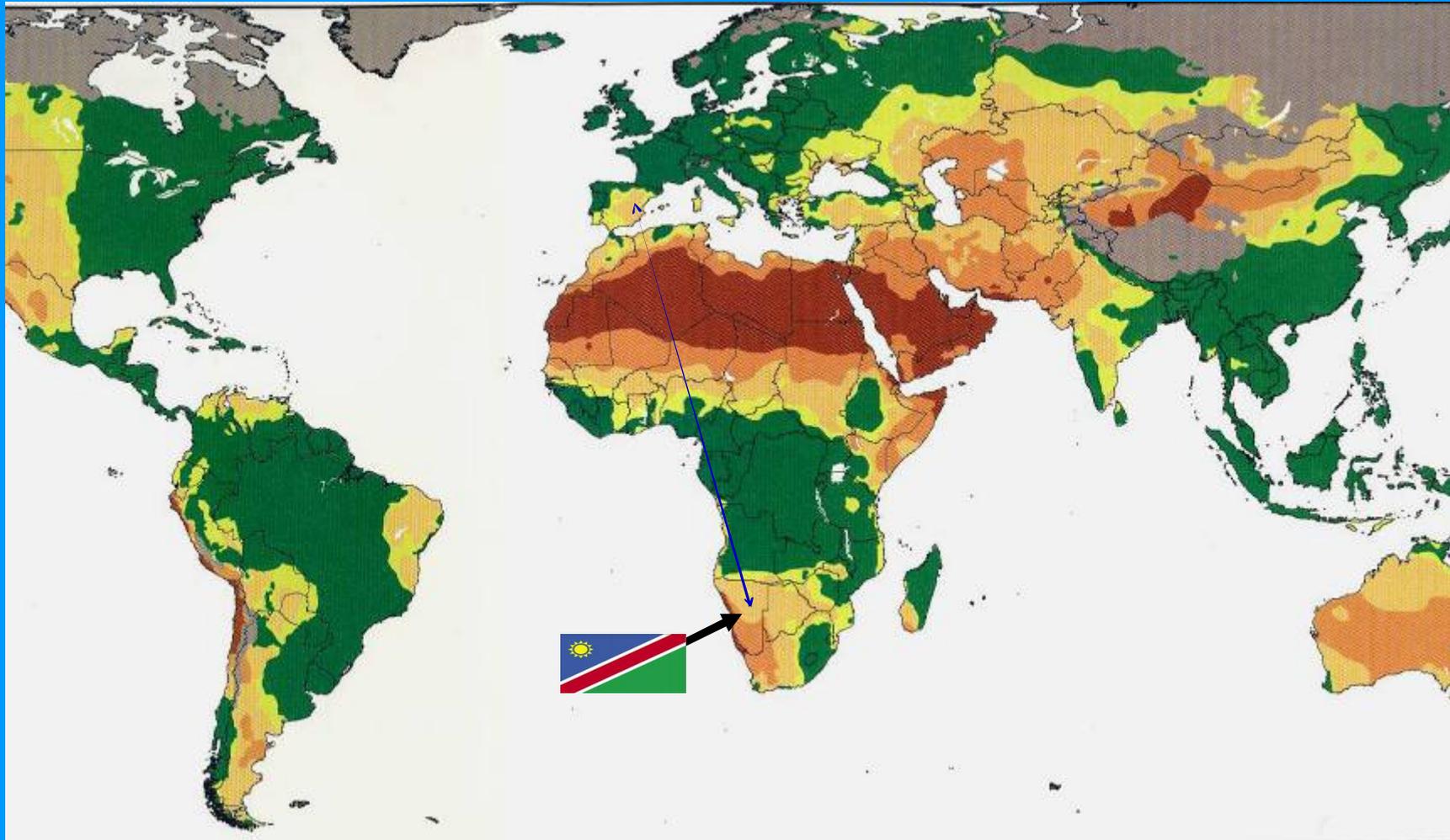


Quenching the Nation's Thirst through Sweetened Seawater: Namibian Experience

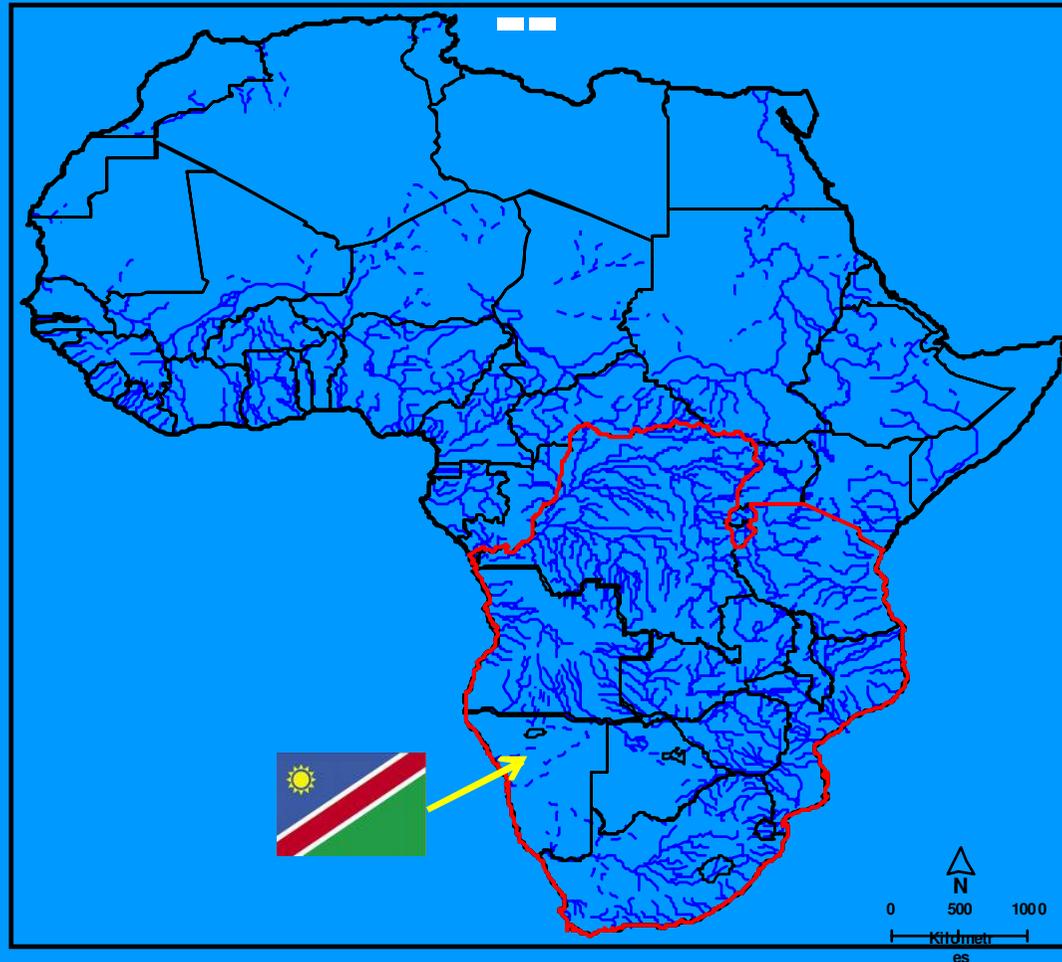
*Presented at the Zaragoza Water Tribune,
Zaragoza, Spain, Sept 2008*

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Where is Namibia?



...No Rivers to Wet the Country



... and every drop of Water Counts



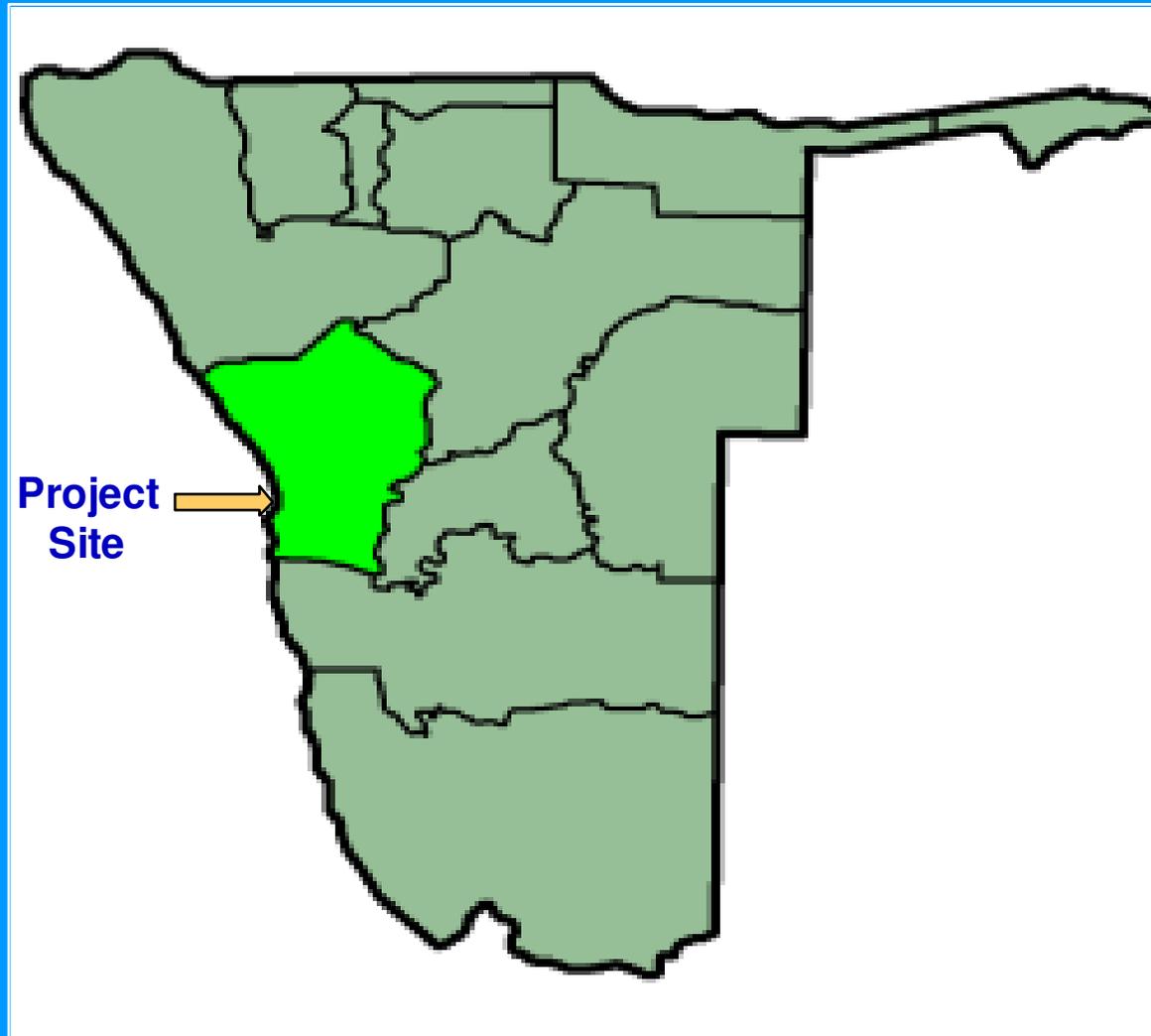
Presentation

- Background about Namibia
- Water Supply in Central Namib Area
- Impact of Uranium Demand on Water Supply
- Water Sources Explored
- Seawater Desalination Project
- Progress Made
- Outstanding Tasks
- Benefits to be Derived
- Comments and Questions

Namibia : Background

Statehood	21 March 1990	
Size	840 000km²	
Population	2 million (70% Rural)	
Rainfall	250mm (National)	
GDP	U\$2 000	
Un-Employment	35%	
Industries	Mining, Tourism, Fishing, Agriculture	

Namibia with Erongo Region



Central Namib : Characteristics



Central Namib : Characteristics

- Little or No Rain (12 mm /a)
- Fragile Environment
- Pristine Beauty – Namib Desert
- Population Very Small – 6% of National
- Popular Tourists Destinations
- Major Port – Walvis Bay
- Fishing, Mining and Tourism

Sources of Water : Ground

Source	Present Abstraction (Mm ³ /a)	Sustainable Yield (Mm ³)
Omdel Aquifer	9 <i>(over-abstraction)</i>	5
Kuiseb Aquifer	5	7
Total	14	12

- ❑ *Current Abstraction Permit for Omdel Aquifer only valid until 2011*
- ❑ *Over-abstraction can cause irreversible damage to the Aquifer and Environment*

Augmenting Coastal Water Supply

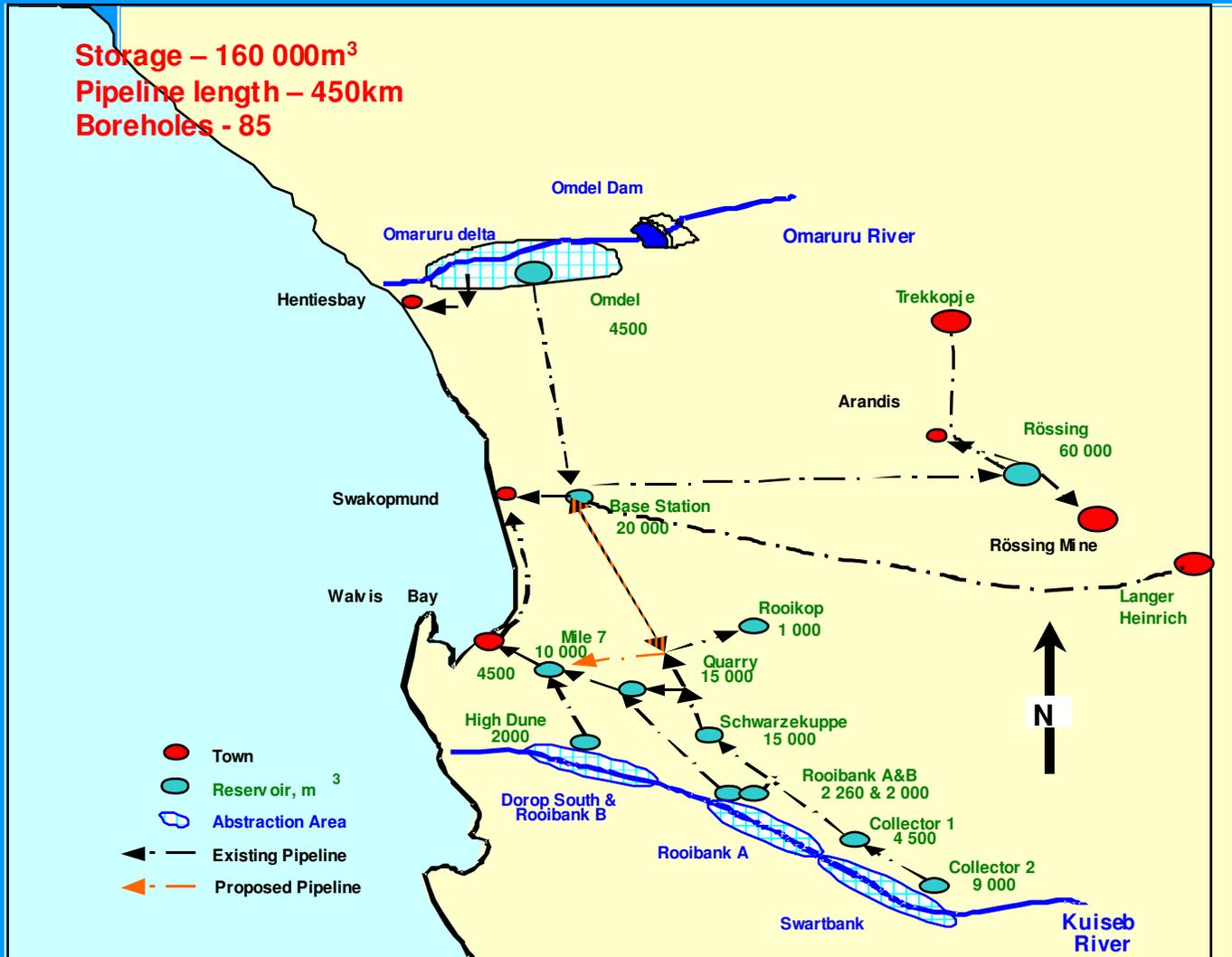
-Extensive Development of Ground Water Sources

-Water Re-use / Reclamation

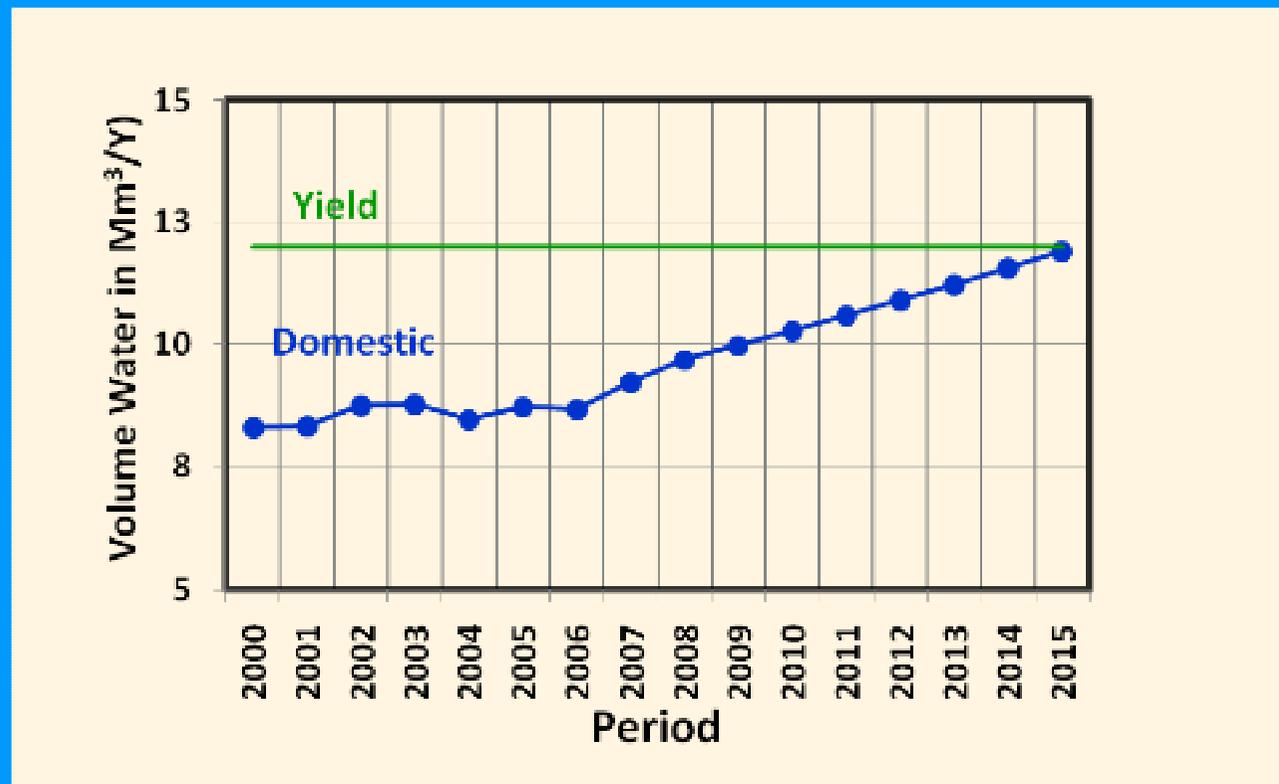
-Artificial Recharge

-Water Demand Management

Water Supply Infrastructure



Domestic Water Demand and Yield



Alternative Water Sources Explored

- ❑ Since 1998 - Extensive Researched on
 - ❑ Towing of icebergs from the South Pole
 - ❑ Tanking from the Mouth of the Congo River
 - ❑ Kunene River Link (Angolan Border)
 - ❑ Seawater Desalination Processes

Increasing Demand for Uranium because

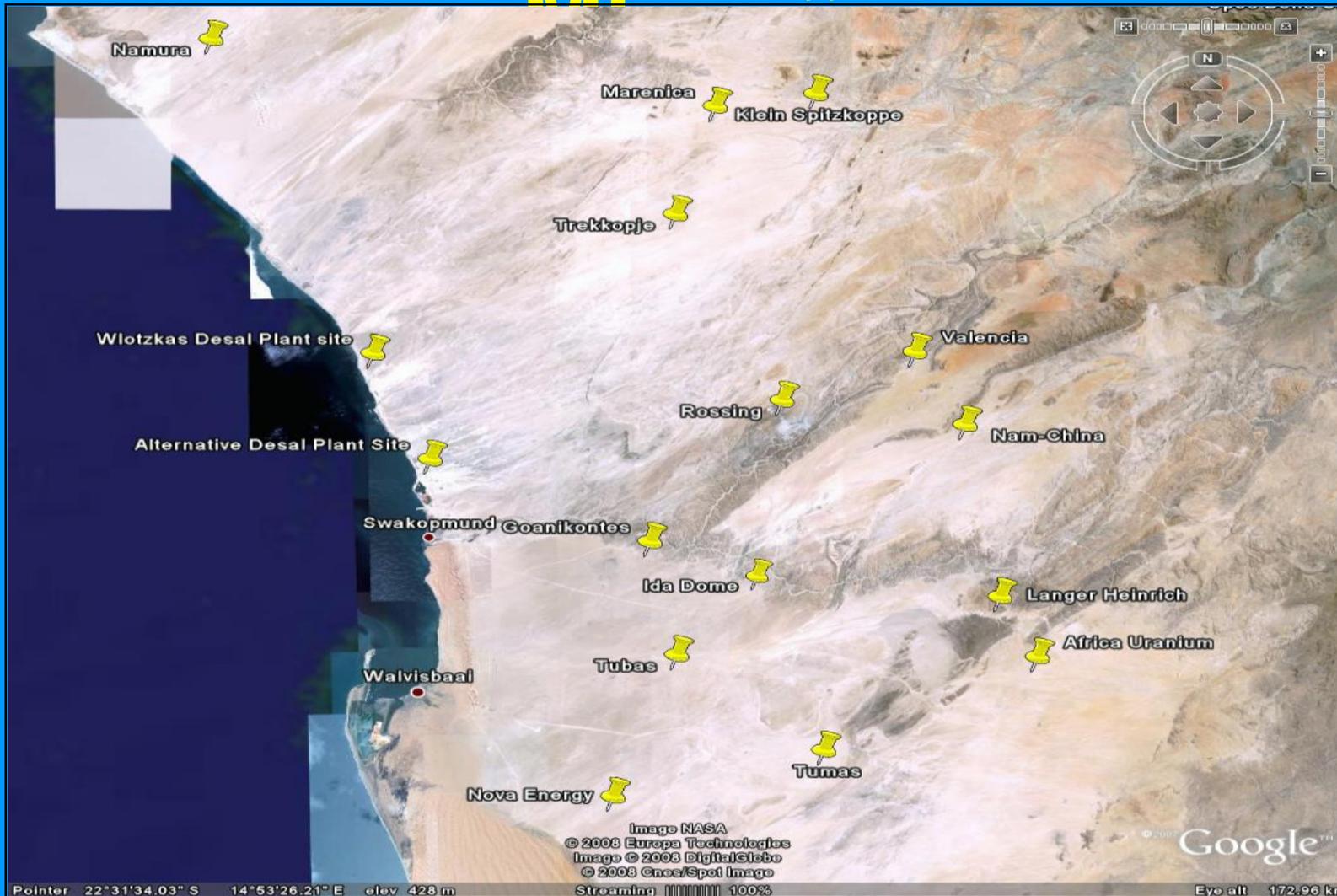
☐ -Uranium Stockpiles Depleted

- Good and Stable Price for Uranium Oxide
- Erratic Oil Prices
- Concerns about Global Warming
- Nuclear Energy as an alternative Energy Source
- Broader Understanding about Nuclear Energy
 - Safety, Health, Costs, Environment

Water Demand by Uranium Mines

	Mine / EPL Holder	Time-frame Increase/Ful Period	Future Demand (Mm ³ /y)	Cumulative Demand (Mm ³ /y)
Production	Basseng	Q1 - 2010	8	8
	Heinrich	Q1 - 2010	5	13
Probable	Valencia	Q1 - 2010	3	16
	Goanikontes	Q1 - 2011	5	21
	Ida Dome	Q1 - 2011	5	26
Possible	Tubas/Tumas	2012	5	31
	Marenica	2012	4	35
	Mamira (Cross)	2012	4	39
	Spitzkoppe	2014	4	43
	Africa Uranium	2014	4	47
	NamaChina	2014	4	51
	Exploration	2014	4	55

Location of “Uranium Mines”



History of Uranium Mining

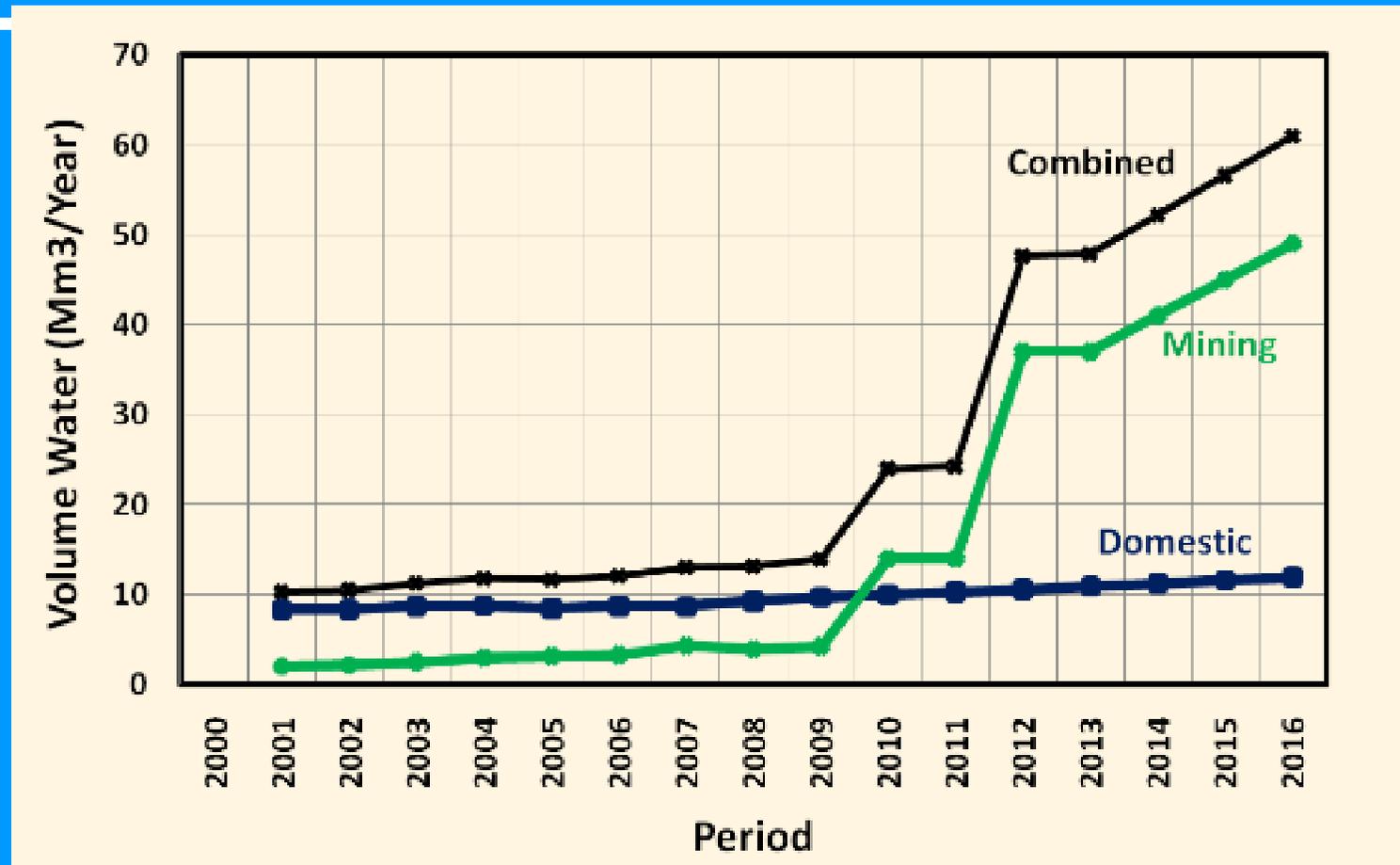
**Rossing Uranium –
1976**



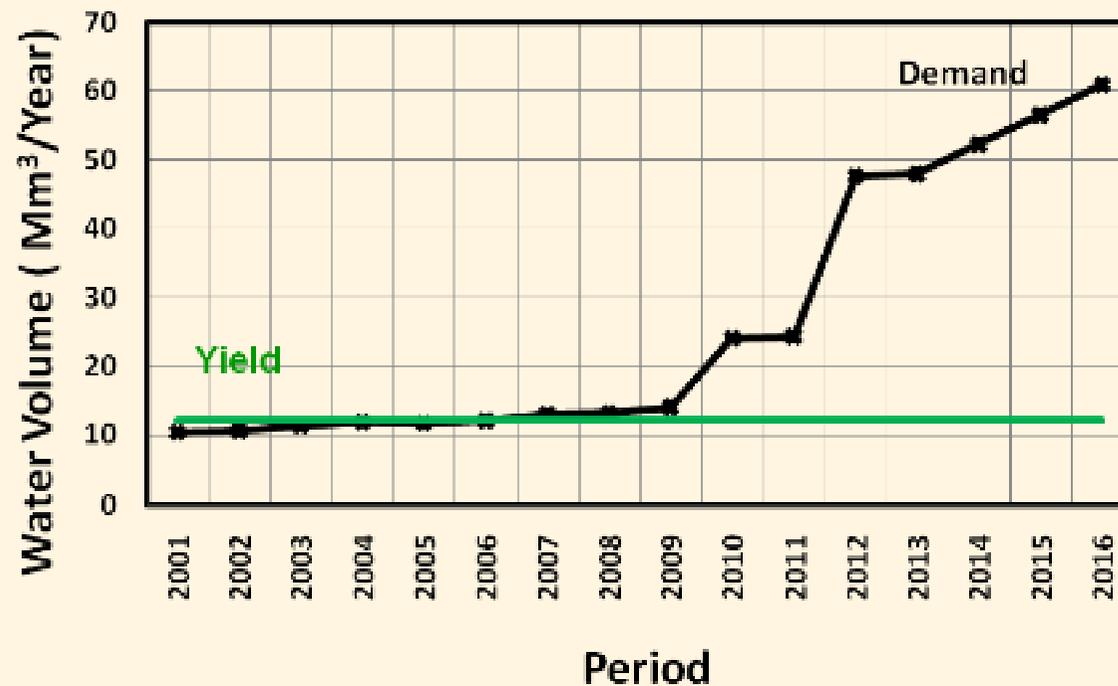
**Langer Heinrich Mine –
2006**



Water Consumption and Projections



Coastal Water Demand & Yield



The Missing Link



Solution to the Water Problem

- ❑ **Sea - as a Source of Raw Water**
- ❑ **Extensive Sampling of Sea Water**
 - Understanding Water Quality & Red Tide
- ❑ **In-house Pilot Study**
 - Importance & Sequence of Pre-Treatment Processes
- ❑ **Sea Water Reverse Osmosis Process**
 - Proven Technology (45%)
 - Costs Consideration (Capital + O&M)
 - Energy Input Minimal (<4 kWh/m³)
 - Little Environmental Impact

Progress Made

No	Activity	Time-Line
1	Appointment of SWRO Expert	28 Nov 07
2	Invitation of Pre-qualification Bids for SWRO Plant	4 Sept 07
3	Invitation of Final Bids for SWRO Plant	15 March 08
4	Appointment of Financial Consultant	14 March 08
5	Closing date for Final Bids for SWRO Plant	13 June 08
6	Cabinet Approval of the SWRO Project	29 June 08
7	Post-Bid Clarification Meeting	15 Aug 08
8	Invitation of Bids for EIA	22 Aug 08
9	Invitation of Pre-qualification Bids for SWI	14 July 08
10	Invitation for Bids for Bathymetric Analysis	1 August 08

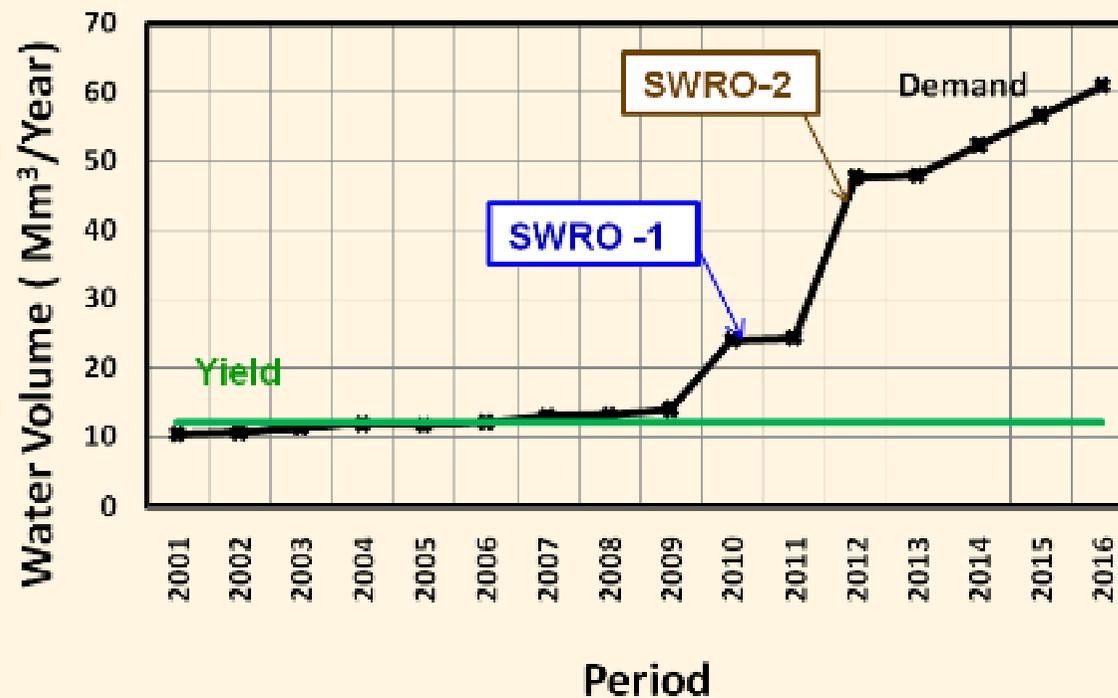
Outstanding Tasks

No	Activity	Time-Line
1	Off-take Agreements with Mines	Oct 08
2	Cabinet Approval of Business Plan and	Oct 08
3	Guarantees	Oct 08
4	Financial Agreements with Funding Institutions	Oct 08
5	Award of Tender for SWRO	Oct-08
6	Commencement of Construction SWRO	Nov-08
7	Award of Tender for SWI	Nov-08
8	Finalise the Bathymetric Survey	Nov-08
9	Finalise EIA Study	Jan-09
10	Appointment of Plant Manager	Jan-08
11	Commencement of Construction SWI	Jan-08
12	Approval of EIA	Mar-09
13	Commissioning of the SWI	Dec-09
14	Pre-Commissioning of the SWRO	Jan-10
15	Final Commissioning SWRO	Apr-10

Namib SWRO Plant

Total Capacity	80 000m ³ /day
Start Up Date	June 2010
Product Recovery	45%
Feed Water TDS	35 000mg/l
Product Water TDS	<100mg/l
Feed Water Temperature	13 - 23°C
RO Process Description	1-pass
Product Boron Concentration	2.5mg/l (WHO)
Number of Trains	10
Operating Pressure	
Energy Consumption	< 4kWh/m ³
Energy Recovery	Robust
Pre-Treatment System	Processes
Post Treatment Method	
Seawater Intake	
Concentrate Disposal	
EPC Contractor	
Project Consultant	RosTek
Membrane Supplier	
Project Delivery Method	
Capital Cost	
Total Water Cost	
Total O&M Cost and Maintenance Cost	

Meeting the Water Demand of Mines



Challenges of the Project

Limited Institutional Technical Capacity

- SWRO Expertise
- Operation and Maintenance of SWRO Plants

-Deadlines

- Non-adherence

-Security of Power Supply

-Creating a Buy-in Culture

-Political Factors

-Multitude of Stakeholders

Interests : Diverse, Conflicting,
Complimentary

Stakeholders



Benefits to be Derived (1)

-SWRO - Reliable Technology

-Sustainable Supply of Water

-Protection of Environment

- Resting of Over-abstracted Aquifer

-Improved Quality of Supplied Water

- Reduction of Salinity

Mining Activities and other Industries

- Employment Creation / Taxation / Royalties

Benefits to be Derived (2)

Mining Clients

- Good Revenue Source (x4)
- Massive Infrastructure Development
- Increase Asset Base (x3)
- Private Public Partnership
- Technology Transfer – SWRO
- Capacity Building

In almost all technical /financial areas

2010 and Southern Africa

AFRICAN CUP OF NATIONS - ANGOLA

FIFA

SOUTH

Sea Water Reverse
Osmosis Plant
NAMIBIA

After 2010... still Counting every Drop



THANK YOU





Christal Muisoor

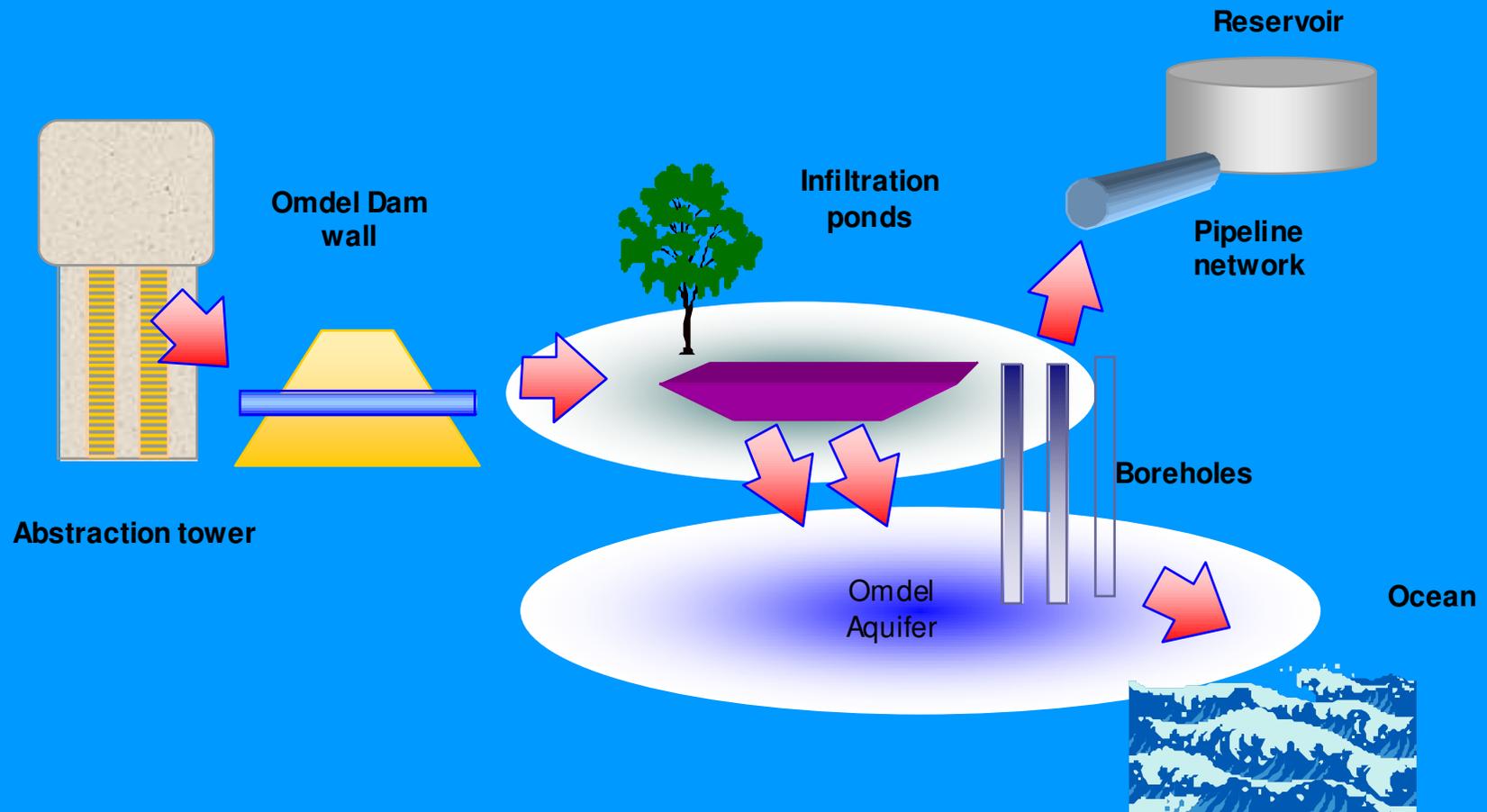
Water Usage for Uranium Production

- **Water Usage in Uranium Mining Operations**
Dust Suppression; Mineral Extraction;
Acid or Base Production; Chemical /
Reagents Preparations; Workshops;
Human Consumption; Environment

~0.3m³ per 1ton (1000kg) U₃O₈



Artificial Recharge: Conceptual



Water Quality Properties

Parameters	Pre-treated Seawater (mg/l)	Final Product (mg/l)
Calcium	398	<80
Magnesium	1 135	<30
Sodium	10 221	<100
Potassium	359	<25
Strontium	4.6	<1
Barium	0.04	<0.01
Iron	0.027	<0.03
Total alkalinity as CaCO ₃	118	<50
Chlorine	17 550	<100
Suplhate	3084	<100
Fluoride	1.0	<0.7
Si, as SiO ₂	2.1	N/A
Boron	5.0	2.5 (WHO)
pH	7.75	7.5-8.5
Temperature (deg. C)	13-23	N/A
Design temp, deg C	15	N/A
SDI (15 min)	<3.0	N/A
Turbidity, NTU	<0.2	<0.5