

# Retaining a Supply



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# Factors that drive the Construction of Reservoirs

- Change in Operational Philosophy in Reservoir Zone
- Ageing Infrastructure
  - Maintenance Contracts.
- Development Driven
  - Cornubia
  - Umhlanga New Town Centre
- Demand exceeding the Supply
  - Population Growth

## Development Driven

### Umhlanga New Town Centre

- Umhlanga 2 Compartment 3 (Upgraded 10MI, total 25MI)
- Gateway Reservoir (5MI)
- Proposed, Zinga Reservoir (5MI)

### Cornubia

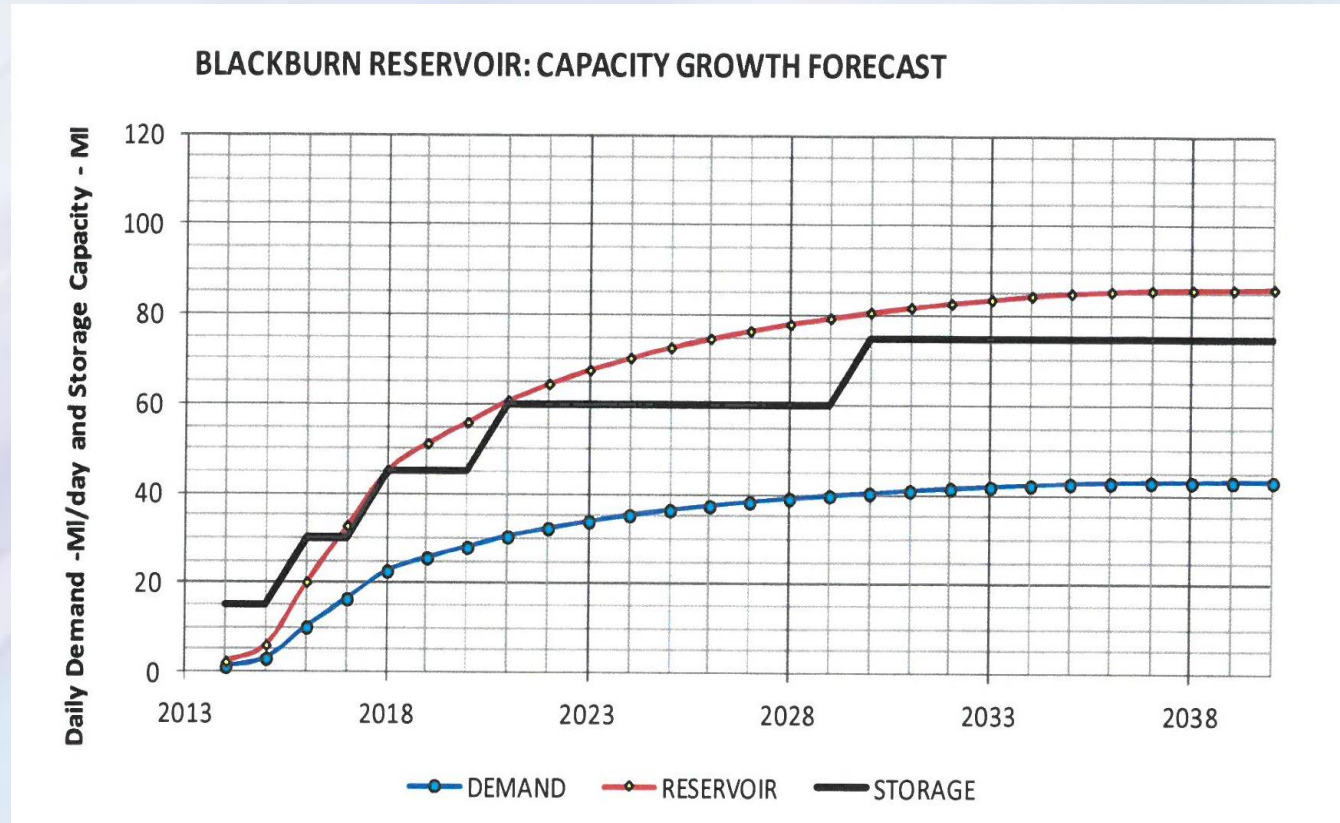
Proposed Facilities based on

- Blackburn Reservoir (full capacity 105MI, current 17.5MI)
- Cornubia Elevated Tower (1.2MI) (proposed)
- Blackburn Steel Elevated Tower (900kl) (proposed)

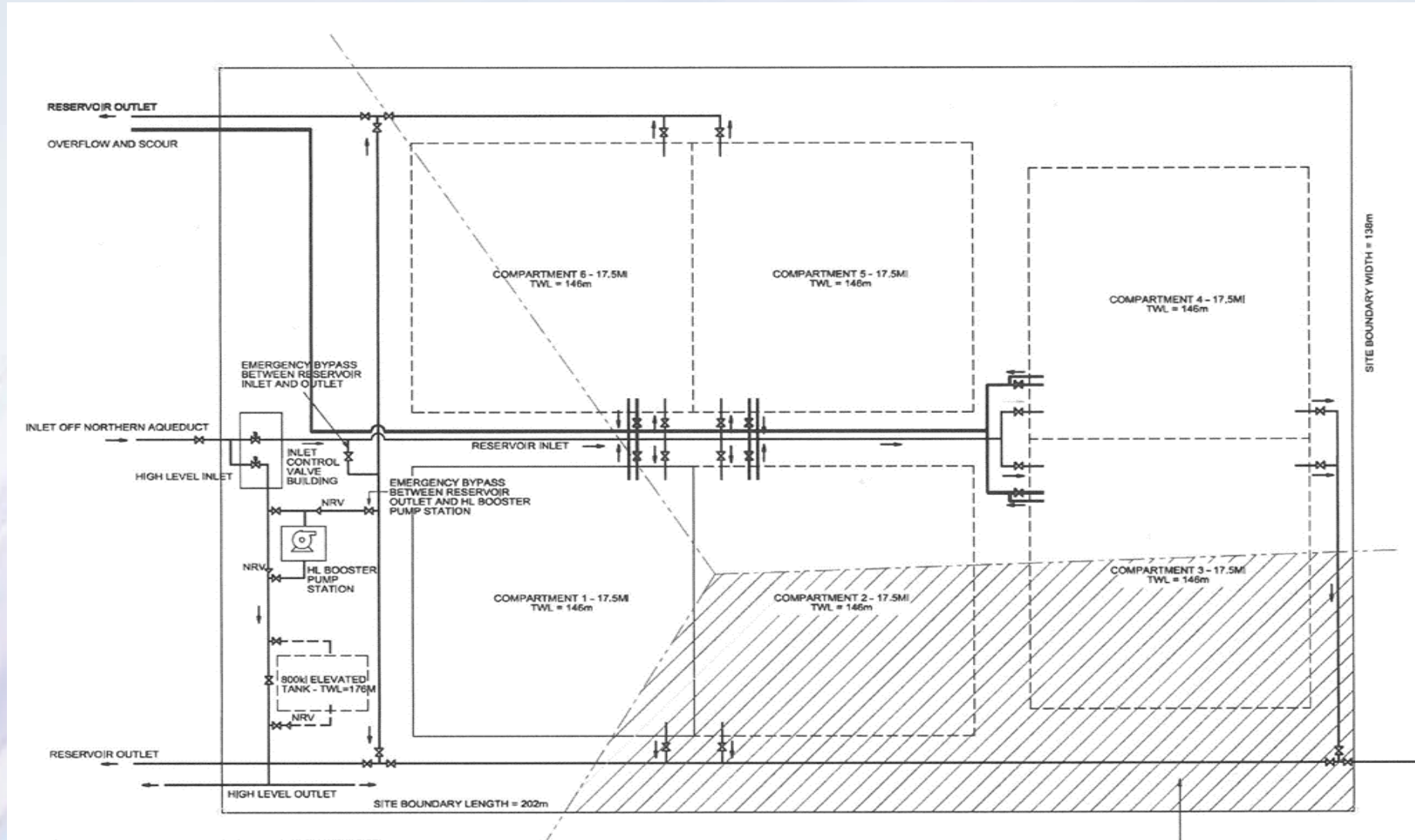
# Development Driven



Modelling of Blackburn Reservoir based on development projections



# Development Driven (Blackburn Reservoir Ultimate Capacity)

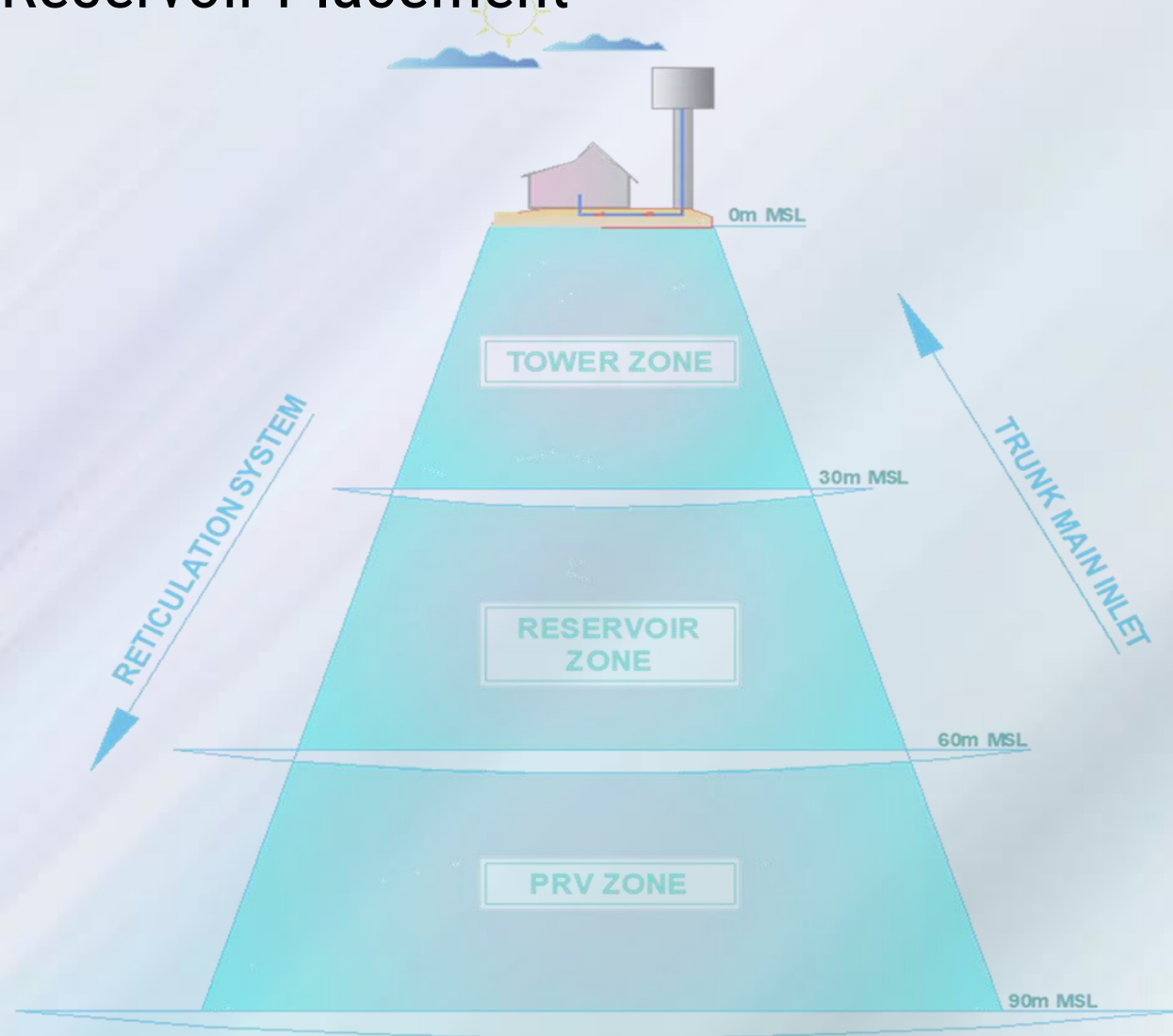


# Development Driven (Blackburn Reservoir Cell 1)



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# EWS standards of Reservoir Placement



# The effects of Population growth vs EWS standards



## Amagcino Reservoir

- Current Capacity 2MI
- Upgrade req. Additional 3MI



## TRADING SERVICES CLUSTER WATER AND SANITATION GROWTH WITHIN THE MUNICIPALITY FROM 2003 TO 2022 SHOWING DEVELOPMENT EXPANSION

by EWS GIS Section

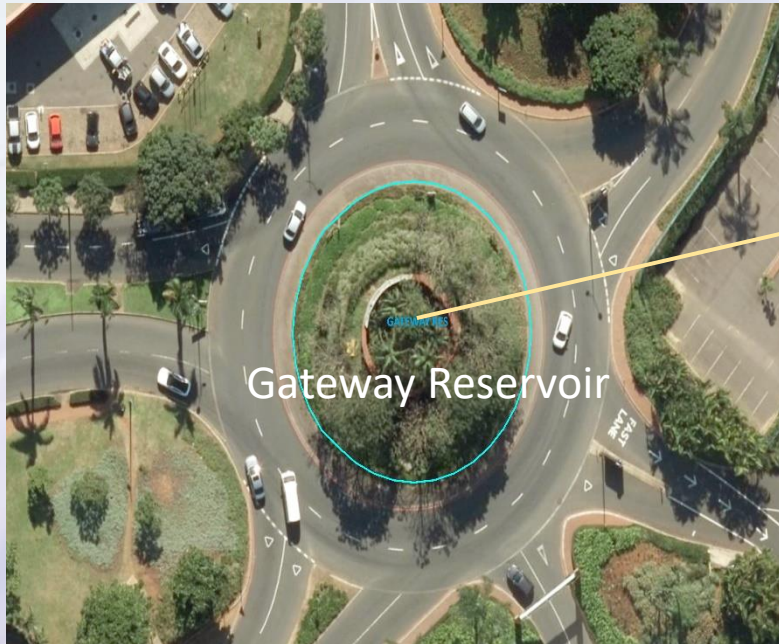
# Adapting to Situations



- Blending in with the Environment
- Accommodate landowner requests
- Conflict resolutions
- Community Partnerships

# Adapting to Situations

- Blending in with the Environment



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- Blending in with the Environment



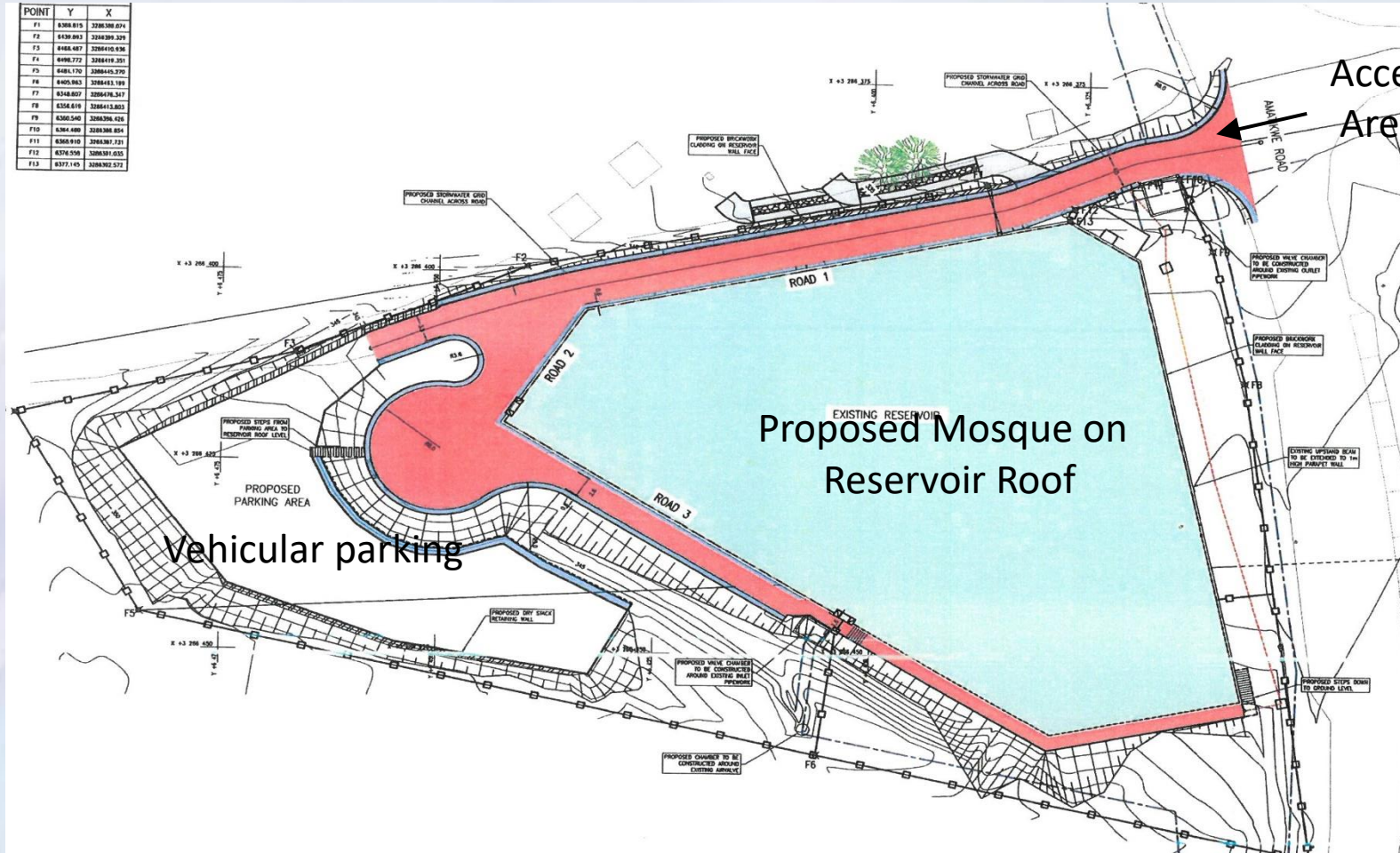
Rosetta Reservoir



Bluff 2 ET overlooking Bluff Golf Course

# Adapting to Situations

- Accommodate Landowner Requests: Amaotana Reservoir



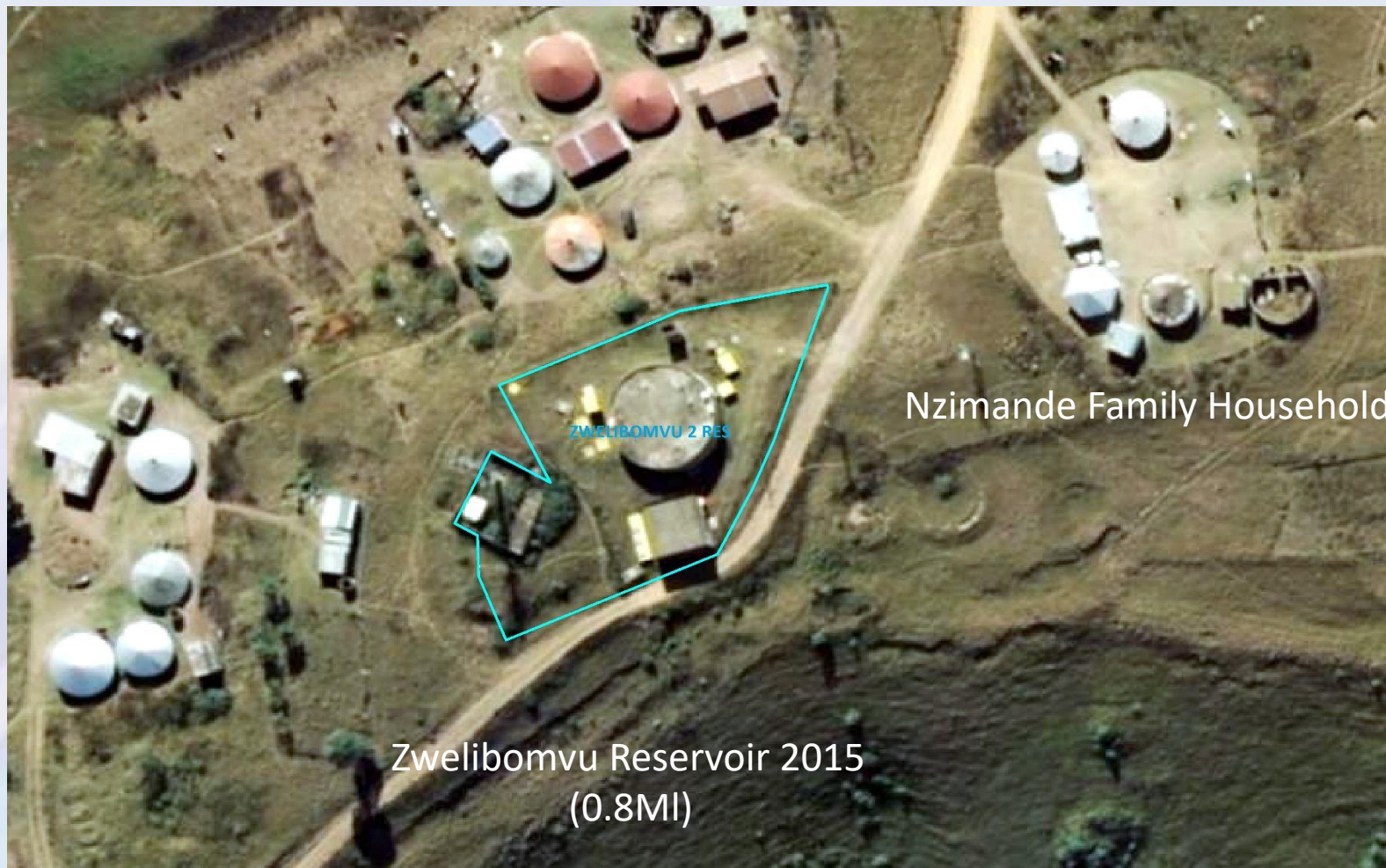
Access Road to Parking Area behind Reservoir

Proposed Mosque on Reservoir Roof

Vehicular parking

# Adapting to Situations

- Conflict Resolution



# Adapting to Situations

- Conflict Resolution



Zwelibomvu Reservoir 2019  
(4.5MI)



# Adapting to Situations

- Community Partnerships: Umlazi 7 Reservoir



# Adapting to Situations



- Influences the Reservoir's:
  - Shape (Circular/Square/Trapezoidal)
  - Depth (Increased wall heights/Fully or partially buried)
  - Capability to Expand to Demand

# Design Standards



## Amendment to SANS 1200G: Structural Concrete

- No addition of water
- Monitoring of weather conditions prior to all concrete pours
- Reduction in Temperature limits during pours
- Limits of discharge times
- Strict Test and Site Controls
- Curing Limitations

# Design Standards



Compliance of these standards ensure:

- Lifespan of 50 years on the structure
- Reduction of Cracks (design limit of 0.1-0.2mm)
- Flexural Strength
- Water Tightness of Structure

Compliance of these standards



Strict Construction Controls



Watertight Structure

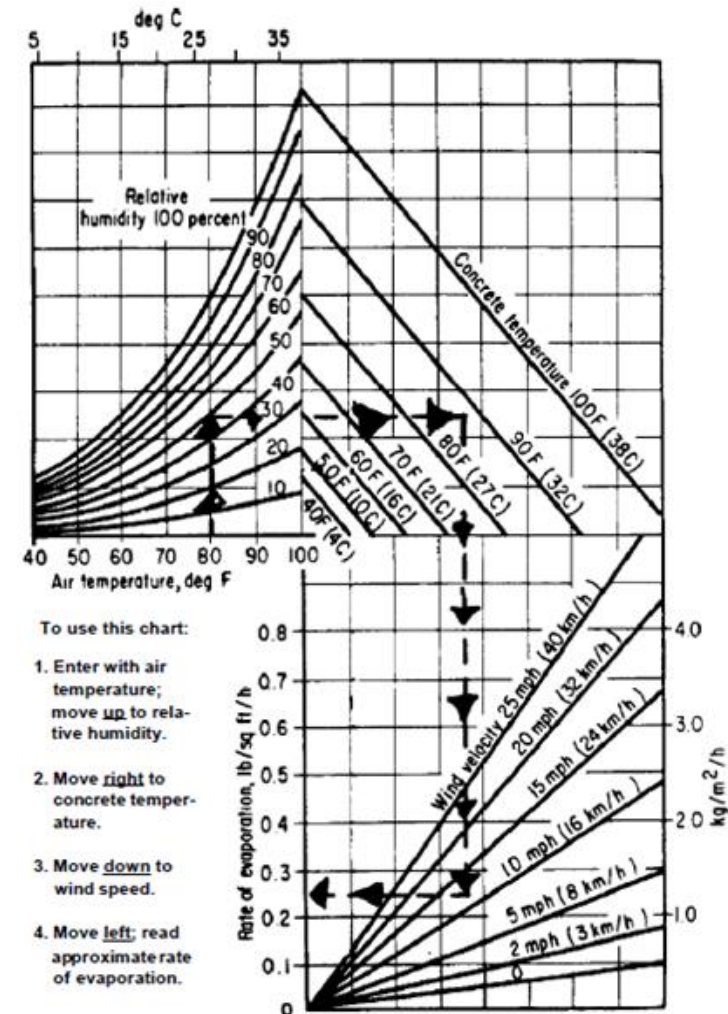


# Compliance of Design Standards during Construction



## Site Preparation

- Installation of Weather Station
  - Free from vandalism
  - Obstruction
  - Elevated and exposed to all the elements
  - Geographical orientated



# Compliance of Design Standards during Construction



## Site Preparation

- Ready Mix Concrete Approval
  - Location of Batch plant- compliance with 90min batching to discharge tolerance
  - Mix Design Approval- compliance of specification (materials) and the risk of non-compliance



# Compliance of Design Standards during Construction



Pouring of Structural Concrete-Monitoring of weather conditions



- Temperature
- Humidity
- Wind Speed and Direction



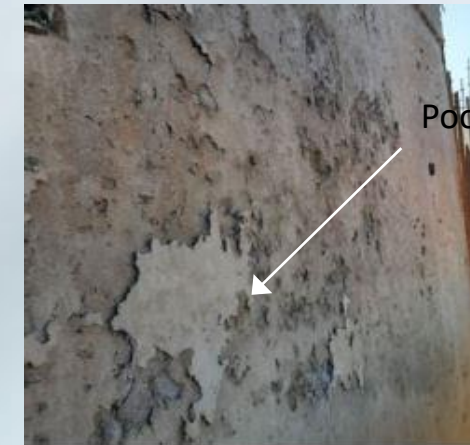
# Compliance of Design Standards during Construction



## Pouring of Structural Concrete-Surface Preparation



- Cleanliness of Surface, free from debris
- Quality of Shutter Oil and removal of excess
- Reinforcing steel according to design
- Sufficient Cover
- Water stops adequately secured
- Concrete Cube Moulds prepped.



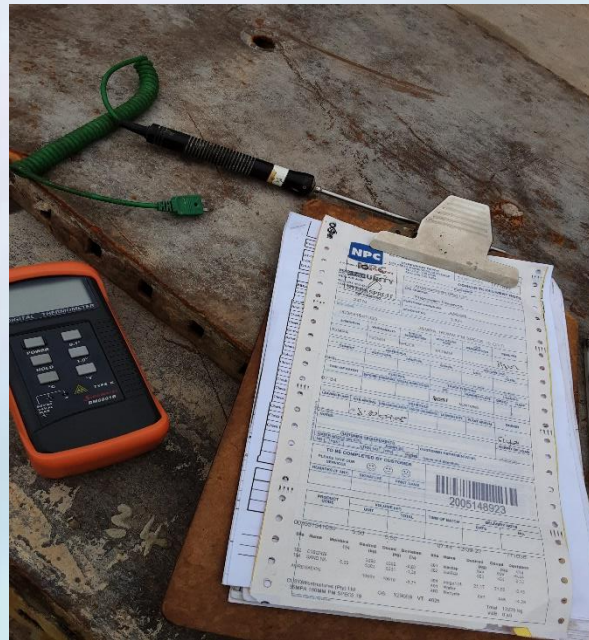
Poor quality shutter oil

# Compliance of Design Standards during Construction



## Pouring of Structural Concrete

- Mix design
- The dispatch time and arrival time
- Temperature
- Slump



# Compliance of Design Standards during Construction



## Pouring of Structural Concrete-Concrete Cubes



Volume of pour (m <sup>3</sup> )	Number of sets
0 – 25	2
26 – 50	4
51 – 100	6
101 – 200	8
+ 201	10 (or as required by the Engineer)



# Compliance of Design Standards during Construction



## Curing of Structural Concrete: SANS 1200G 5.5.8 (a-d)

- The use of curing compounds not permitted
- Only potable water
- Wetted Hessian sacking to be used in conjunction plastic sheeting on certain elements.
- Certain curing method's certain structure components



# Compliance of Design Standards during Construction

## Further Testing Requirements

- Concrete Strength- concrete cubes



Table 5 - Acceptance criteria for concrete strength

Acceptance Category	Strength $C_s$ = Average minimum strength for 3 cubes at 28 days (Mpa)
Characteristic strength for water retaining structures	35
Full acceptance	$C_s \geq 37$
Conditional acceptable	$33 \leq C_s < 37$
Rejection	$C_s < 33$

Mix Code: 3531541030

Date cast	Delivery Note	7D Cube 1	7D Cube 2	7D Cube 3	7 day Avg	28D Cube 1	28D Cube 2	28D Cube 3	28 day Avg
2022/08/16	770871	46.7	51.5	53.4	50.5	72.3	69.2	64.8	68.8
2022/09/12	771039	52.5	50.3	52.1	51.6	62.9	66.7	66.6	65.4
2022/09/12	771046	51.2	49.1	51.1	50.5	73.1	66.8	67.4	69.1
2022/09/22	771116	59.2	57.7	57.2	58.0	71.7	72.1	73.5	72.4
2022/09/26	771134	59.5	60.5	55.9	58.6	74.3	76.0	76.9	75.7
2022/09/26	771141	56.8	59.1	57.5	57.8	68.5	74.6	74.1	72.4
2022/10/12	771255	43.8	43.7	45.6	44.4	62.0	61.4	59.9	61.1
2022/10/12	771266	47.8	45.5	45.0	46.1				
2022/10/21	771337	42.3	44.5	47.5	44.8				

# Compliance of Design Standards during Construction



## Further Testing Requirements

- Durability Index - water sorptivity
  - oxygen permeability
  - chloride conductivity

Table 1 - Acceptance criteria for durability testing structural element

Acceptance Category	Oxygen permeability index (log scale)	Water sorptivity (mm h)	Chloride Conductivity
Full acceptance	$O_p \geq 9.15$	$W_s \leq 8$	$C_c \leq 0.75$
Conditional acceptance	$9.15 \geq p > 9.0$	$8 < W_s \leq 12$	$0.75 < C_c \leq 1.50$
Acceptance with remedial measures	$9.0 \geq p > 8.75$	$12 < W_s \leq 15$	$1.50 < C_c \leq 2.50$
Rejection	$O_p < 8.75$	$W_s > 15$	$C_c > 2.50$



<b>OPI (log value)</b>		
Sample	A – 552/4249/A	10.78
	B – 552/4250/A	10.74
	C – 552/4251/A	10.02
	D – 552/4252/A	10.41
<b>AVERAGE</b>		<b>10.37</b>
<b>CoV</b>		<b>87.12</b>
<b>Sorptivity (mm/√hr)</b>		
Sample	A – 552/4249/A	4.43
	B – 552/4250/A	4.42
	C – 552/4251/A	3.54
	D – 552/4252/A	4.71
<b>AVERAGE</b>		<b>4.28</b>
<b>CoV</b>		<b>11.96</b>
<b>Chloride Conductivity (mS/cm)</b>		
Sample	A – 552/4253/B	0.38
	B – 552/4254/B	0.37
	C – 552/4255/B	0.37
	D – 552/4256/B	0.40
<b>AVERAGE</b>		<b>0.38</b>
<b>CoV</b>		<b>3.7</b>

# Compliance of Design Standards during Construction



## Further Testing Requirements

- Concrete Cover



**TABLE 8 - ACCEPTANCE CRITERIA FOR CONCRETE COVER**

Acceptance Category	Concrete Cover (mm) (for specified cover of 50mm)
Full acceptance	$70 > C_d \geq 50$
Conditional acceptance	$45 \leq C_d < 50$
Acceptance with remedial measures	$40 \leq C_d < 45$
Rejection	$C_d < 40, C_d > 70$

# Compliance of Design Standards during Construction



## Further Testing Requirements

- Water Tightness Testing of Structure and Roof
  - Roof - prior to testing of structure
    - flooding of the entire roof, maintain a depth of 100mm over 72hrs
  - Structure - no backfilling
    - interior surface cleaned and hosed
    - specified filling rate
    - 7-day absorption period
    - 7-day testing period with limitation to allowed drop of levels





# Consequences of not maintaining Design Controls

High Wind Speeds and Low Temperatures



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# Consequences of not maintaining Design Controls

Insufficient vibration



# Consequences of maintaining Design Controls



Maintaining the temperature during Summer



Concrete outside the maximum temperature threshold is rejected

Installation of Chilling Plants

# Consequences of maintaining Design Controls



CONCRETE WORKING FOR WATER – FEBRUARY 2024

# FUN FACTS

eThekweni Water and Sanitation Unit operates and maintains:

- 14 500km of watermains
- ±380 water storage facilities with a combined total capacity of 1680ML (1.6 billion litres)
- Approx. 1-million-meter connection points

*Thank you!!!*