for 96% of the bulk industrial use
- Extensive work has been done by industries in this area already; further scope for savings is limited, but still possible

# Water Conservation/ Water Demand Management – Bulk Industrial

- Key Factors influencing this project:
  - Extent to which industrial processes can be further optimised
  - Scope for further reductions in water requirements

# Water Conservation/ Water Demand Management – Bulk Industrial

| Unit Reference Value (R/m³)<br><br>*Minimum URV* | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
|---|---|---|---|
| | *Range of URVs* | | |
| Capital Cost (R million) | *Range of costs* | | |
| Estimated saving | 2.8 million $m^3$/a (7.7 Ml/day) over 5 years | | |
| Implementation Programme | 2.5 years indicative | | |
| Environmental & Social impacts | Minimal<br>• Specific to type of WC/WDM | | |

# Water Conservation/ Demand Management – Bulk Industrial

- Strengths
  - Small percentage reductions in water requirement corresponds to a large volume saved, given the large usage volumes by industries
  - Relatively low-cost
  - Effectively non-existent environmental impacts
- Weaknesses
  - Limited scope for further savings by industries
- Recommendations
  - Closely liaise with key bulk industries regarding further water WC/WDM measures and progress
  - Confirm current WC/WDM situation at focus bulk industries

# Water Conservation/ Water Demand Management – Urban

Reduction in wastage due to leaks and poor user practices & reduction of non-revenue water (NRW)

- Up to 31 % NRW in Richards Bay (5.3 million $m^3/a$)
- Some initiatives in place (leak detection, pressure reduction)
- Consideration of practical, achievable NRW
- Further opportunities - active leakage control, water efficient fittings in new developments (through by-laws), continued raising of awareness

## Water Conservation/ Water Demand Management – Urban

- Key Factors influencing this project:
  - Metering and monitoring is critical to ensure improved revenue collection
  - Successful implementation of WC/WDM requires adequate budgeting, resourcing and commitment by users and authorities
  - Not just a focus during droughts

# Water Conservation/ Water Demand Management – Urban

| Unit Reference Value ($R/m^3$)<br><br>*Minimum URV* | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
|---|---|---|---|
| | *Range of URVs* | | |
| Capital Cost (R million) | *Range of costs* | | |
| Estimated savings | 4 million $m^3/a$ (11.0 Ml/day) over 10 years | | |
| Implementation Programme | 2.5 years indicative | | |
| Environmental & Social impacts | Minimal<br>• Specific to type of WC/WDM | | |

# WC/WDM - Urban

- Strengths
  - Relatively low-cost: increase of system yield without expensive additional bulk infrastructure
  - Effectively non-existent environmental impacts
- Weaknesses
  - Adequate political support, budgeting and resourcing
  - After the meter: depends on individual users' habits, which are difficult to influence
  - Some WC/WDM may have social impacts which should be carefully managed e.g. tariffing
- Recommendations
  - Promote adoption (e.g. public awareness campaigns) & adequate financing and support
  - Improve monitoring and metering
  - Confirm current municipal WC/WDM initiatives & projects

# Rainwater Harvesting

Collection and storage of rainwater from household roofs for outdoor and indoor non-potable domestic uses

- In addition to rainwater tanks, additional fittings are required to integrate the supply into the existing supply system in a house
- Conjunctive use (supplementing municipal supply, not replacing it)
- Option investigated here is that rainwater will be conjunctively used for garden use or for flushing toilets & washing machines

## Rainwater Harvesting

- Key Factors influencing this project:
  - Level of adoption: would depend on individual householders
  - Financing ability of individual households
  - Yield and costs depend on roof area, tank size, target drawdown etc.

# Rainwater Harvesting

| Unit Reference Value (R/m³)<br><br>*Minimum URV* | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
|---|---|---|---|
| | 10.23 | 11.04 | 11.89 |
| Capital Cost (R million) | R5,000 – R28,000 | | |
| Firm Yield (HFY) | Up to 200 kl/a per household | | |
| Implementation Programme | 2 years (by-law, subsidies) | | |
| Environmental & Social impacts | Limited<br>• Main concern is that water needs to be treated for any potable use | | |

# Rainwater Harvesting

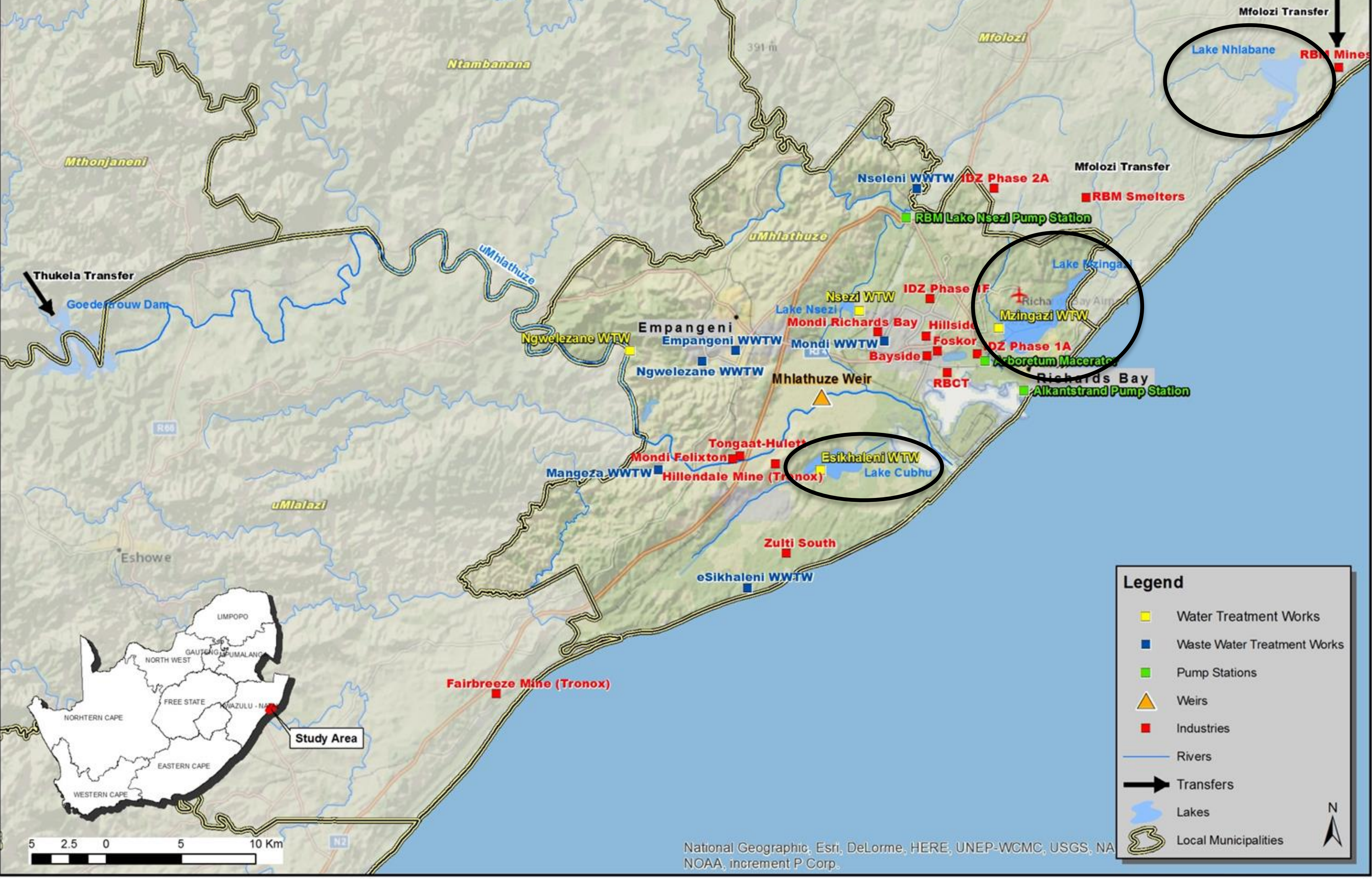
- Strengths
  - Limited environmental impacts
  - Relatively low capital cost but high URVs
  - Provides a back-up system to municipal water-supply
- Weaknesses
  - Maximum possible yield is not large
  - Depends on individual households' adoption – limited uptake
  - Smaller houses less suitable
- Recommendations
  - Promote adoption (e.g. public awareness campaigns, subsidies etc.)
  - More suitable to new developments, as retrofitting is expensive

# Limiting supply from over-abstracted coastal lakes

Increasing the minimum levels of abstraction to attain (aspired) sustainable abstraction from the three coastal lakes of the WSS so as to limit the current extent of abstraction

- Lakes Mzingazi, Cubhu and Nhlabane
- Two increased maximum abstraction levels considered relative to defined Drought Maintenance Levels (DMLs) & Management Maintenance Levels (MMLs)
- Actual abstraction levels are lower than the defined environmental DMLs

# Limiting supply from over-abstracted coastal lakes



## Limiting supply from over-abstracted coastal lakes

- Key Factors influencing this project:
  - Very low confidence in groundwater contribution to yields
  - Lake yields exclude groundwater yield components
  - Historical abstraction significantly more than lake yields

# Limiting supply from over-abstracted coastal lakes

| Unit Reference Value (R/m³) | Discount Rate 6% | Discount Rate 8% | Discount Rate 10% |
|---|---|---|---|
| | 0.0 | 0.0 | 0.0 |
| Capital Cost (R million) | 0,0 | 0.0 | 0.0 |
| Firm Yield (HFY) | -4.3 / -9.9 million $m^3$/a (-11.8 / -27.1 Ml/day) | | |
| Implementation Programme | 5.5 years | | |
| Environmental & Social impacts | (Aimed at) positive environmental impacts<br>Potential costs and impacts of replacing yield from alternative sources | | |

# Limiting supply from over-abstracted coastal lakes

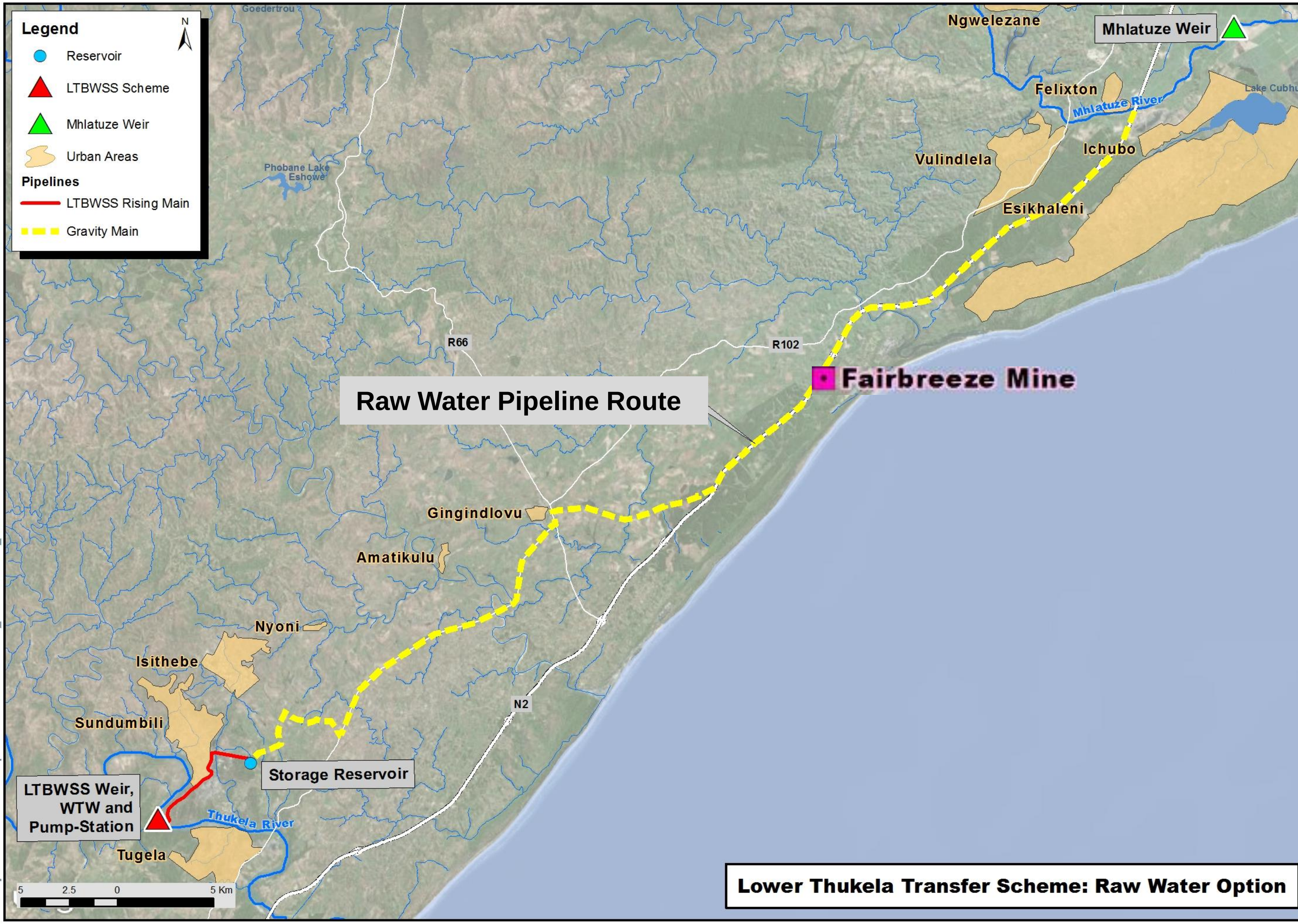
- Strengths
  - Aimed at improved lake sustainability
- Weaknesses
  - Science on which sustainable yields of the lakes were determined is weak
  - Groundwater-lake interactions not adequately quantified
  - Confidence of the determined sustainable lake yields are low
  - Will reduce overall yield of Richards Bay WSS
  - Lost yield must be replaced with other (likely more expensive) sources with potential socio-economic impact
- Recommendations
  - Undertake measurements of impedance of sediment layer in the lakes & obtain improved water balance measurements to calibrate groundwater models of the lakes
  - Improve confidence in lake yields

# Coastal Pipeline from Lower Thukela River

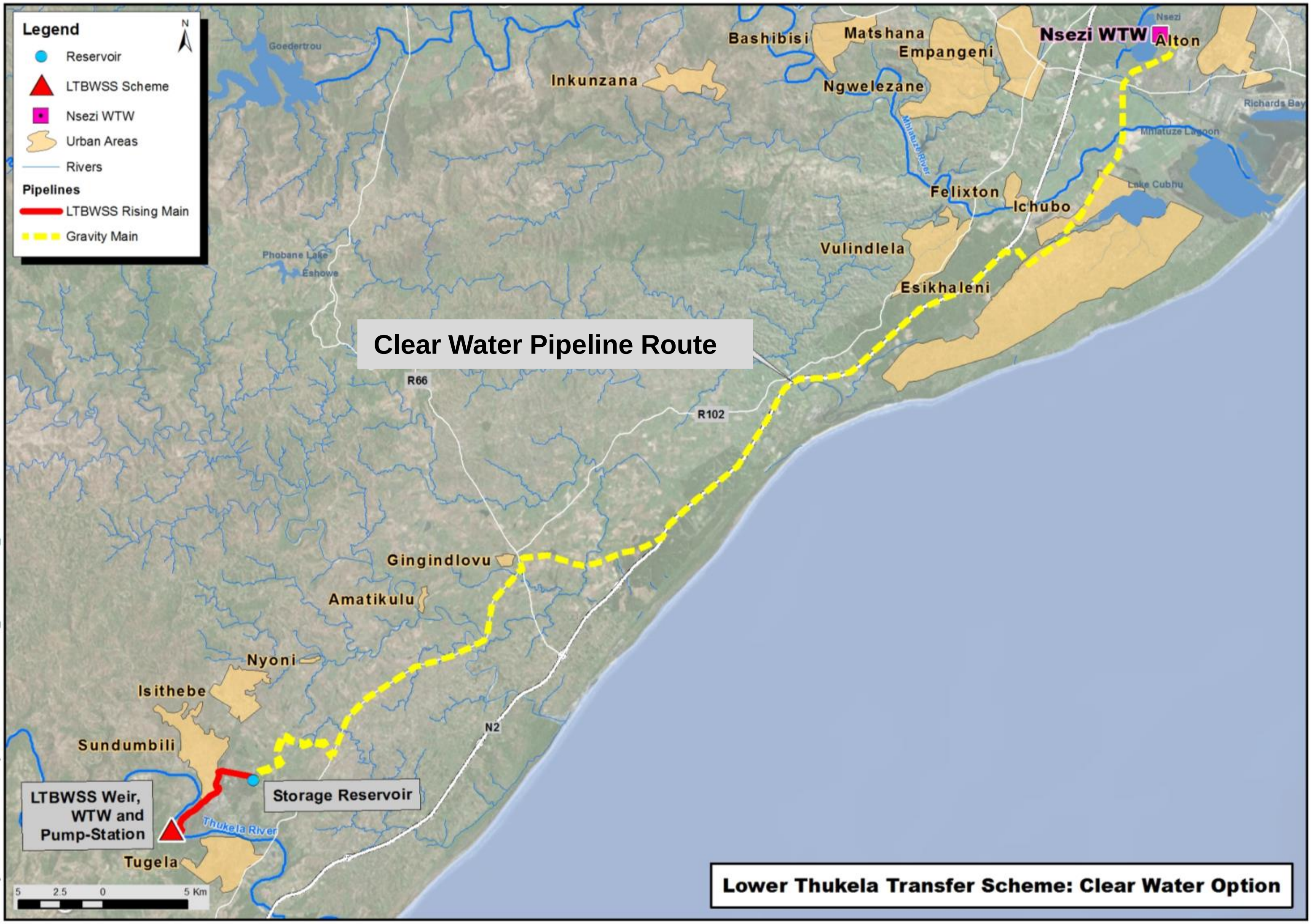
Transfer of water from lower Thukela River at Mandini to Richards Bay, supplying some coastal communities enroute

- Existing infrastructure, part of Umgeni Water's Lower Thukela Bulk Water Supply Scheme would be used
- New infrastructure would consist of pipelines, pump-stations , reservoir & desilting works
- Water could be transferred treated or untreated
- Depending on availability, volumes of either 55Ml/day or 110Ml/day (only long-term) were considered

# Coastal Pipeline from the Lower Thukela River – Raw Water Options



# Coastal Pipeline from the Lower Thukela River – Clear Water Options



# Coastal Pipeline from Lower Thukela River

- Key Factors influencing this project:
  - Current allocation from Thukela River
  - Co-ordination with Umgeni Water and Tronox to investigate possibility of sharing infrastructure
  - Socio-economic benefits of providing water to coastal communities en route to Richards Bay
  - Environmental impacts of inter-basin transfer of water

# Coastal Pipeline from Lower Thukela River

| Unit Reference Value ($R/m^3$)<br>*110Ml/d Raw Water Option including supply to Fairbreeze Mine* | Discount Rate<br>6% | Discount Rate<br>8% | Discount Rate<br>10% |
|---|---|---|---|
| | 4.60 | 5.47 | 6.42 |
| Capital Cost (R million) | 1382.25 | 1382.25 | 1382.25 |
| Firm Yield (HFY) *portion* | 15.1 million $m^3$/a (41.3 Ml/day)/<br>35.2 million $m^3$/a (96.3 Ml/day) | | |
| Implementation Programme | 11.5 years | | |
| Environmental & Social impacts | Limited to moderate<br>• Pipelines follow existing railway and road servitudes<br>• Erosion potential at outfall point (Mhlatuze River) is limited<br>• Abstraction uses existing infrastructure | | |

# Coastal Pipeline from Lower Thukela River

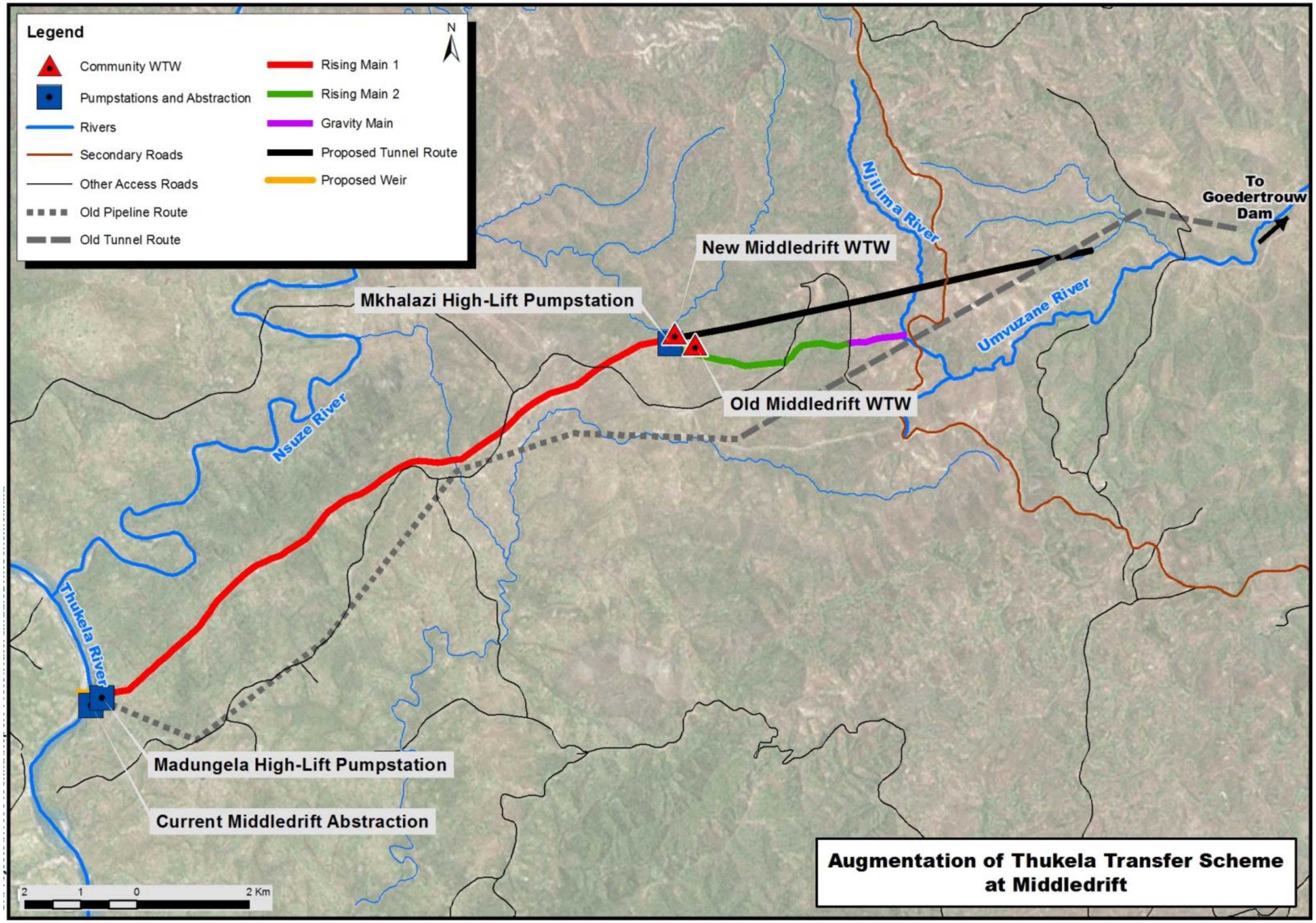
- Strengths
  - Positive socio-economic impacts
  - Limited to moderate environmental impacts
  - Existing allocation from Thukela River
- Weaknesses
  - Difficulties of integrating scheme with existing infrastructure
- Recommendations
  - Confirmation of availability of water from Thukela
  - Liaison with Umgeni Water and Tronox to investigate possibility of shared infrastructure
  - Pre-Feasibility evaluation

# Increased capacity of Thukela-Mhlatuze Transfer Scheme

Increased transfer of water from the Thukela River at Middledrift to a tributary of the Mhlatuze River that drains to Goedertrouw Dam

- Existing scheme consists of largely temporary infrastructure with capacity to transfer 1.2 $m^3/s$ (37.8 million $m^3/a$)
- Original plans for pipeline & tunnel replaced with emergency scheme - extra pipeline over the watershed was built instead of a tunnel
- Development has been evaluated for 1, 2 or 3 phases of increased transfers, for a variety of infrastructure combinations

# Increased capacity of Thukela-Mhlatuze Transfer Scheme



# Increased capacity of Thukela-Mhlatuze Transfer Scheme

| **Unit Reference Value ($R/m^3$)** *Phase 1 (incremental)* | **Discount Rate 6%** | **Discount Rate 8%** | **Discount Rate 10%** |
|---|---|---|---|
| | **5.87** | **6.55** | **7.27** |
| **Capital Cost (R million)** | **842.39** | **842.39** | **842.39** |
| **Firm Yield (HFY)** | **47.3 million $m^3$/a (129.6 Ml/day) : Phase 1** | | |
| **Implementation Programme** | **11.5 years** | | |
| **Environmental & Social impacts** | **Moderate**<br>• Pipelines follow existing servitudes<br>• Erosion potential at outfall point<br>• Abstraction impacts (weir etc.)<br>• Impacts of inter-basin transfer of water<br>• Increased availability of water to local communities | | |

## Increased capacity of the Thukela-Mhlatuze Transfer Scheme

- Key Factors influencing this project:
  - Availability of water from Thukela River
  - Existing "Fairbreeze Mine" allocation
  - Future water requirements; when and if each of phases will be required
  - Trade-off between higher capital costs of installing tunnel, and higher operating cost of operating pipelines over the watershed
  - Environmental impacts of inter-basin transfer of water

# Increased capacity of Thukela-Mhlatuze Transfer Scheme

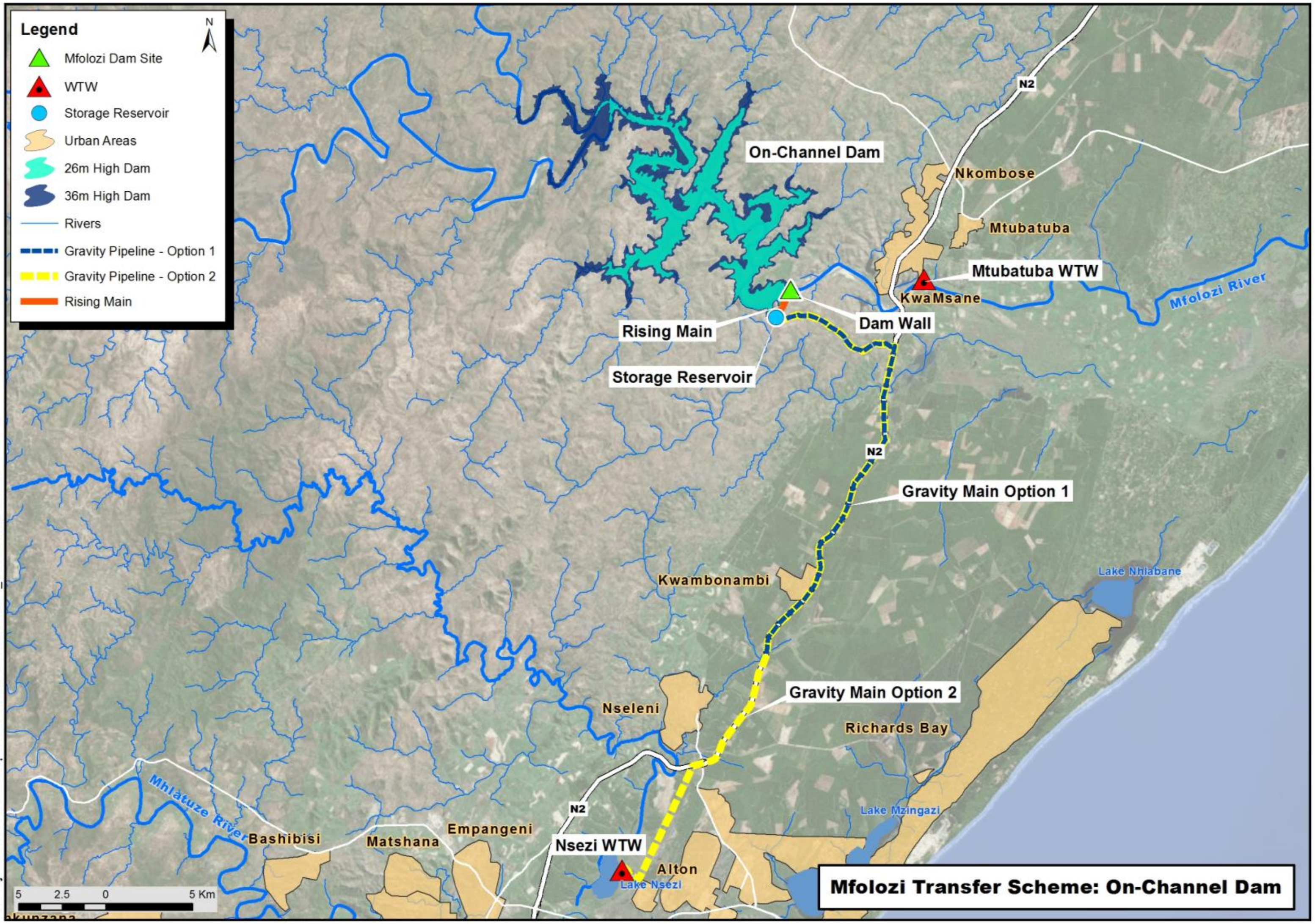
- Strengths
  - Positive socio-economic impacts
  - Moderate environmental impacts
  - Large yield (especially in later phases)
- Weaknesses
  - Some uncertainty regarding extent of availability of water from Thukela River
- Recommendations
  - Confirmation of extent of availability of water from Thukela River
  - Pre-Feasibility evaluation

# On-Channel Dam & Transfer from Mfolozi River

Construction of an earthfill on-channel dam on the Mfolozi River at the Kwesibomvu Site, investigated in previous studies

- Water pumped from dam to storage reservoir and then gravitated to either Nsezi WTW or to an outfall point on Lake Nsezi
- Would provide water to Nsezi WTW, Mtubatuba WSS & other small towns outside the uMhlathuze Local Municipality
- Two dam sizes investigated (26m-high and 36m-high)

# On-Channel Dam & Transfer from Mfolozi River



## On-Channel Dam & Transfer from Mfolozi River

- Key Factors influencing this project:
  - Environmental factors: proximity of Hluhluwe-iMfolozi Game Reserve, pans/wetland areas, inundation, watercourse obstruction
  - Need for additional water supply to Mtubatuba and surrounding areas
  - Impacts of inter-basin transfer of water
  - Flooding issues on the Mfolozi River (very large flood peaks are common)

# On-Channel Dam & Transfer from Mfolozi River

| | | | |
|---|---|---|---|
| **Unit Reference Value ($R/m^3$)**<br>***26m-high dam with (long) pipeline to Nsezi WTW*** | **Discount Rate**<br><br>**6%** | **Discount Rate**<br><br>**8%** | **Discount Rate**<br><br>**10%** |
| | **4.40** | **5.33** | **6.35** |
| **Capital Cost (R million)** | **2272.8** | **2272.8** | **2272.8** |
| **Firm Yield (HFY)** | **66.6 million $m^3/a$ (182.5 Ml/day)** | | |
| **Implementation Programme** | **12.5 years** | | |
| **Environmental & Social impacts** | **Significant**<br>• **Inundation of land, including several pans**<br>• **Interruption of river processes**<br>• **Impacts of inter-basin transfer of water**<br>• **Increased availability of water to local communities** | | |

# On-Channel Dam & Transfer from Mfolozi River

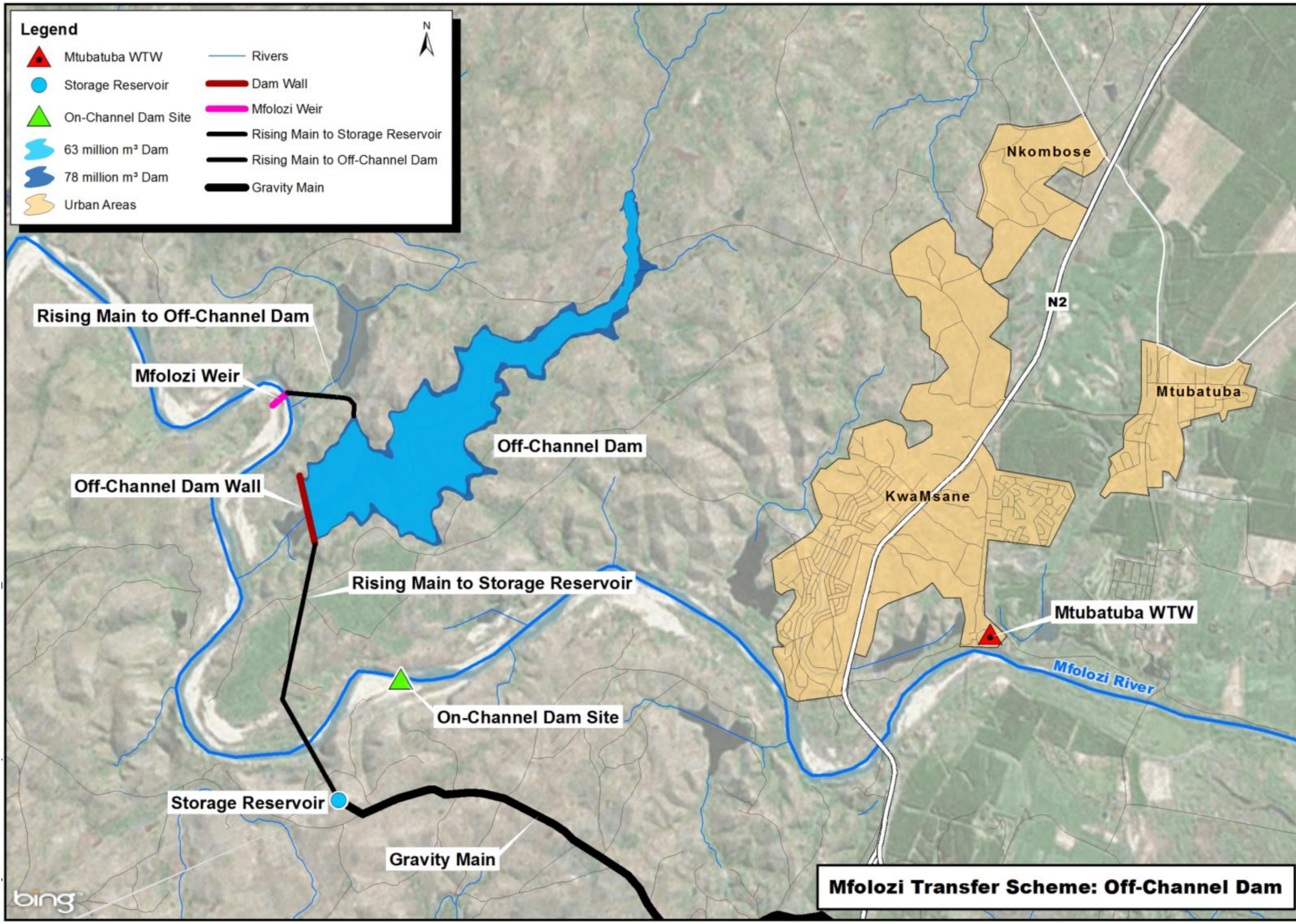
- Strengths
  - Positive socio-economic impacts
  - Large yield, even of the smaller (26m-high) dam
- Weaknesses
  - Significant environmental impacts
  - Large area of land inundated ($10km^2$ – $14km^2$)
- Recommendations
  - Pre-Feasibility evaluation if necessary to compare further with off-channel storage

# Off-Channel Dam and Transfer from the Mfolozi River

## Construction of weir in Mfolozi River and earthfill off-channel dam

- Water pumped from weir in Mfolozi River to off-channel dam, then pumped from dam to reservoir & gravitated to Nsezi WTW or Lake Nsezi
- Smaller than on-channel dam, with lower environmental impacts
- Would provide water to Nsezi WTW, Mtubatuba WSS & other small towns outside the uMhlathuze Municipality
- Two pumping rates investigated ($2 m^3/s$ & $2.5\ m^3/s$)
- Two dam sizes investigated for each pumping rate

# Off-Channel Dam and Transfer from the Mfolozi River



## Off-Channel Dam and Transfer from the Mfolozi River

- Key Factors influencing this project:
  - Environmental factors: smaller area inundated than on-channel dam, fewer environmentally-sensitive areas affected
  - However, one pan (Nkatha) inundated
  - Impacts of inter-basin transfer of water
  - Meets need for additional water supply to Mtubatuba and surrounding areas

# Off-Channel Dam and Transfer from the Mfolozi River

| Unit Reference Value (R/$m^3$) *$2m^3$/s flow from Mfolozi River to a 63.2 million $m^3$dam, with (long) pipeline to Nsezi WTW* | Discount Rate 6% | Discount Rate 8% | Discount Rate 10% |
|---|---|---|---|
| | 4.68 | 5.36 | 6.09 |
| Capital Cost (R million) | 1152.8 | 1152.8 | 1152.8 |
| Firm Yield (HFY) | 47.1 million $m^3$/a (129.0 Ml/day) | | |
| Implementation Programme | 12 years | | |
| Environmental & Social impacts | Moderate to significant<br>• Inundation of land, incl. Nkatha pan<br>• Impacts of inter-basin transfer of water<br>• Increased availability of water to local communities | | |

# Off-Channel Dam and Transfer from the Mfolozi River

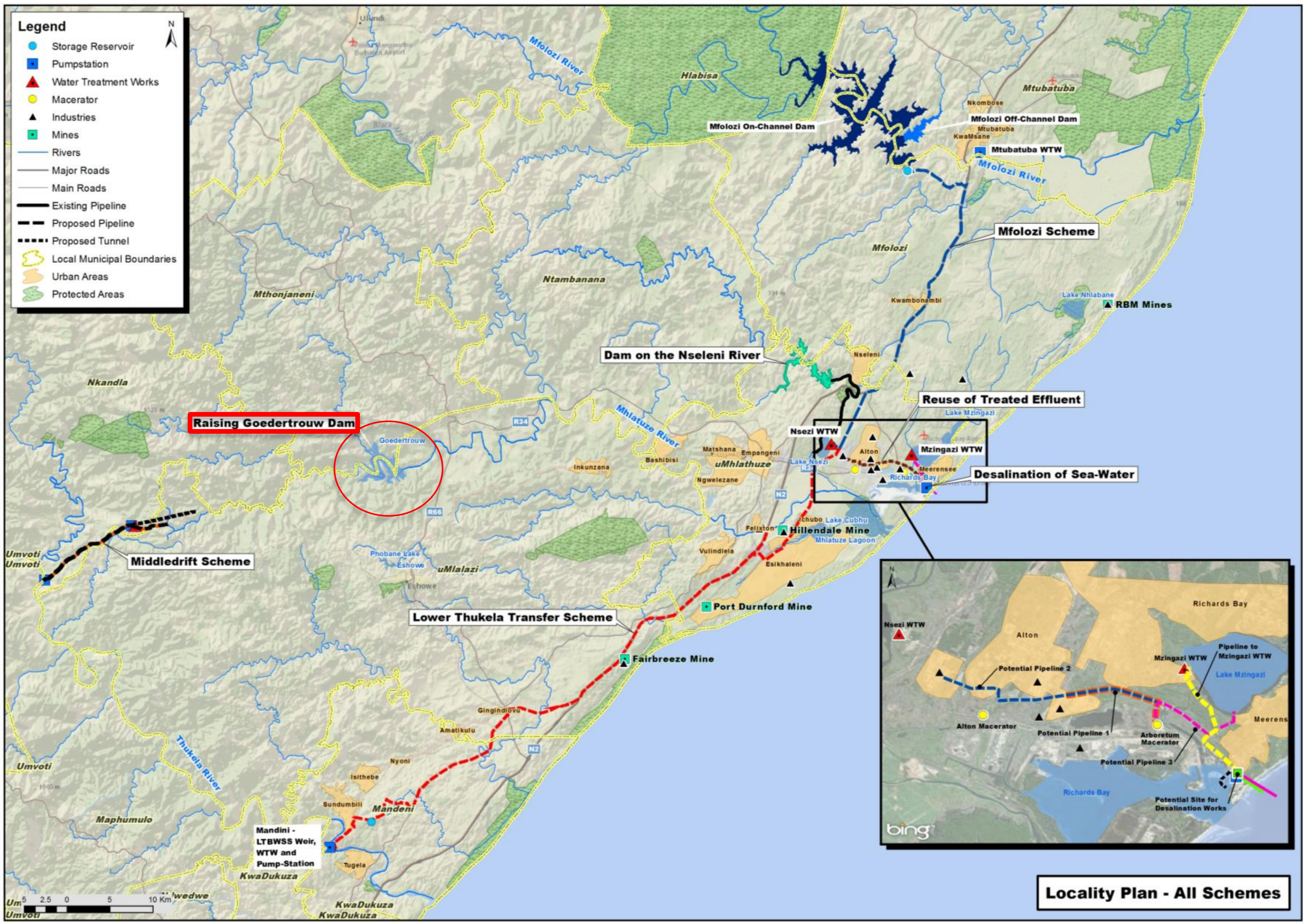
- Strengths
  - Positive socio-economic impacts
  - Significant yield,
  - Smaller area inundated than on-channel dam ($2km^2$ – $4km^2$)
- Weaknesses
  - Inter-basin transfer of water
  - Environmental impacts
- Recommendations
  - Pre-Feasibility evaluation

# Raising of Goedertrouw Dam

Increasing the height of Goedertrouw Dam by 2.8m to create an additional yield of 3.9 million $m^3/a$

- Construct labyrinth or piano key weir to increase height of spillway and decrease required freeboard
- Construction of a concrete wave wall on the existing earthfill dam wall

# Raising of Goedertrouw Dam



# Raising of Goedertrouw Dam

- Key Factors influencing this project:
  - Yield is small, but capital cost and scale of the project are correspondingly limited
  - Environmental & social impacts are minimal: small increase in inundated area

# Raising of Goedertrouw Dam

| Unit Reference Value (R/m³)<br>*2m³/s flow from Mfolozi River to a 63.2 million m³dam, with pipeline to Nsezi WTW* | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
|---|---|---|---|
| | 1.24 | 1.53 | 1.83 |
| Capital Cost (R million) | 77.6 | 77.6 | 77.6 |
| Firm Yield (HFY) | 3.9 million $m^3/a$ (10.7 Ml/day) | | |
| Implementation Programme | 7 years | | |
| Environmental & Social impacts | Minimal.<br>• Inundation of small additional land area<br>• Ecological releases would continue to be made | | |

# Raising of Goedertrouw Dam

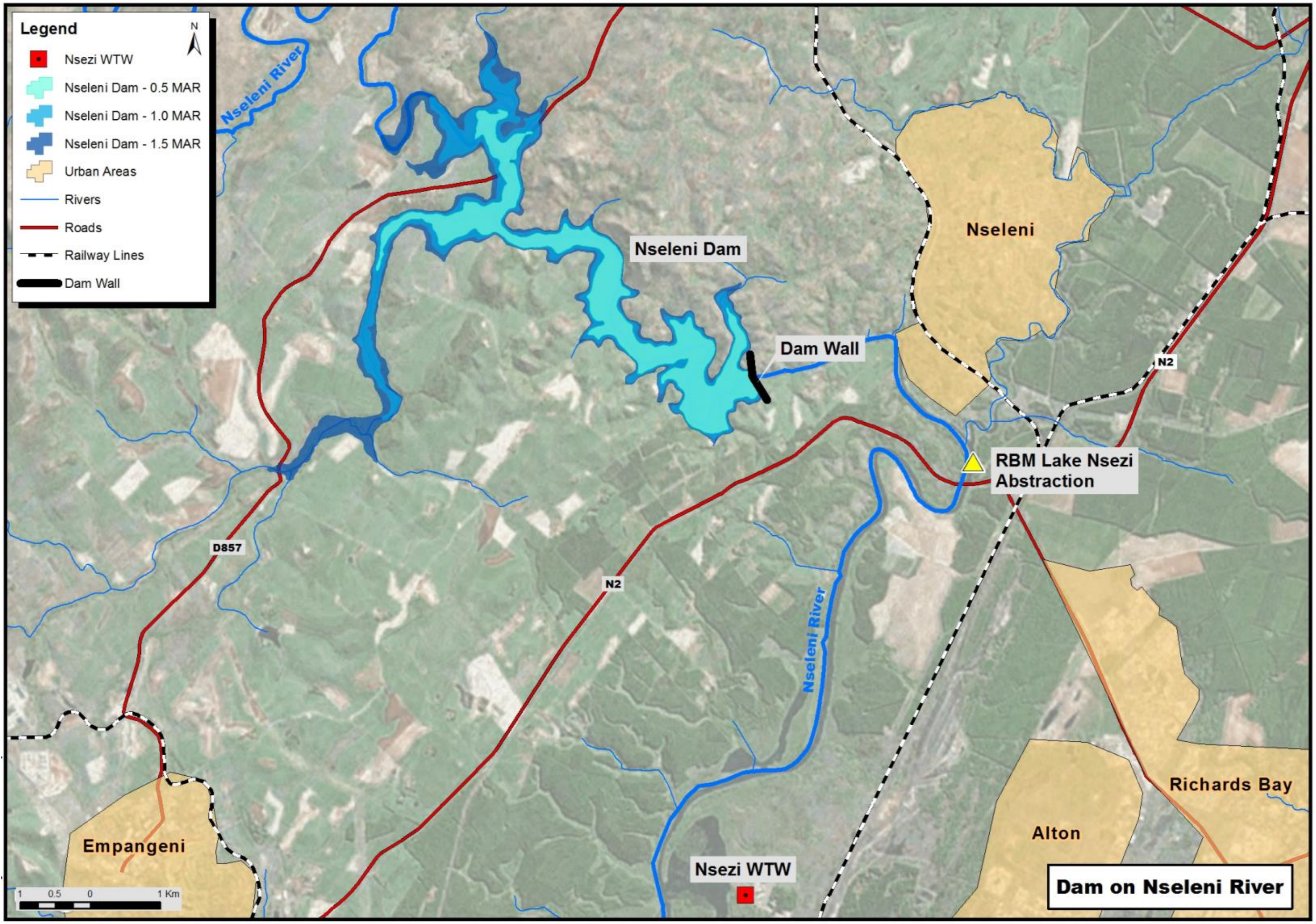
- Strengths
  - Low cost and quick to implement
  - Minimal environmental & social impact
- Weaknesses
  - Limited increase in yield
- Recommendations
  - Feasibility Study / Detailed design

# Dam on the Nseleni River

Construction of an earthfill on-channel dam on the Nseleni River

- Water would be released down to Lake Nsezi for abstraction and treatment
- Three dam sizes were investigated (0.5MAR, 1MAR and 1.5MAR)
- 4 initial dam sites screened

# Dam on the Nseleni River



# Dam on the Nseleni River

- Key Factors influencing this project:
  - Environmental factors: inundation of between 300 and 700 Ha of land, a farm dam (Crystal Dam) and a section of road (D857)
  - Water quality issues in the river downstream and in Lake Nsezi

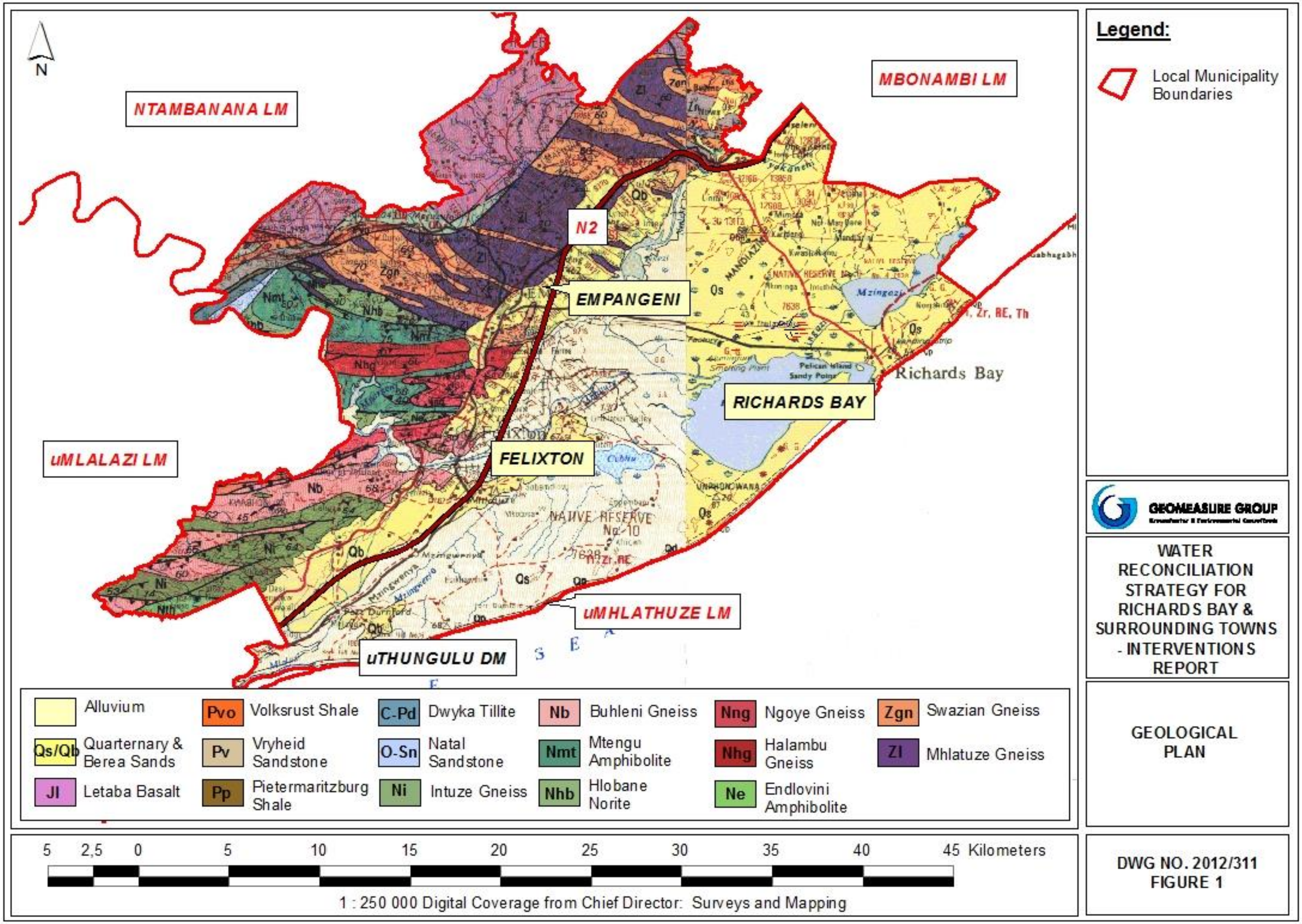
# Dam on the Nseleni River

| Unit Reference Value (R/m$^3$)<br>*1 MAR dam (43.11 million m$^3$ storage)* | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
|---|---|---|---|
| | 1.90 | 2.29 | 2.70 |
| Capital Cost (R million) | 175.0 | 175.0 | 175.0 |
| Firm Yield (HFY) | 6.1 million m$^3$/a (16.7 Ml/day) | | |
| Implementation Programme | 11 years | | |
| Environmental & Social impacts | Significant, but mitigatable<br>• Inundation of land, a farm dam and a section of road<br>• Interruption of river processes, movement of aquatic species, sediment etc. | | |

# Dam on the Nseleni River

- Strengths
  - Some social/ environmental impacts are mitigatable
  - Increased assurance of supply to RBM and Nsezi WTW
  - Improved operational flexibility
- Weaknesses
  - Significant environmental and social impacts
- Recommendations
  - Pre-Feasibility evaluation

# Groundwater Overview



N
NTAMBANANA LM
MBONAMBI LM
uMLALAZI LM
N2
EMPANGENI
RICHARDS BAY
Richards Bay
FELIXTON
uMHLATHUZE LM
uTHUNGULU DM
Legend:
Local Municipality Boundaries
GEOMEASURE GROUP
WATER RECONCILIATION STRATEGY FOR RICHARDS BAY & SURROUNDING TOWNS - INTERVENTIONS REPORT
GEOLOGICAL PLAN
DWG NO. 2012/311
FIGURE 1
Alluvium
Qs/Qb Quarternary & Berea Sands
Jl Letaba Basalt
Pvo Volksrust Shale
Pv Vryheid Sandstone
Pp Pietermaritzburg Shale
C-Pd Dwyka Tillite
O-Sn Natal Sandstone
Ni Intuze Gneiss
Nb Buhleni Gneiss
Nmt Mtengu Amphibolite
Nhb Hlobane Norite
Nng Ngoye Gneiss
Nhg Halambu Gneiss
Ne Endlovini Amphibolite
Zgn Swazian Gneiss
Zl Mhlatuze Gneiss
5 2,5 0 5 10 15 20 25 30 35 40 45 Kilometers
1 : 250 000 Digital Coverage from Chief Director: Surveys and Mapping

# Groundwater Overview

Geology and Geohydrology : Quaternary Sands

- Eastern portion of the study area underlain by Quaternary Sands, considered as primary aquifers within the unconsolidated sediments. They extend just to the west of the N2 (Qs and Qb)
- High primary porosity and permeability
- Highly productive and excellent sources for bulk water supply
- Vulnerable to impact from possible pollution sources, such as high concentration of industrial and commercial developments
- Borehole yields range between 0.5 – 3.0 l/sec, however, decreased permeability due to the presence of discontinuous clay lenses decreases the groundwater potential in certain areas
- Potential for sourcing bulk water supply from the primary aquifers in areas unaffected by development (away from R' Bay).

# Groundwater Overview

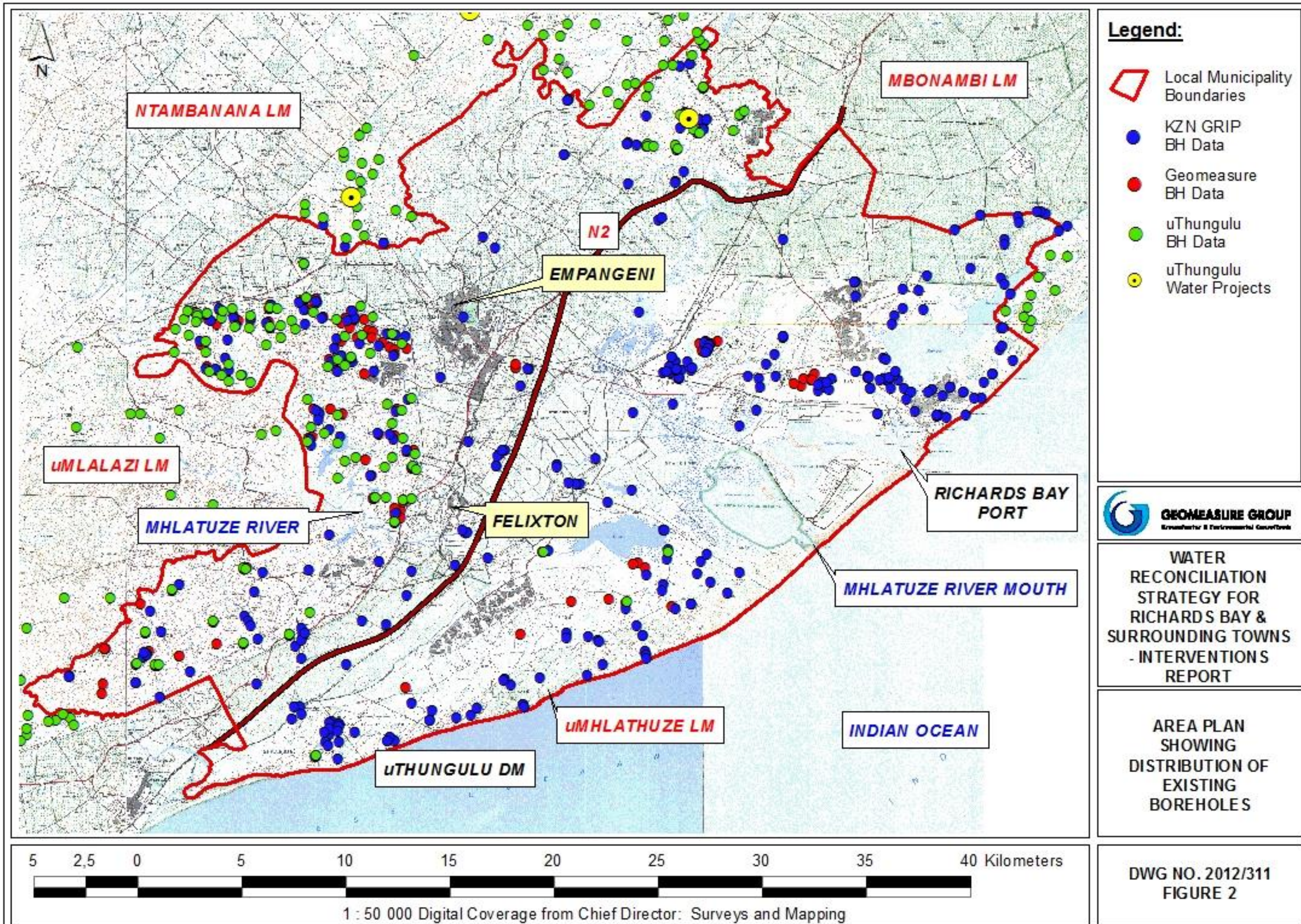
Geology and Geohydrology : Natal Structural and Metamorphic Province, Karoo Supergroup & Natal Group:

- Secondary aquifers in the consolidated formations
- Weathered and fractured rock aquifers - negligible primary porosity
- Groundwater movement confined to joints, fractures and geological contacts
- Groundwater development options often limited to these zones
- Borehole yields typically range between 0.1 – 1.5 l/sec and water quality is generally poor and requires treatment.
- Borehole yields in excess of 3.0 l/sec can occur in zones between the weathered and unweathered formations or intersection of zones
- Potential for sourcing bulk water supply from these aquifers also does exist

# Groundwater Overview

Distribution of Existing Boreholes:

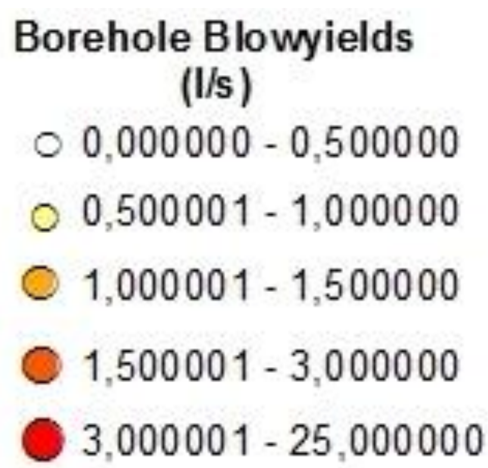
- Map overleaf shows distribution of existing boreholes
- Borehole info from Geomeasure In-house database, KZN GRIP (Groundwater Resource Information Project), database compiled for DWS & uThungulu DM Borehole Database
- More recent yield and aquifer information, as well as new borehole locations (and information) is crucial to attain a more representative idea of the current borehole and subsequent groundwater use within the study area
- Borehole info from uThungulu DM urgently required

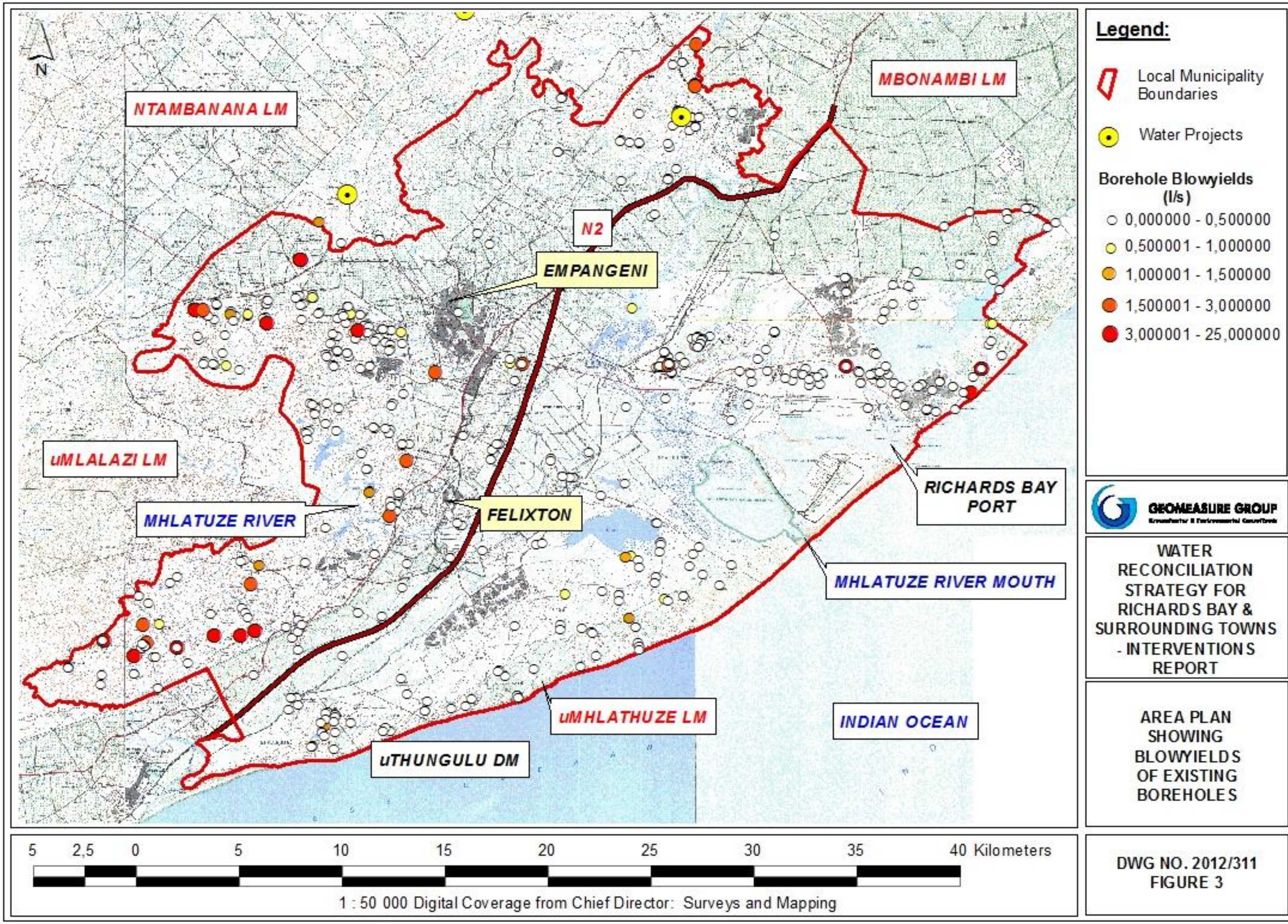

Legend:
Local Municipality Boundaries
KZN GRIP BH Data
Geomeasure BH Data
uThungulu BH Data
uThungulu Water Projects
N
NTAMBANANA LM
MBONAMBI LM
N2
EMPANGENI
uMLALAZI LM
MHLATUZE RIVER
FELIXTON
RICHARDS BAY PORT
MHLATUZE RIVER MOUTH
uMHLATHUZE LM
INDIAN OCEAN
uTHUNGULU DM
5 2,5 0 5 10 15 20 25 30 35 40 Kilometers
1 : 50 000 Digital Coverage from Chief Director: Surveys and Mapping
GEOMEASURE GROUP
WATER RECONCILIATION STRATEGY FOR RICHARDS BAY & SURROUNDING TOWNS - INTERVENTIONS REPORT
AREA PLAN SHOWING DISTRIBUTION OF EXISTING BOREHOLES
DWG NO. 2012/311
FIGURE 2

# Groundwater Overview

Blowyields of Existing Boreholes:

- Map overleaf shows categorised blowyields of existing boreholes (excluding uThungulu DM data) in l/sec
- Blowyields are estimated during the drilling of the boreholes and are not actual measured yields (sustainable yields), however, they do provide insight into whether a borehole may be suitable for bulk water supply
- The blowyields have been categorised as follows:






WATER RECONCILIATION STRATEGY FOR RICHARDS BAY & SURROUNDING TOWNS - INTERVENTIONS REPORT

AREA PLAN SHOWING BLOWYIELDS OF EXISTING BOREHOLES

DWG NO. 2012/311
FIGURE 3

# Groundwater Overview

Implications of Blowyield Results:

- Majority of boreholes within study area have blowyields <0.5 l/sec – and is considered unfavourable for bulk water supply
- The boreholes of interest in terms of bulk water supply, are those with blowyields ranging between 1.5 – 3.0 l/sec and 3.0 – 25 l/sec.
- Following areas may potentially be suitable for further investigation:

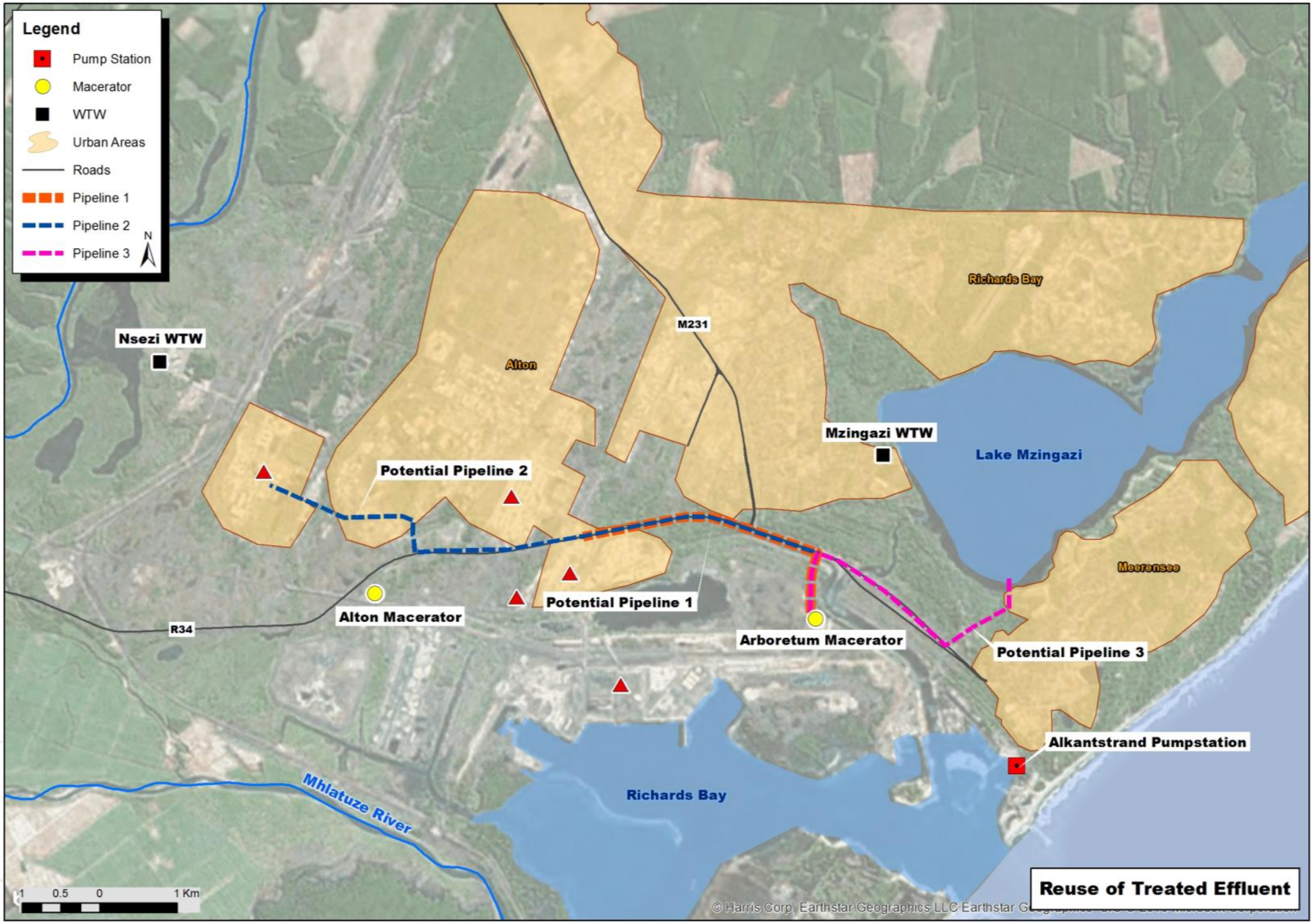
  - area south and west of Mhlatuze River,
  - area west of Empangeni (but north of Felixton)
  - northernmost portion of study area (but west of the N2)

# Arboretum Effluent Reuse Scheme

## Treatment and reuse of effluent at a treatment at the site of the Arboretum macerator

- Construction of a regional activated sludge WWTW & biological nutrient removal process with membrane bioreactors
- Accommodate both existing and future domestic load of Arboretum & Alton pump stations
- Treated effluent could be sold directly to bulk industrial users, or pumped for discharge into Lake Mzingazi for indirect reuse

# Arboretum Effluent Reuse Scheme



# Arboretum Effluent Reuse Scheme

- Key Factors influencing this project:
  - Uptake of water by users (Direct Reuse)
  - Quality of effluent and hence requirements for treating it to an acceptable standard, especially for indirect potable reuse

# Arboretum Effluent Reuse Scheme

| | | | |
|---|---|---|---|
| Unit Reference Value (R/m$^3$) | Discount Rate<br><br>6% | Discount Rate<br><br>8% | Discount Rate<br><br>10% |
| | 6.41 | 6.96 | 7.69 |
| Capital Cost (R million) | 569.0 | 569.0 | 569.0 |
| Firm Yield (HFY) | 11.0 million m$^3$/a (30.1 Ml/day) | | |
| Implementation Programme | 9 years | | |
| Environmental & Social impacts | Moderate<br>• Negative social perceptions of reuse<br>• Sludge disposal<br>• Impacts on water quality in Lake Mzingazi (currently unquantified) | | |

# Arboretum Effluent Reuse Scheme

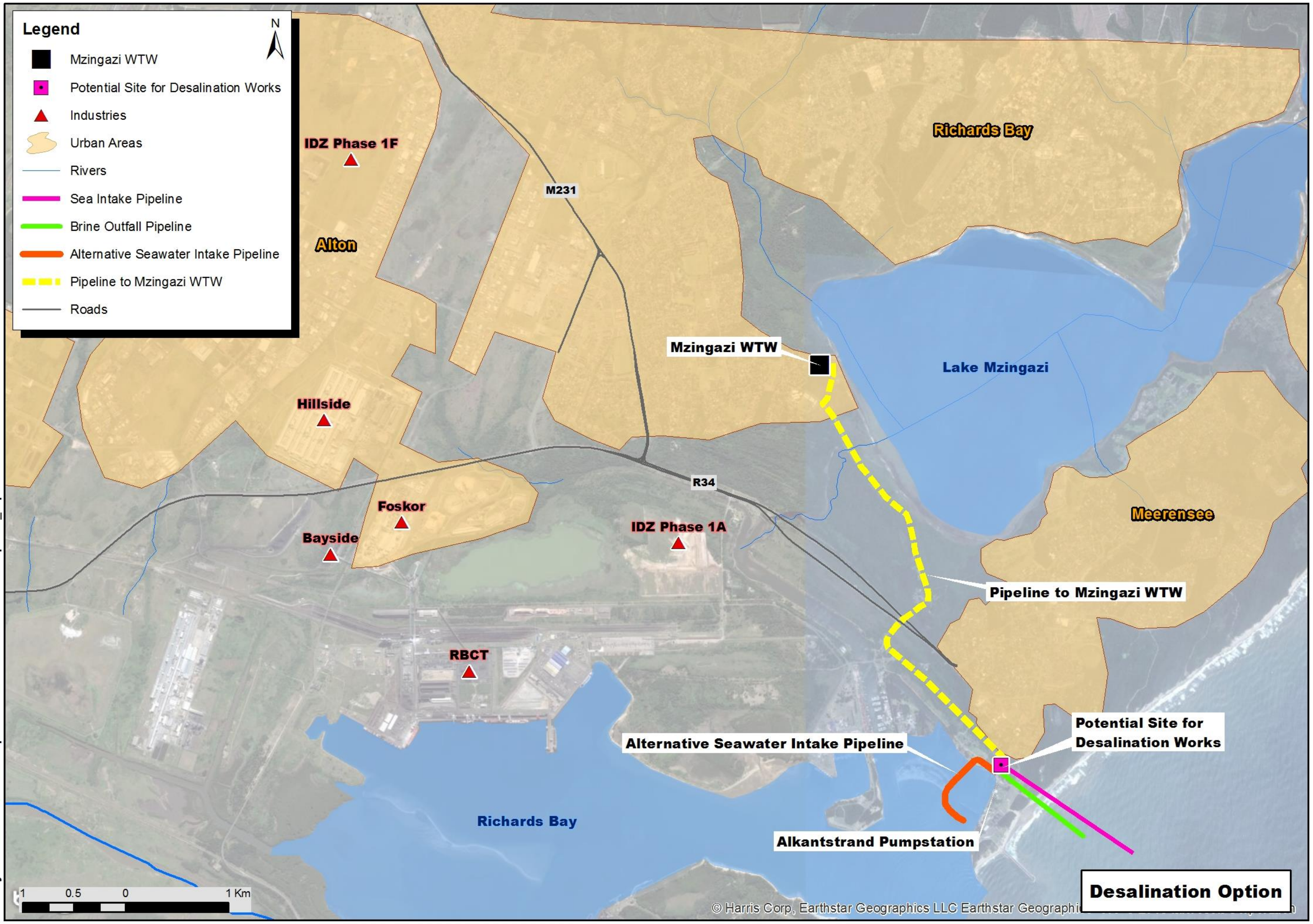
- Strengths
  - Low environmental impacts
  - Recovering water into the system that would otherwise be lost
- Weaknesses
  - Negative social perceptions of reuse
  - Low quality of industrial effluent, and high proportion relative to domestic effluent, means limited volume that could be treated
- Recommendations
  - Feasibility evaluation:
    - Further investigation into potential impact on water quality in Lake Mzingazi
    - Further investigation into likelihood of industrial users accepting effluent
    - Consider synthesis with seawater desalination

# Desalination of Seawater

Seawater will be fed by an intake in the Richards Bay harbour to a site close to the Alkantstrand pump station, where the reverse osmosis desalination plant will be situated. Potable water will be pumped to the Mzingazi WTW for blending

- Intake pipelines can either be installed in the harbour or out to sea
- Outfall to sea
- Potential synthesis with Alkantstrand pump station or Reuse could be considered

# Desalination of Seawater



# Desalination of Seawater

- Key Factors influencing this project:
  - Finding a suitable site for one or more phases
  - Integration into the WSS and operational measures
  - Difficulty and cost of constructing in the marine environment
  - Possibility that utilisation of the plant could be low due to high operational cost (which leads to high unit water cost)

# Desalination of Seawater

| Unit Reference Value (R/m³) *Harbour intake pipeline, full utilisation* | Discount Rate 6% | Discount Rate 8% | Discount Rate 10% |
|---|---|---|---|
| | 4.41 | 5.31 | 6.27 |
| Capital Cost (R million) | 995.4 | 995.4 | 995.4 |
| Firm Yield (HFY) | 21.9 million $m^3$/a (60 Ml/day) | | |
| Implementation Programme | 9 years | | |
| Environmental & Social impacts | Limited to moderate<br>• Marine construction<br>• Brine outfall<br>• Site may have impacts, as yet unspecified | | |

# Desalination of Seawater

- Strengths
  - Unlimited supply of seawater
  - Not rain-dependent
  - Very high assurance of supply
  - Can be phased
  - Harbour provides opportunity for significant cost saving
- Weaknesses
  - Difficulties of marine construction
  - High operational cost / Probability of low utilisation
  - High energy requirement
  - Specialised operation
- Recommendations
  - Selection of a suitable site
  - Operational integration to be assessed

# Implementation Programmes

| SCHEME | Reconnaissance (Strategy approved) | Pre-Feasibility | Feasibility | | | Construction / Implementation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Budget/ TOR / Appoint Consultant | Feasibility Study/ EIA/ Monitoring | DWS Reserve determination | Budget/ TOR / Appoint Consultant | DWS licensing process (Reserve) | DEA&DP approval process | Design / tender preparation & award | Construct /Implement/Council Bylaw | Warm up / first filling | | TOTAL Maximum time to develop yield | |
| | | | | Simultaneous | Simultaneous | | Simultaneous | Simultaneous | | | Start | End | Start | End |
| | | | | | | | | | | | | | | |
| Bulk industrial WC/WDM | | | 0.25 | 0.5 | | 1 | | | 0.5 | 0.5 | | | | **2.5** |
| Urban WC/WDM | | | 0.25 | 0.5 | | 1 | | | 0.5 | 0.5 | | | | **2.5** |
| Rainwater harvesting | 1 | | | | | | | | | 1 | | | | **2** |
| Limiting supply from over-abstracted coastal lakes | 1 | | 0.5 | 3 | 2 | | | | | 0.5 | | | | **5.5** |
| Increased capacity of the Thukela-Mhlathuze Transfer Scheme | 1 | | 0.5 | 2 | 1 | 1 | 1 | 2 | 2 | 2.5 | | | | **11.5** |
| Coastal pipeline from the lower Thukela River | 1 | | 0.5 | 2 | 1 | 1 | 1 | 2 | 2 | 2.5 | | | | **11.5** |
| Mfolozi River on-channel transfer scheme: Kwesibomvu Dam | 1 | | 0.5 | 2 | 2 | 1 | 2 | 2 | 2 | 3.5 | 0 | 1 | **11.5** | **12.5** |
| Mfolozi River off-channel transfer scheme | 1 | | 0.5 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 0 | 1 | **11** | **12** |
| Raising Goedertrouw Dam | 1 | | 0.5 | 0.5 | | 1 | 1 | 1.5 | 1 | 1.5 | | | **7** | **7** |
| Dam on the Nseleni River | 1 | | 0.5 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 0 | 1 | **10** | **11** |
| Groundwater scheme | 1 | 2 | 0.5 | 2 | 1 | 1 | 2 | 2 | 2 | 1.5 | | | | **12.5** |
| Arboretum Effluent Reuse Scheme | 1 | | 0.25 | 0.5 | | 1 | 2 | 2 | 2 | 2.5 | | | | **9** |
| Desalination of seawater | 1 | | 0.5 | 2 | | 1 | 2 | 2 | 2 | 2 | | | | **9** |
| | | | | | | | | | | | | | | |

# Scenario Planning

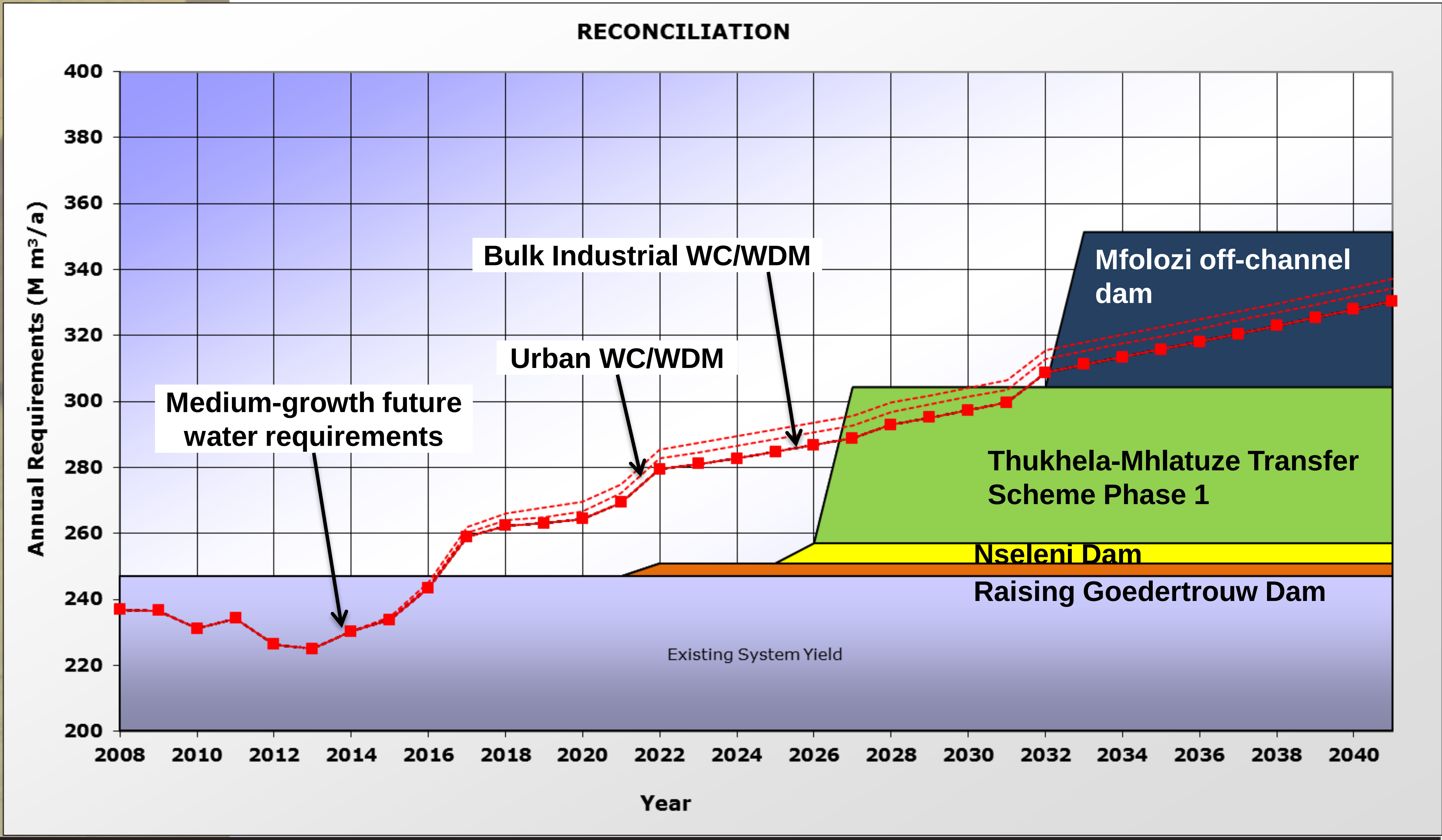
# Scenario Planning

- What to evaluate in scenario planning?
  - Scenarios are combinations of selected Interventions
  - Identify further influences on water balance
  - Consider Stakeholder preferences
- Scenario Planning
  - Set up Water Resources Planning Model (WRPM)
  - Evaluate Scenarios with WRPM
  - Present scenario results

# Further influences to consider in Scenario Planning

- Reducing yield of Goedertrouw Dam as a result of sedimentation
- Climate change
- Potential further ecological Reserve implementation

# R'Bay WSS: Water balance mock-up



# Way Forward

# Way Forward

- Source further interventions information needed
- Refine interventions following workshop
- Write draft Interventions Report & disseminate for comment
- Proceed with the Scenario Planning Task

*- Thank you -*