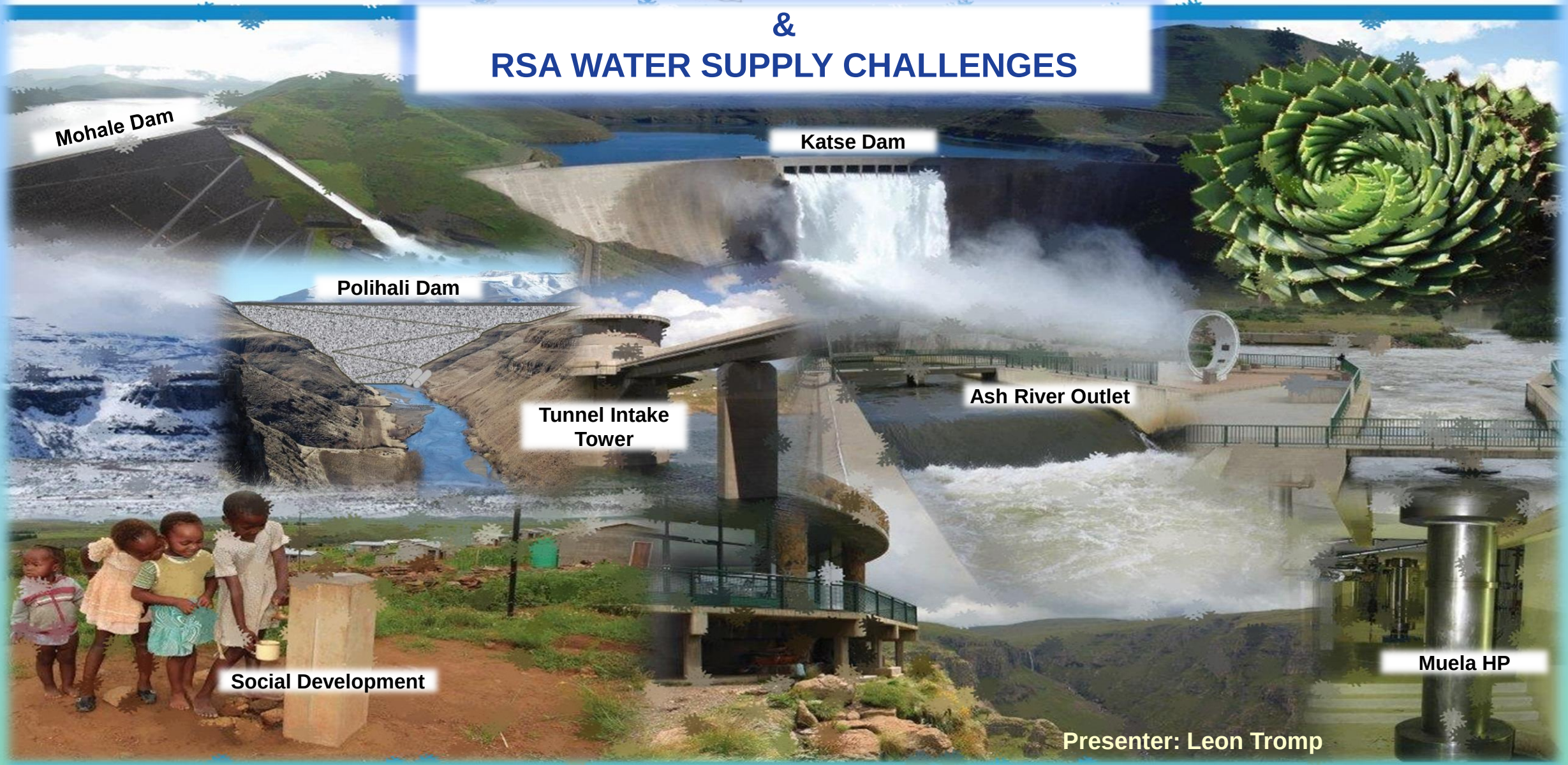
LHWP
LESOTHO HIGHLANDS WATER PROJECT

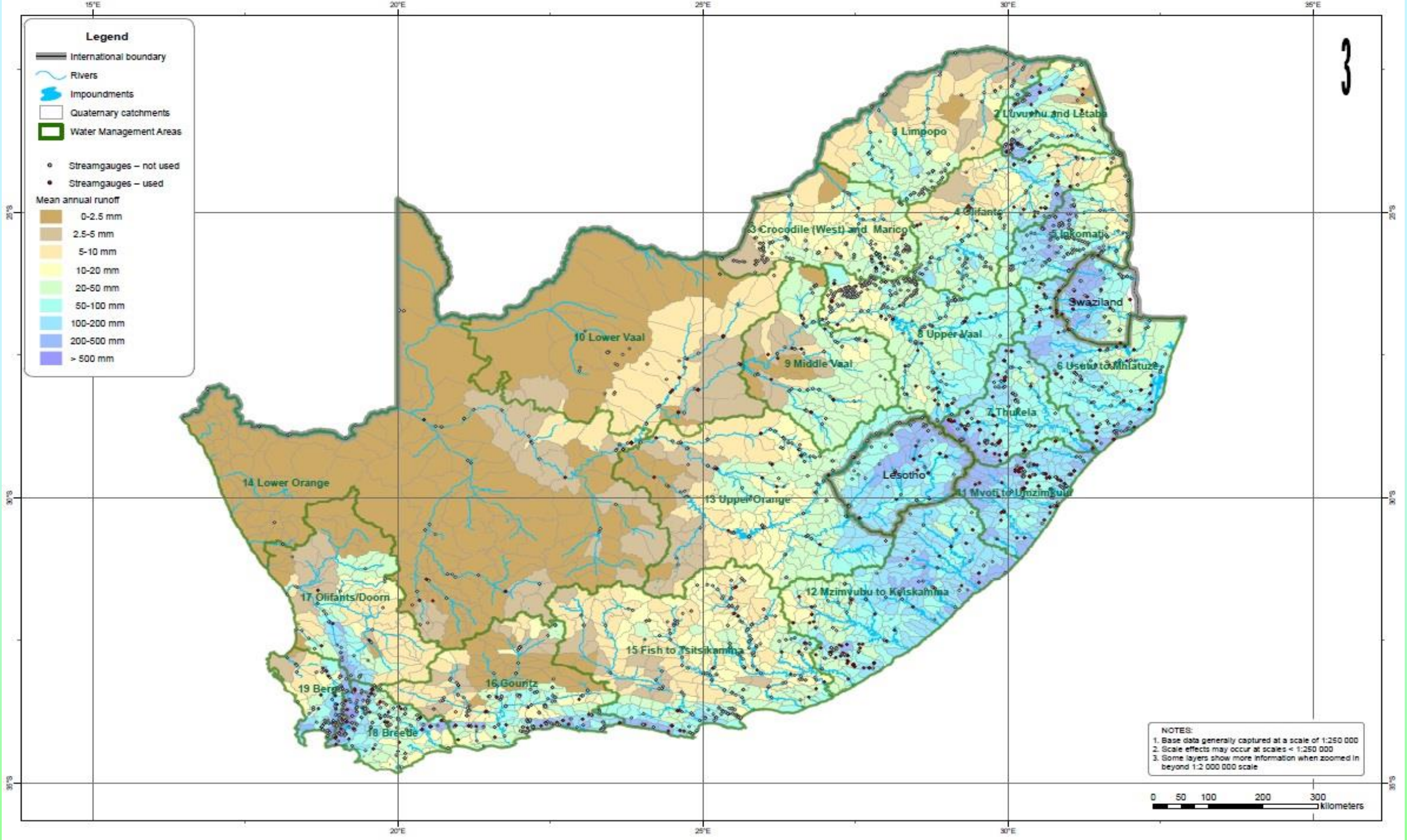
South Africa | Lesotho
Lesotho Highlands Water Project

&
RSA WATER SUPPLY CHALLENGES



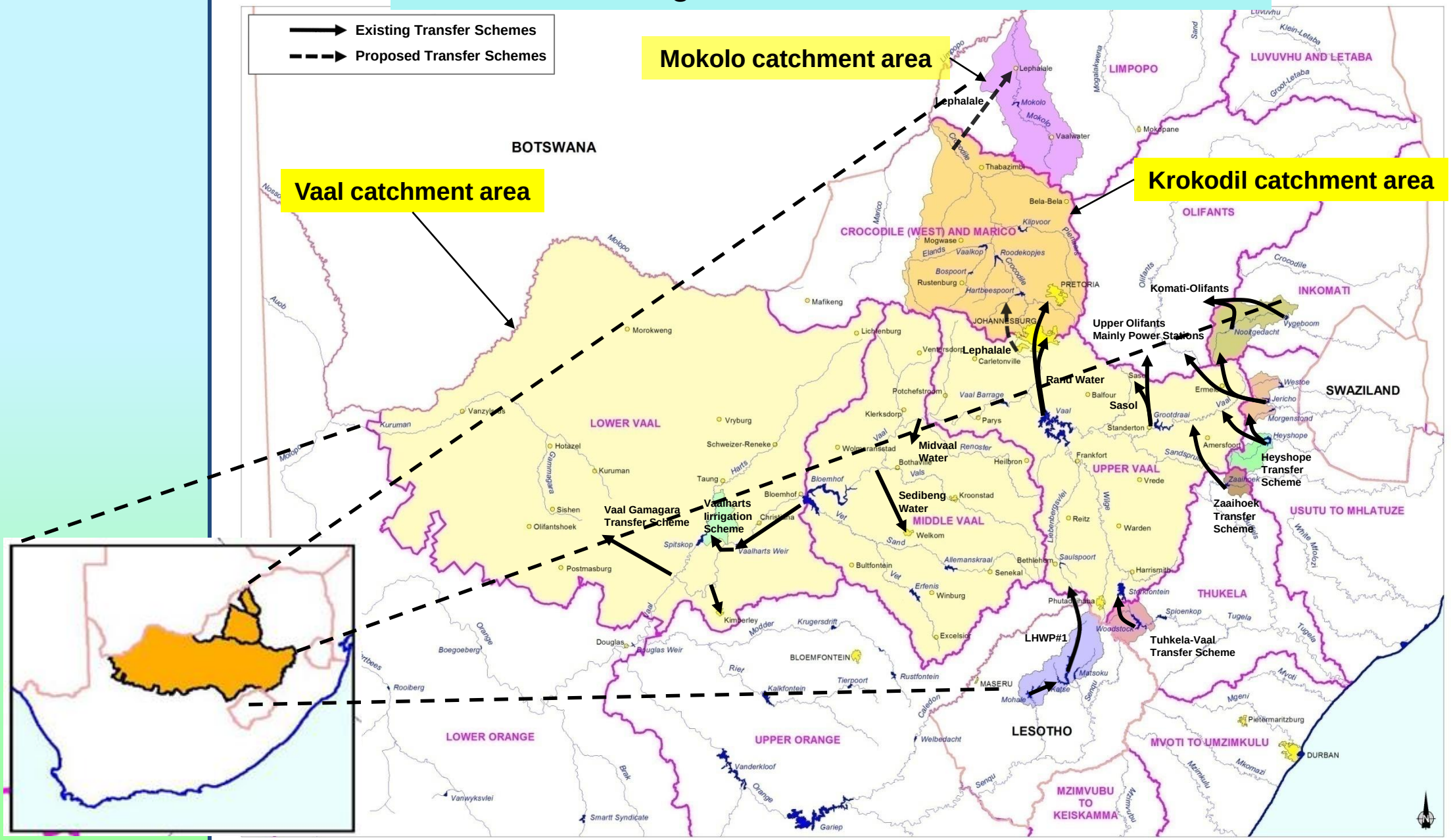
Presenter: Leon Tromp

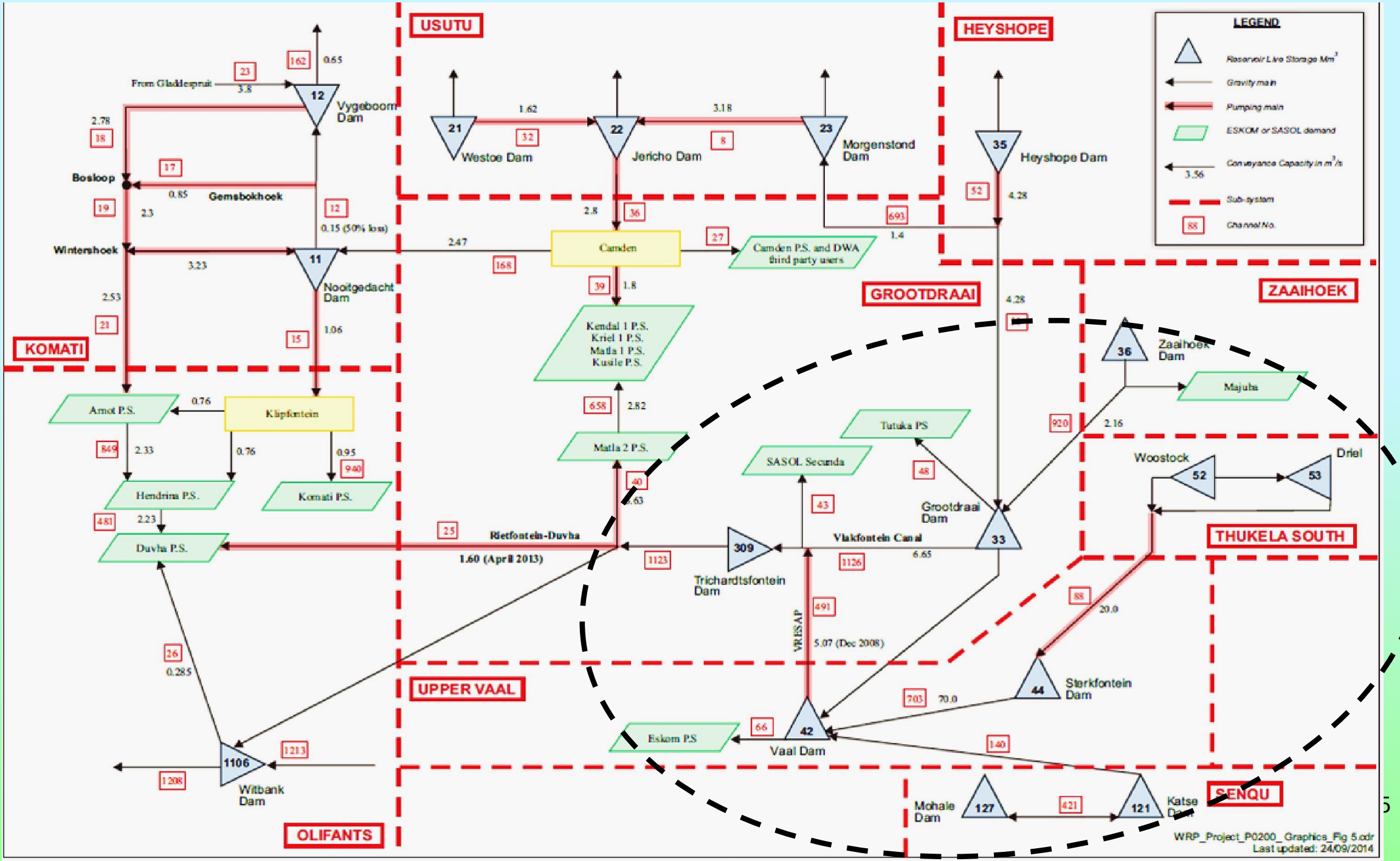
CONTENTS

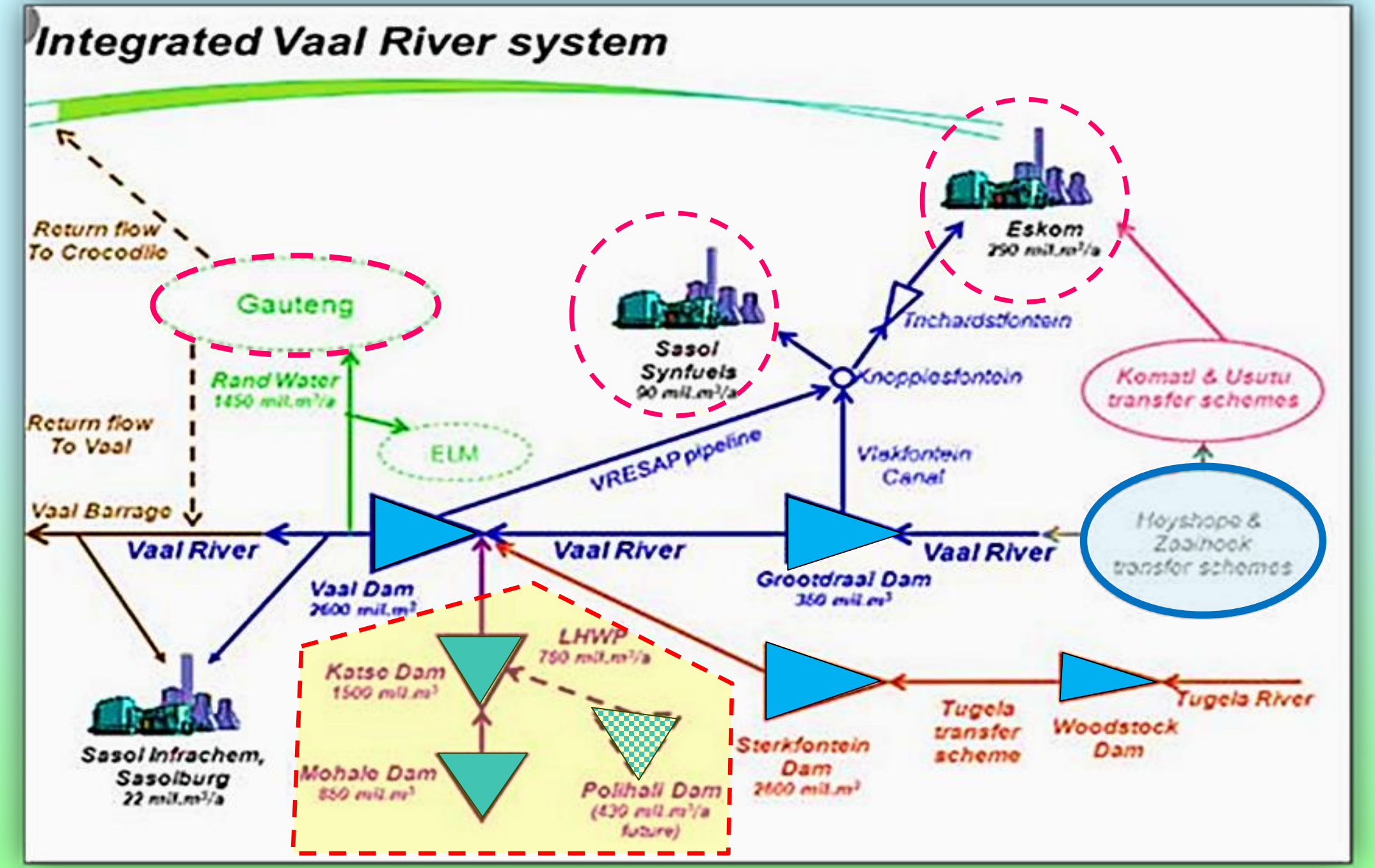

Legend
International boundary
Rivers
Impoundments
Quaternary catchments
Water Management Areas
Streamgauges – not used
Streamgauges – used
Mean annual runoff
0-2.5 mm
2.5-5 mm
5-10 mm
10-20 mm
20-50 mm
50-100 mm
100-200 mm
200-500 mm
> 500 mm
3
1 Limpopo
2 Luvuvhu and Letaba
3 Crocodile (West) and Marico
4 Olifants
5 Inkomati
6 Usutu to Mhlatuze
7 Thukela
8 Upper Vaal
9 Middle Vaal
10 Lower Vaal
11 Mvoti to Umzimkulu
12 Mzimvubu to Keiskamma
13 Upper Orange
14 Lower Orange
15 Fish to Tsitsikamma
16 Gouritz
17 Olifants/Doorn
18 Breede
19 Berg
Swaziland
Lesotho
NOTES:
1. Base data generally captured at a scale of 1:250 000
2. Scale effects may occur at scales < 1:250 000
3. Some layers show more information when zoomed in beyond 1:2 000 000 scale
0 50 100 200 300
kilometers

INTEGRATED VAAL RIVER SYSTEM

Vaal Water Management Area and its three catchments

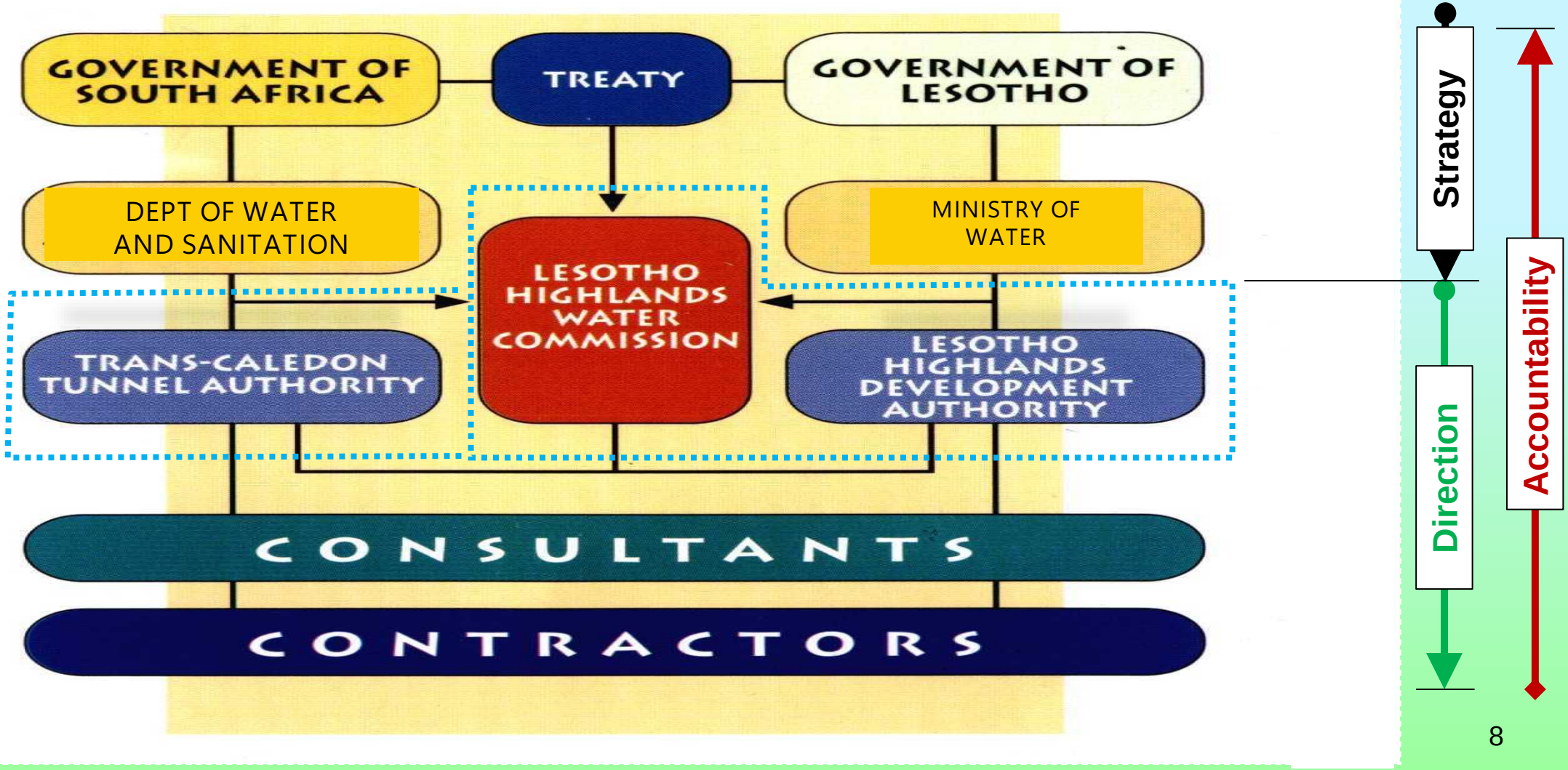



USUTU
HEYSHOPE
GROOTDRAAI
ZAAIHOEK
KOMATI
UPPER VAAL
OLIFANTS
THUKELA SOUTH
SENQU
LEGEND
Reservoir Live Storage Mm³
Gravity main
Pumping main
ESKOM or SASOL demand
Conveyance Capacity in m³/s
3.56
Sub-system
88
Channel No.
From Gladdespruit
23
3.8
162
0.65
12
Vygeboom Dam
2.78
18
Bosloop
17
0.85
Gemsbokhoek
19
2.3
12
0.15 (5.0% loss)
Wintershoek
3.23
11
Nooitgedacht Dam
2.53
21
15
1.06
21
Westoe Dam
1.62
32
22
Jericho Dam
3.18
8
23
Morgenstond Dam
2.8
36
2.47
168
Camden
27
Camden P.S. and DWA third party users
39
1.8
Kendal 1 P.S.
Kriel 1 P.S.
Matla 1 P.S.
Kusile P.S.
658
2.82
Matla 2 P.S.
40
1.63
693
1.4
35
Heyshope Dam
52
4.28
4.28
Amot P.S.
0.76
Klipfontein
849
2.33
0.76
0.95
940
Hendrina P.S.
Komati P.S.
481
2.23
Duvha P.S.
25
Rietfontein-Duvha
1.60 (April 2013)
1123
309
Trichardtsfontein Dam
43
SASOL Secunda
Tutuka PS
48
Vlakfontein Canal
6.65
1126
Grootdraai Dam
33
491
VRESAP
5.07 (Dec 2008)
36
Zaaihoek Dam
Majuba
920
2.16
Woostock
52
53
Driel
88
20.0
26
0.285
1106
Witbank Dam
1213
1208
Eskom P.S
66
42
Vaal Dam
203
70.0
44
Sterkfontein Dam
140
Mohale Dam
127
421
121
Katse Dam
WRP_Project_P0200_Graphics_Fig 5.cdr
Last updated: 24/09/2014

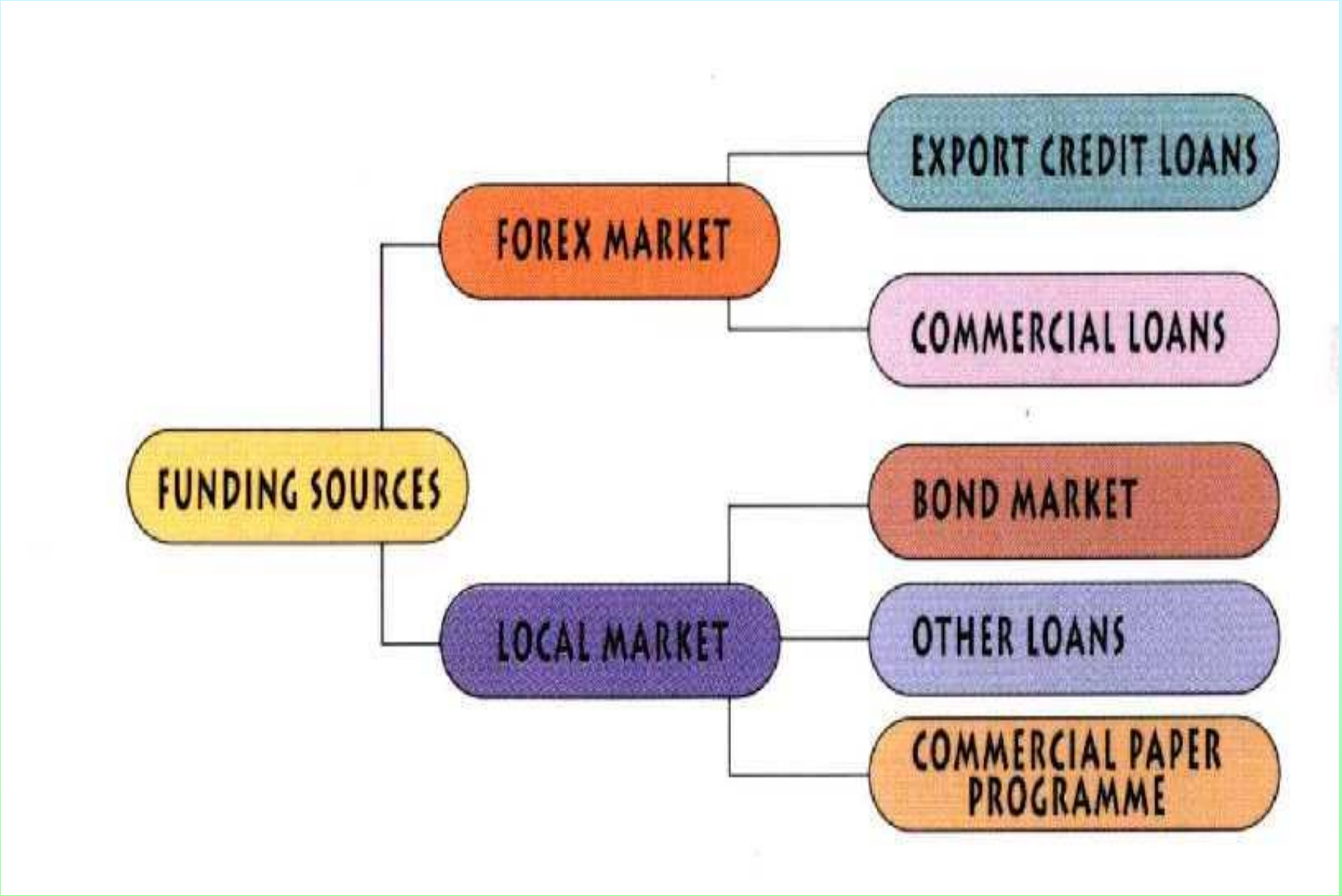

Integrated Vaal River system
Return flow
To Crocodile
Gauteng
Rand Water
1450 mill.m³/a
Return flow
To Vaal
ELM
Vaal Barrage
Vaal River
Vaal River
Vaal River
Vaal Dam
2600 mill.m³
VRESAP pipeline
Sasol
Synfuels
90 mill.m³/a
Eskom
290 mill.m³/a
Tinchardsfontein
Knopjiesfontein
Viskfontein
Canal
Komati & Usutu
transfer schemes
Heyshope &
Zaaihoek
transfer schemes
Grootdraal Dam
350 mill.m³
LHWP
780 mill.m³/a
Katse Dam
1500 mill.m³
Mohale Dam
850 mill.m³
Polihali Dam
(430 mill.m³/a
future)
Sterkfontein
Dam
2600 mill.m³
Tugela
transfer
scheme
Woodstock
Dam
Tugela River
Sasol Infrachem,
Sasolburg
22 mill.m³/a

- ✓ **RSA-LESOTHO TREATY - 24 Oct 1986**
- ✓ **PHASE II AGREEMENT - August 2011**

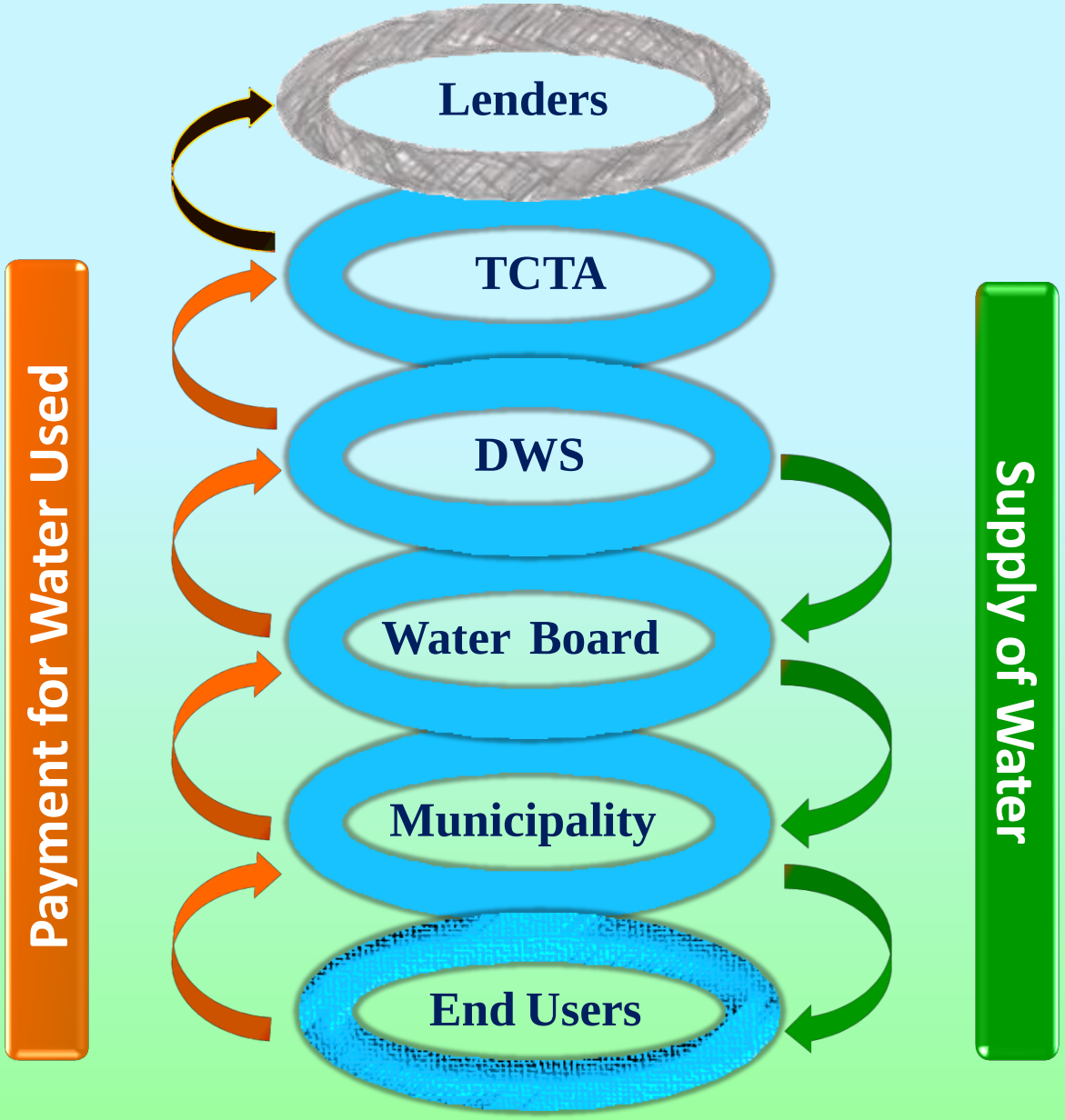
LHWP GOVERNANCE



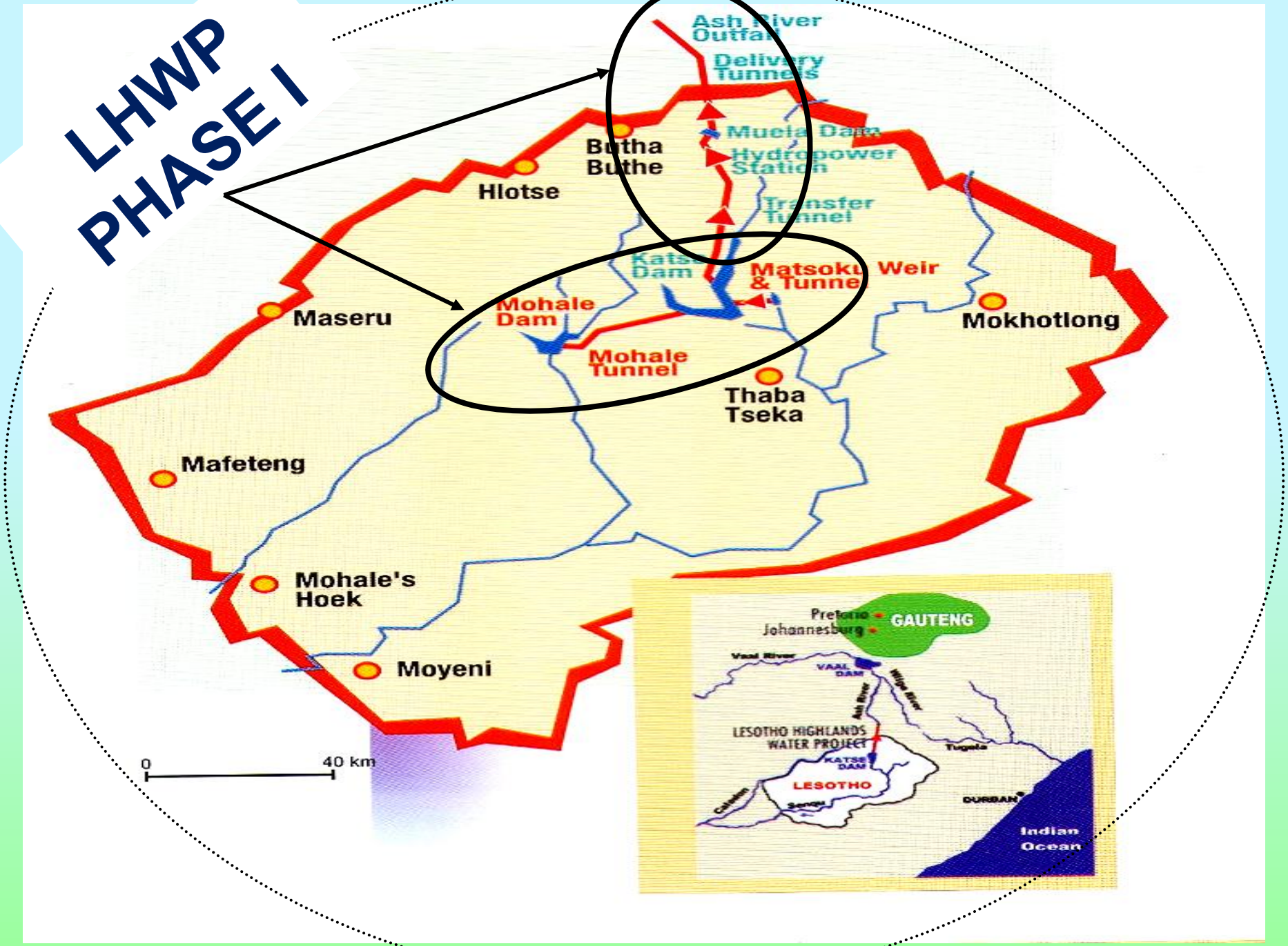
FUNDING SOURCES



Water Supply Chain & Revenue Collection



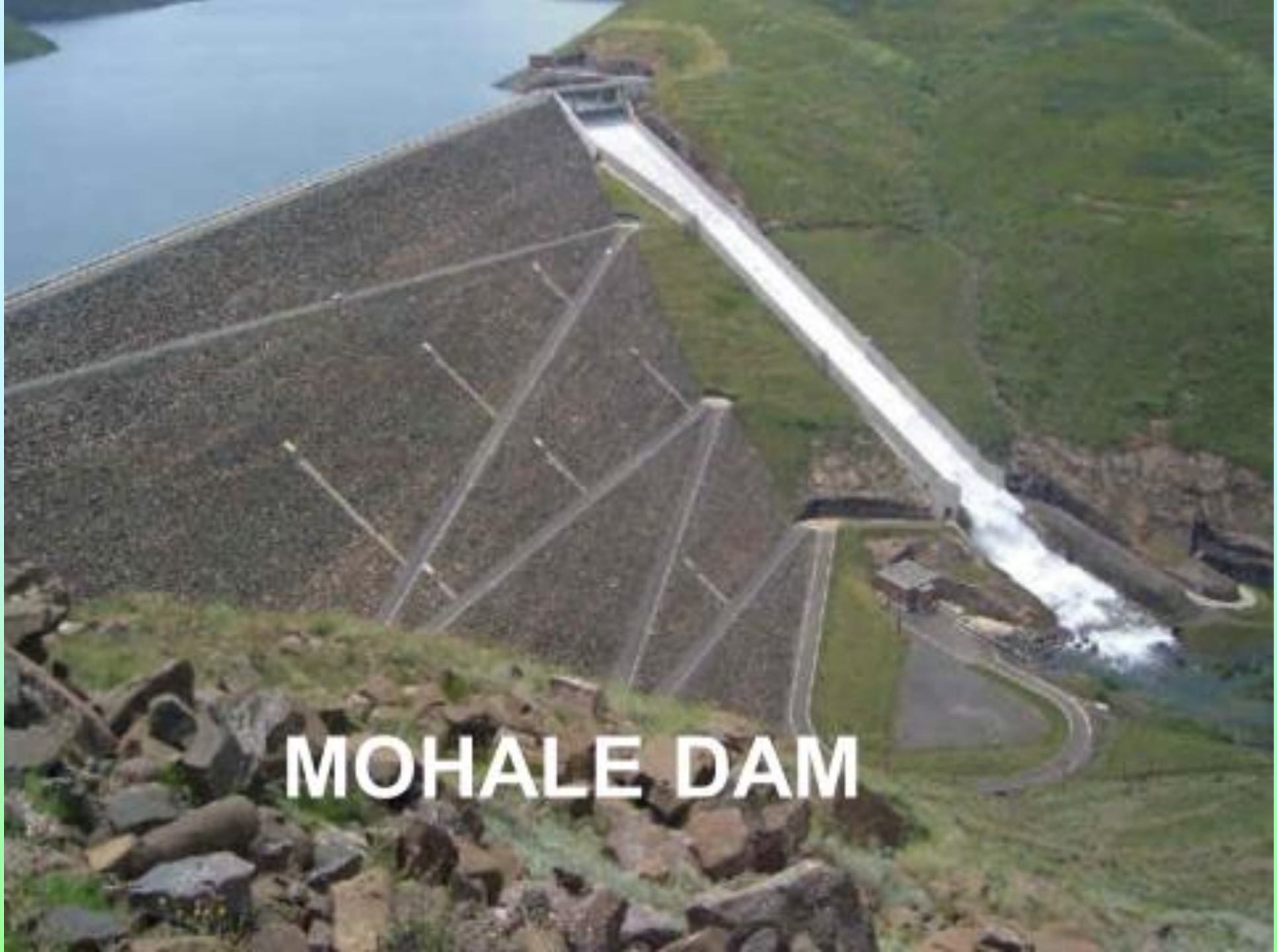
LHWP PHASE I


Ash River Outfall
Delivery Tunnels
Muela Dam
Hydropower Station
Butha Buthe
Hlotse
Transfer Tunnel
Katse Dam
Matsoku Weir & Tunnel
Mohale Dam
Mohale Tunnel
Maseru
Mokhotlong
Thaba Tseka
Mafeteng
Mohale's Hoek
Moyeni
0
40 km
GAUTENG
Pretoria
Johannesburg
Vaal River
VAAL DAM
Ash River
Wilge River
LESOTHO HIGHLANDS WATER PROJECT
KATSE DAM
Tugela
LESOTHO
Caledon
Senqu
DURBAN
Indian Ocean

LHWP : MAIN FEATURES

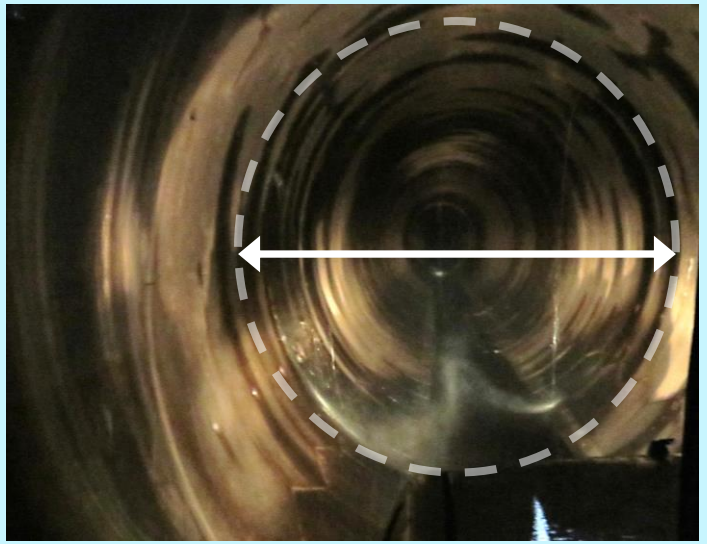
		Phase 1A	Phase 1B
• Water delivery		18 m^3/s	11 m^3/s
• Main reservoirs		Katse Dam – 185 m	Mohale Dam – 145 m
		Muela Dam – 55 m	Matsoku Weir – 13 m
• Tunnels		88 km	30 & 6 km
• Hydropower		72 mW	
• Access roads	New	172 km	36 km & 70 km
	Upgraded	170 km	64 km
• Electric power lines		334 km & 14 sub st	72 km & 5 sub st
• Telecommunications			
• Construction villages		3	2
• Rail sidings		1	1
• Border posts		2	
• Water delivery		Jan 1997	Jan 2004
• TOTAL COST		M 6 932 mil (M62 000) @ 1997	M 4 212 mil (M28 300) @ 2004

KATSEDAM

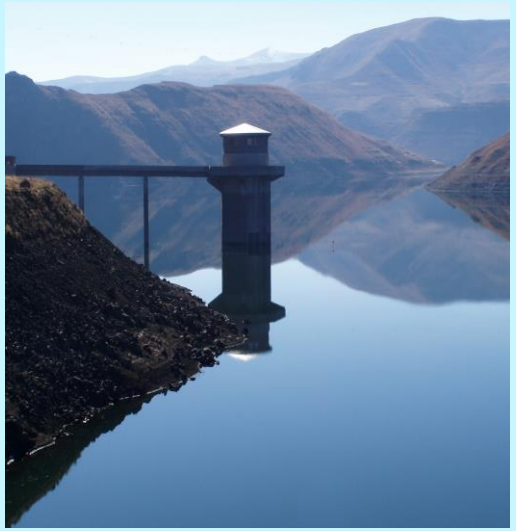

MOHALE DAM

Access adit

Access dome



Inside tunnel

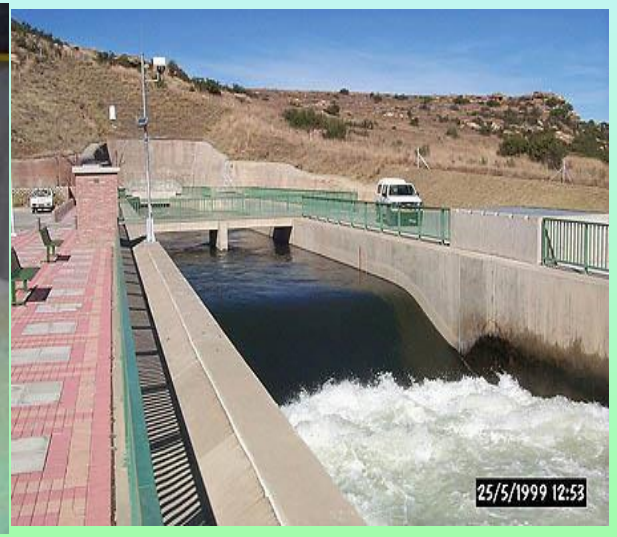


Katse Tunnel Intake

Surge shaft

Muela Hydropower generation chamber

Flow measurement equiment



Ash River Outlet

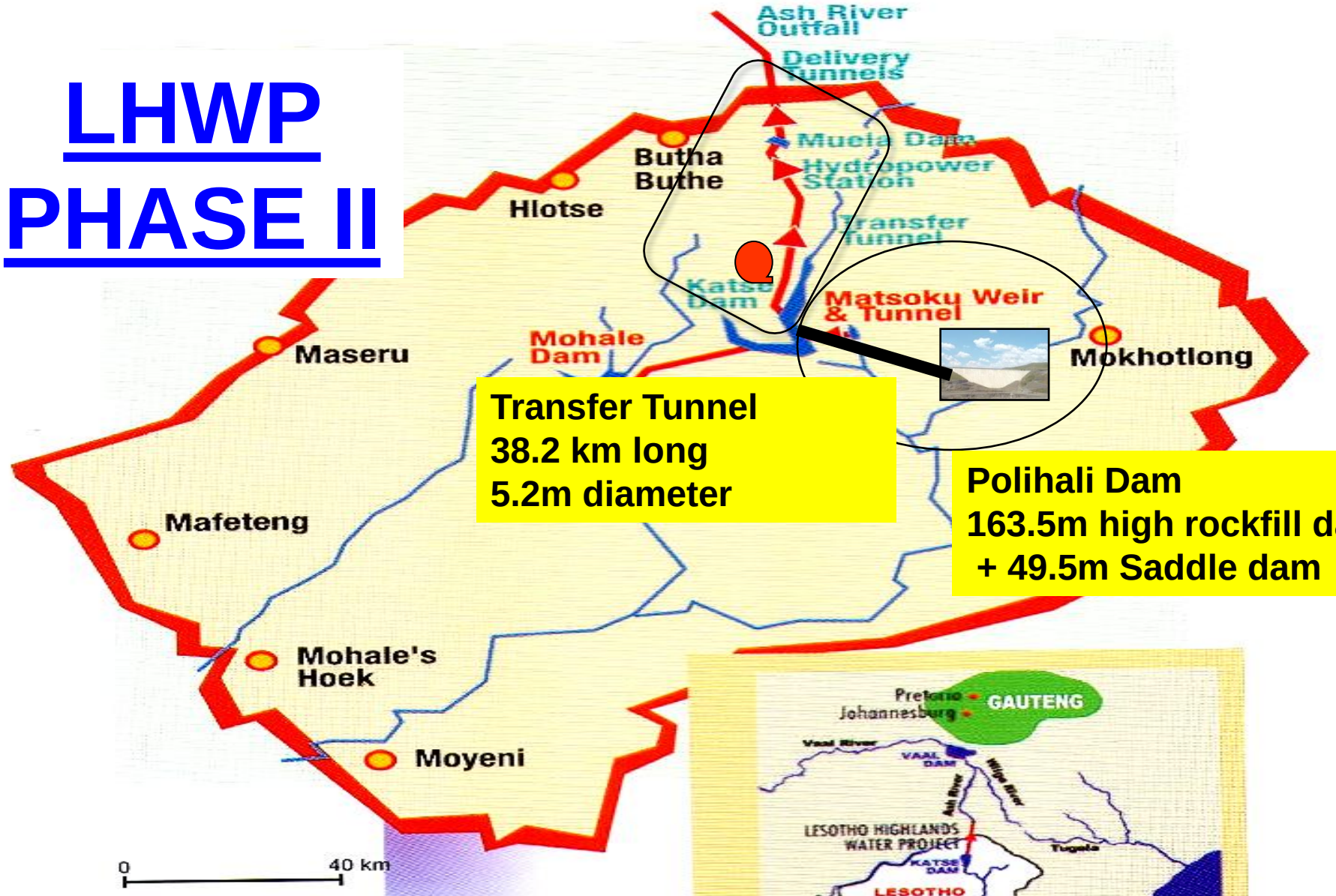

FIVE MOUNTAIN PASSES


Powerlines


TWO BRIDGES FOR THE PRICE OF ONE
760m long & 86m high


ASRIVER OUTLET
@
CLARENS

LHWP PHASE II

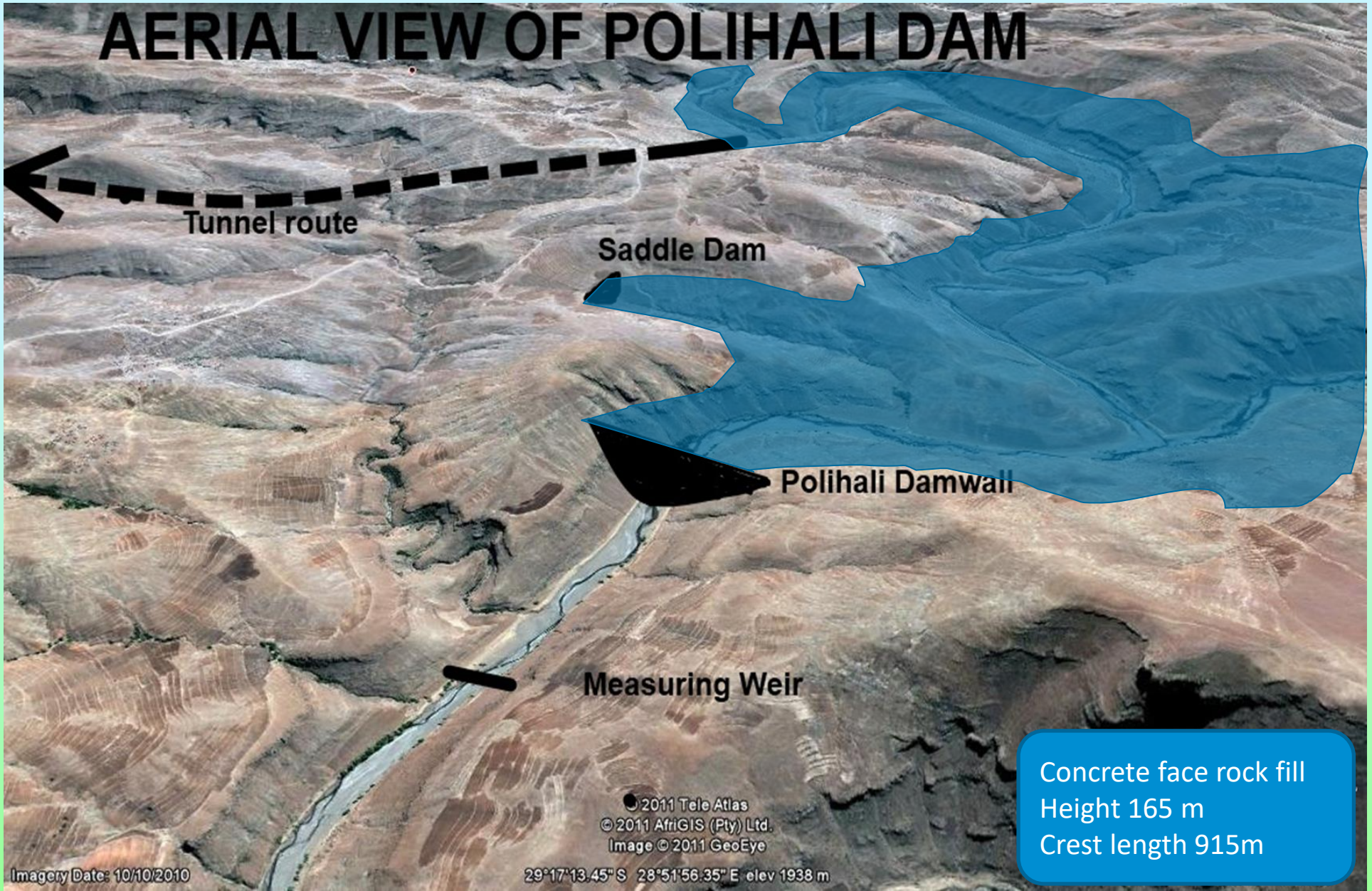


Transfer Tunnel
38.2 km long
5.2m diameter

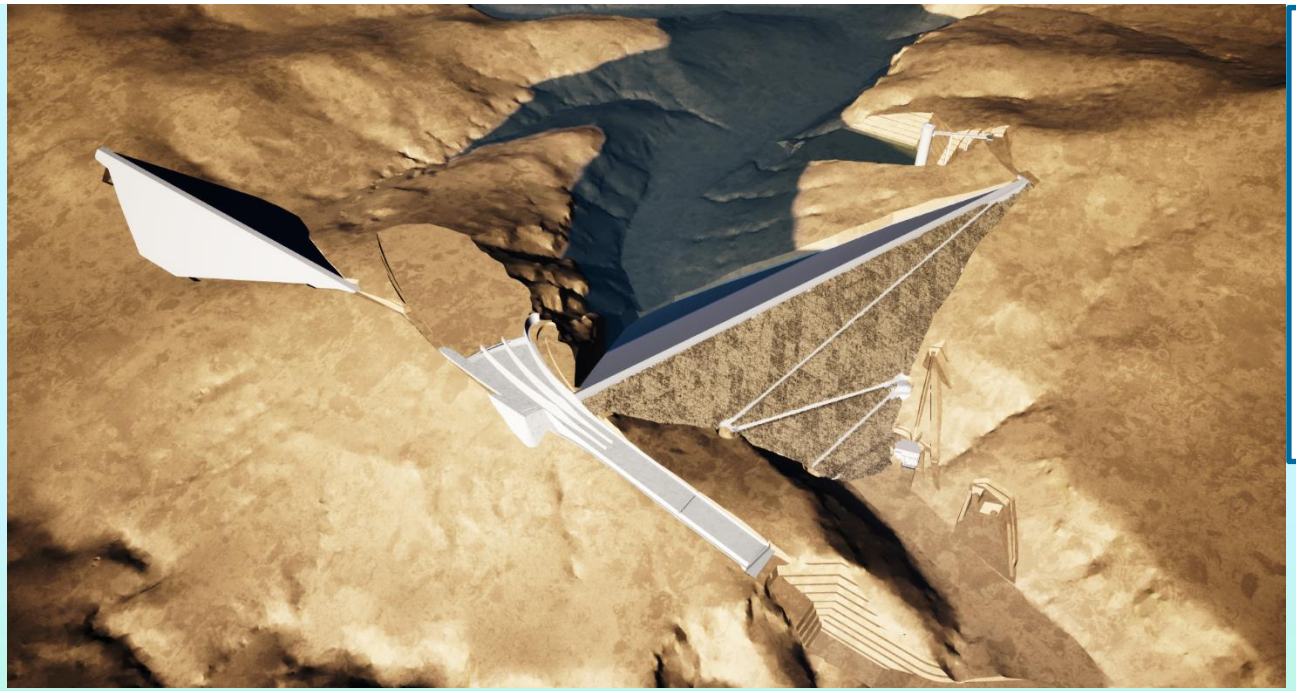
Polihali Dam
163.5m high rockfill dam
+ 49.5m Saddle dam

Total water deliveries
Phase I = 780 bill litres per year
Phase II = 465 bill litres per year

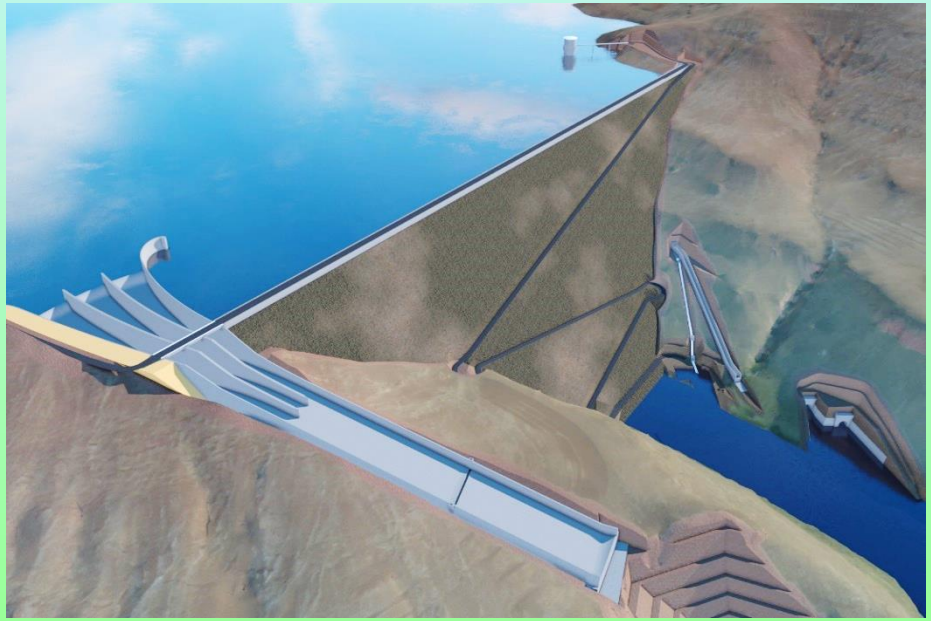
PHASE II: Polihali Dam & Saddle Dam



POLIHALI DAM 3D MODEL



- 163.5m high CFRD and 5-m high saddle dam
- Concrete side-channel spillway
- Free-standing Intake tower



CONSTRUCTION PHOTOS

C4020: Polihali Dam Construction

Main Dam Excavation: Right Bank

Crusher Plant Assembly

Left Bank Excavation

PHASE II: POLIHALI to KATSE TUNNEL

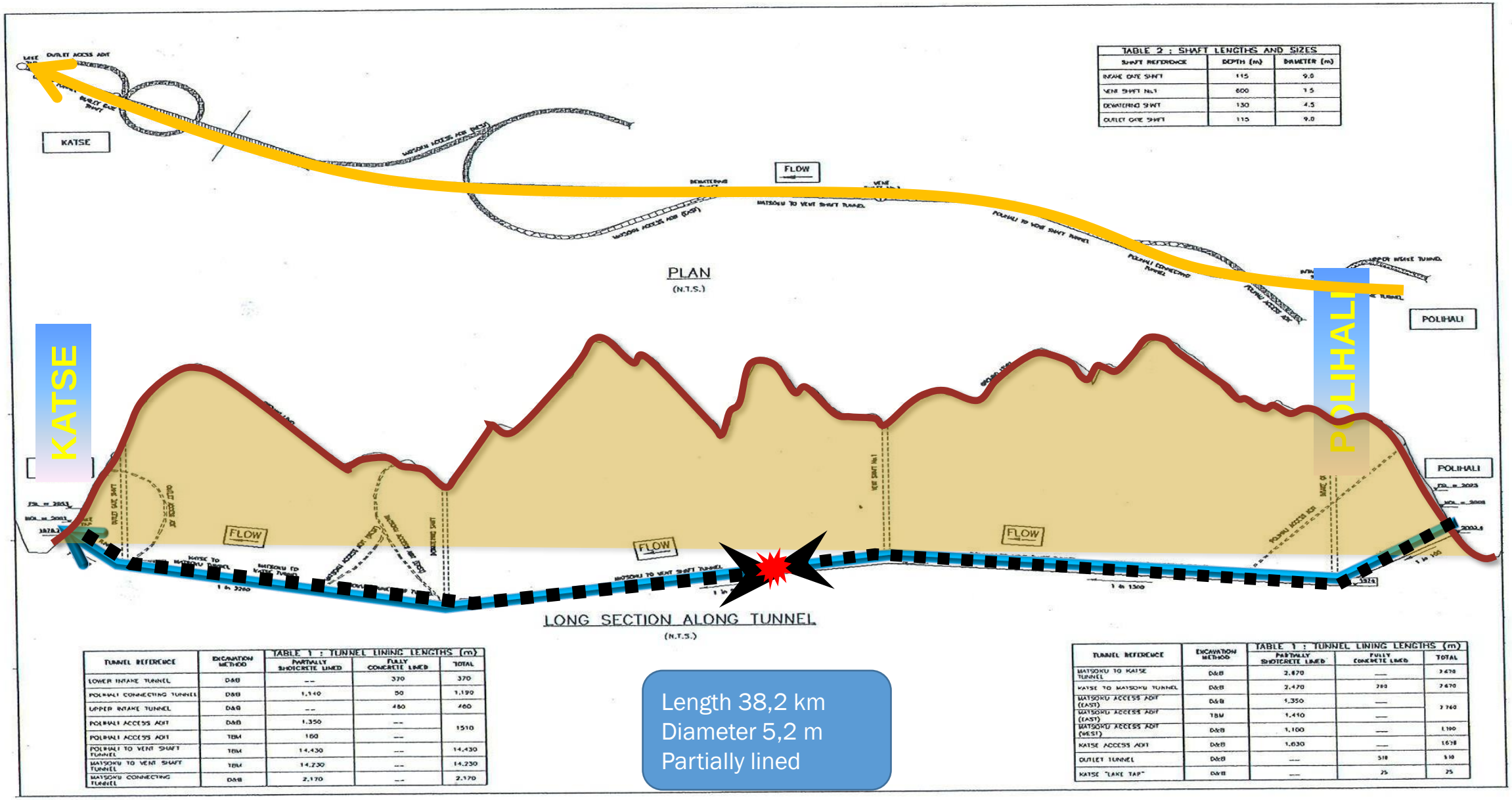


TABLE 2 : SHAFT LENGTHS AND SIZES

SHAFT REFERENCE	DEPTH (m)	DIAMETER (m)
INTAKE GATE SHAFT	115	9.0
VENT SHAFT No.1	600	7.5
DEWATERING SHAFT	130	4.5
OUTLET GATE SHAFT	115	9.0

TABLE 1 : TUNNEL LINING LENGTHS (m)

TUNNEL REFERENCE	EXCAVATION METHOD	PARTIALLY SHOTCRETE LINED	FULLY CONCRETE LINED	TOTAL
LOWER INTAKE TUNNEL	D&B	--	370	370
POLIHALI CONNECTING TUNNEL	D&B	1,140	50	1,190
UPPER INTAKE TUNNEL	D&B	--	460	460
POLIHALI ACCESS ADIT	D&B	1,350	--	1510
POLIHALI ACCESS ADIT	TBM	160	--	
POLIHALI TO VENT SHAFT TUNNEL	TBM	14,430	--	14,430
MATSOKU TO VENT SHAFT TUNNEL	TBM	14,230	--	14,230
MATSOKU CONNECTING TUNNEL	D&B	2,170	--	2,170

TABLE 1 : TUNNEL LINING LENGTHS (m)

TUNNEL REFERENCE	EXCAVATION METHOD	PARTIALLY SHOTCRETE LINED	FULLY CONCRETE LINED	TOTAL
MATSOKU TO KATSE TUNNEL	D&B	2,870	--	2470
KATSE TO MATSOKU TUNNEL	D&B	2,470	280	2470
MATSOKU ACCESS ADIT (EAST)	D&B	1,350	--	2760
MATSOKU ACCESS ADIT (EAST)	TBM	1,410	--	
MATSOKU ACCESS ADIT (WEST)	D&B	1,100	--	1190
KATSE ACCESS ADIT	D&B	1,630	--	1678
OUTLET TUNNEL	D&B	--	518	518
KATSE "LAKE TAP"	D&B	--	25	25

Figure 4-9: Polihali Katse Tunnel: General Arrangement for Southern Alignment

CONSTRUCTION PHOTOS

Construction of Transfer Tunnel

Katse TBM Access Adit

Polihali TBM Access Adit

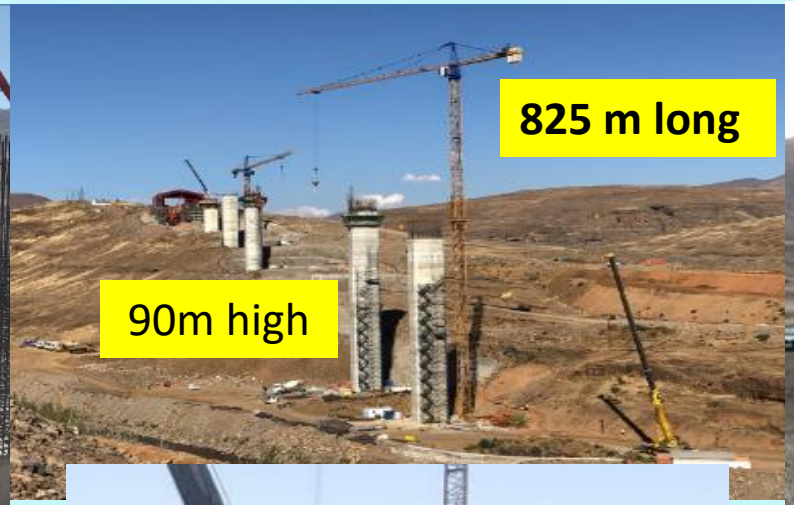
Batch Plants & Segment Plants

CONSTRUCTION PHOTOS

Polihali Infrastructure

CONSTRUCTION PHOTOS

Senqu Bridge Construction



ENVIRONMENTAL CONSERVATION AND SOCIO-ECONOMIC

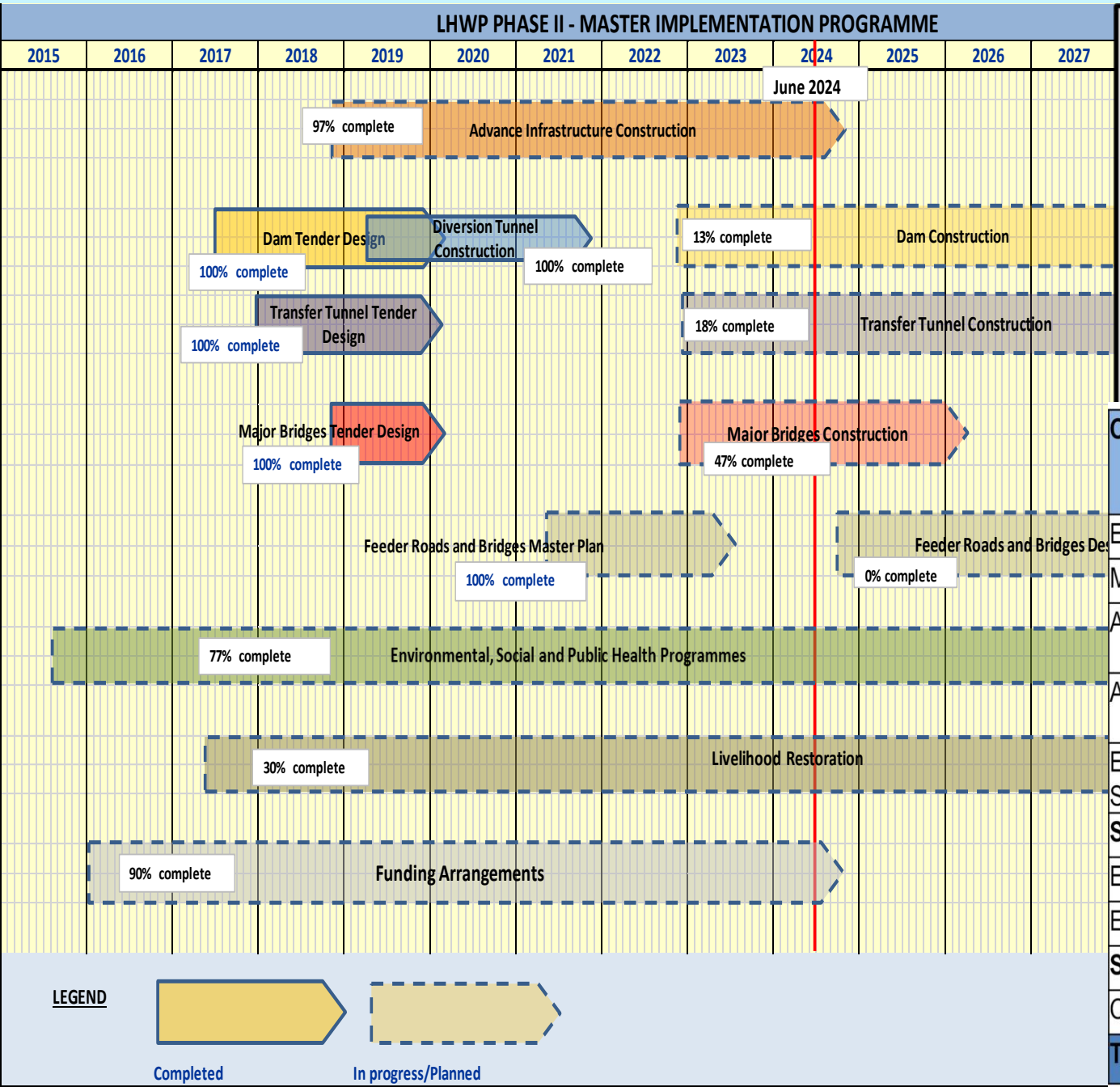
SUSTAINABLE MANAGEMENT OF WATER & NATURAL RESOURCES

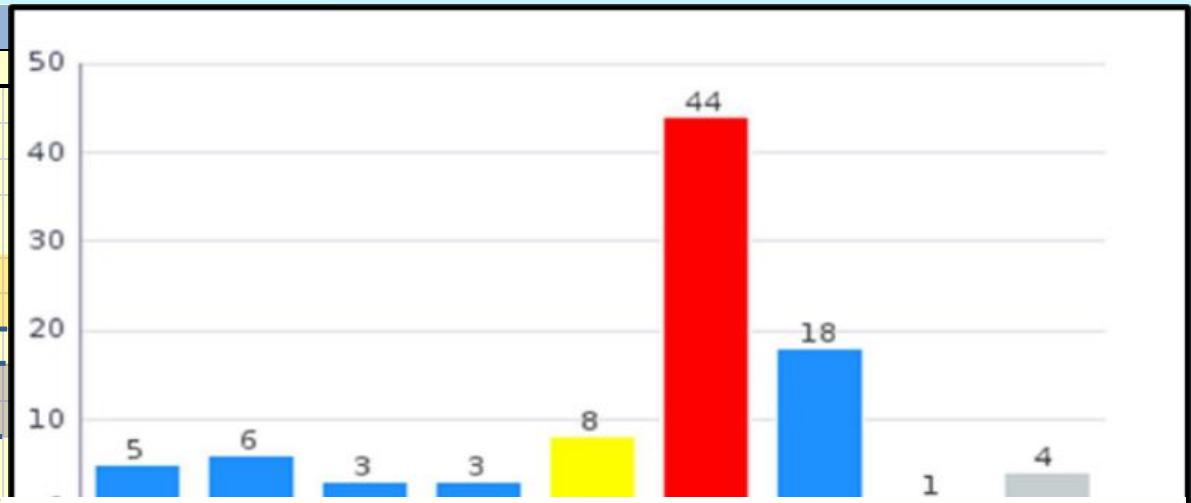
1. Wetlands Restoration & Conservation
2. Range Management & Conservation
3. Waste Management Monitoring
4. Biodiversity Management
5. Conservation – Rare & Threatened Flora & Fauna
6. Environmental Flow Requirements (EFR) Monitoring
7. Water Quality Monitoring & Management
8. Environmental Awareness

SOCIO-ECONOMIC DEVELOPMENT

1. Relocation Action Plans under implementation
2. Livelihood Restoration Projects under planning, to be implemented on affected communities.
3. Public Health Action Plans under implementation with responsible ministries and NGOs
4. Social Development Master Plans under consideration

PHASE 11 MASTER IMPLEMENTATION:

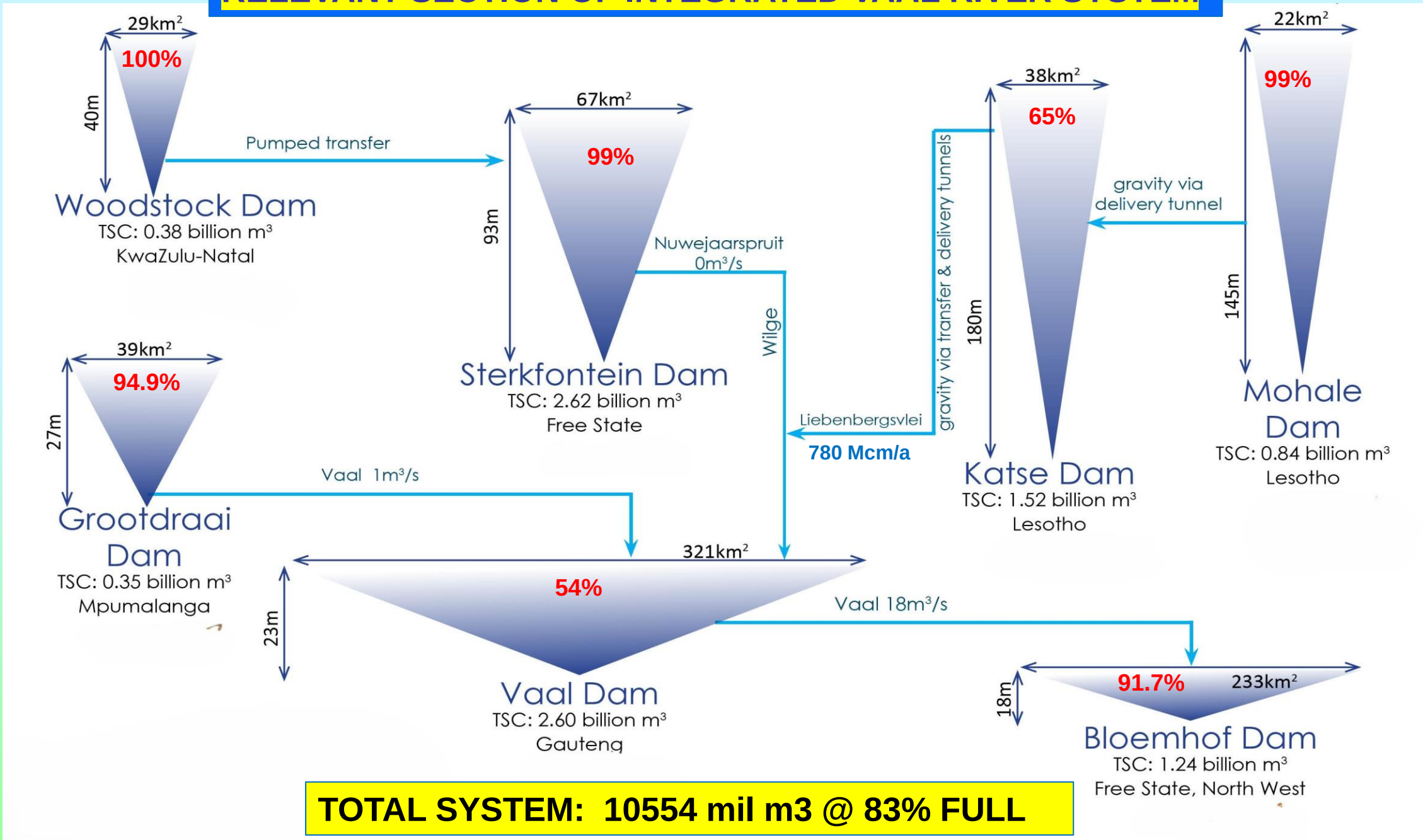




Cost Category	Revised LTCP (Nov 2022) R' mil	Cost (to May 2024) R' mil	
Engineering	R 2 713	R 1 193	44,8%
Main Works	R 17 703	R 3 506	19,8%
Advance Infrastructure	R 8 092	R 4 853	60,0%
Administration and PMU	R 1 567	R 1 538	98,2%
Environmental and Social	R 1 545	R 203	13,1%
Sub-Total	**R 31 621**	**R 11 292**	**35,7%**
Escalation- LSL	R 5 675	R 657	11,6%
Escalation- Forex	R 1 418	R 501	35,4%
Sub-totals	**R 38 714**	**R 12 450**	**32,2%**
Contingency	R 3 342		
Total	**R 42 056**	**R 12 450**	**29,6%**

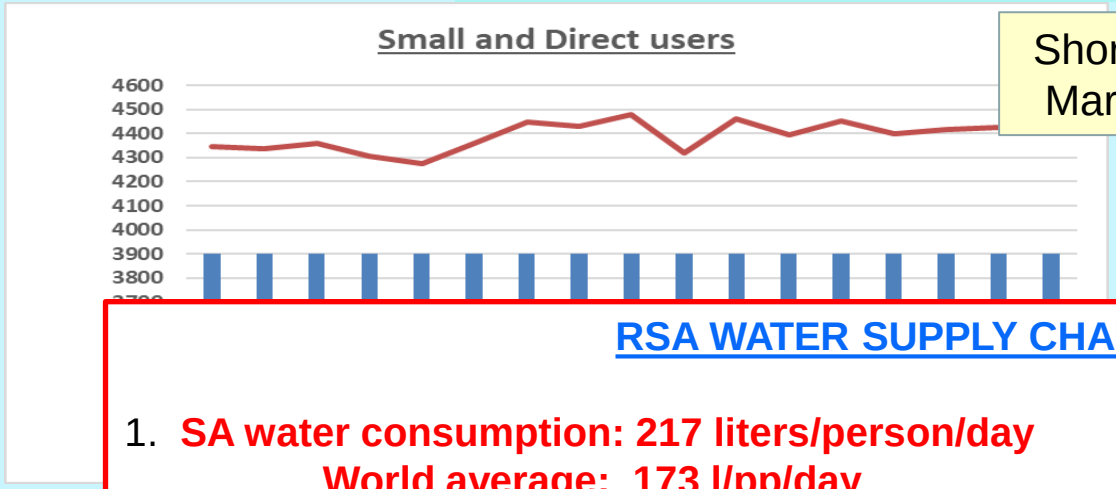
LHWP TUNNEL OUTAGE

RELEVANT SECTION OF INTEGRATED VAAL RIVER SYSTEM

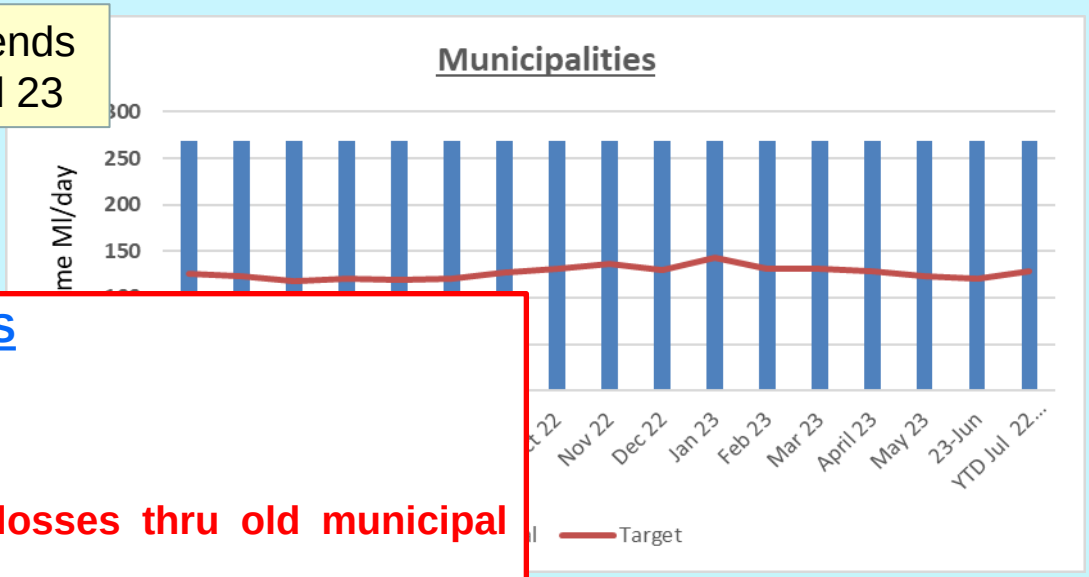


TOTAL SYSTEM: 10554 mil m3 @ 83% FULL

SHORT AND LONGTERM WATER DEMAND BY RANDWATER

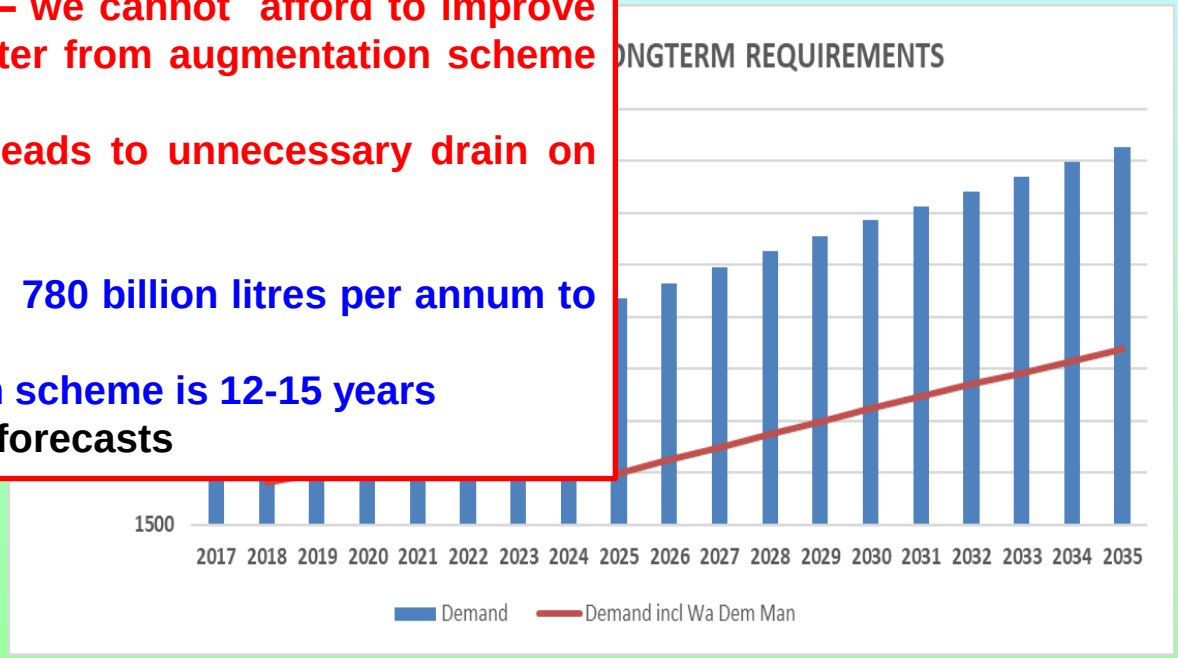


Short term trends
Mar 22 to Jul 23



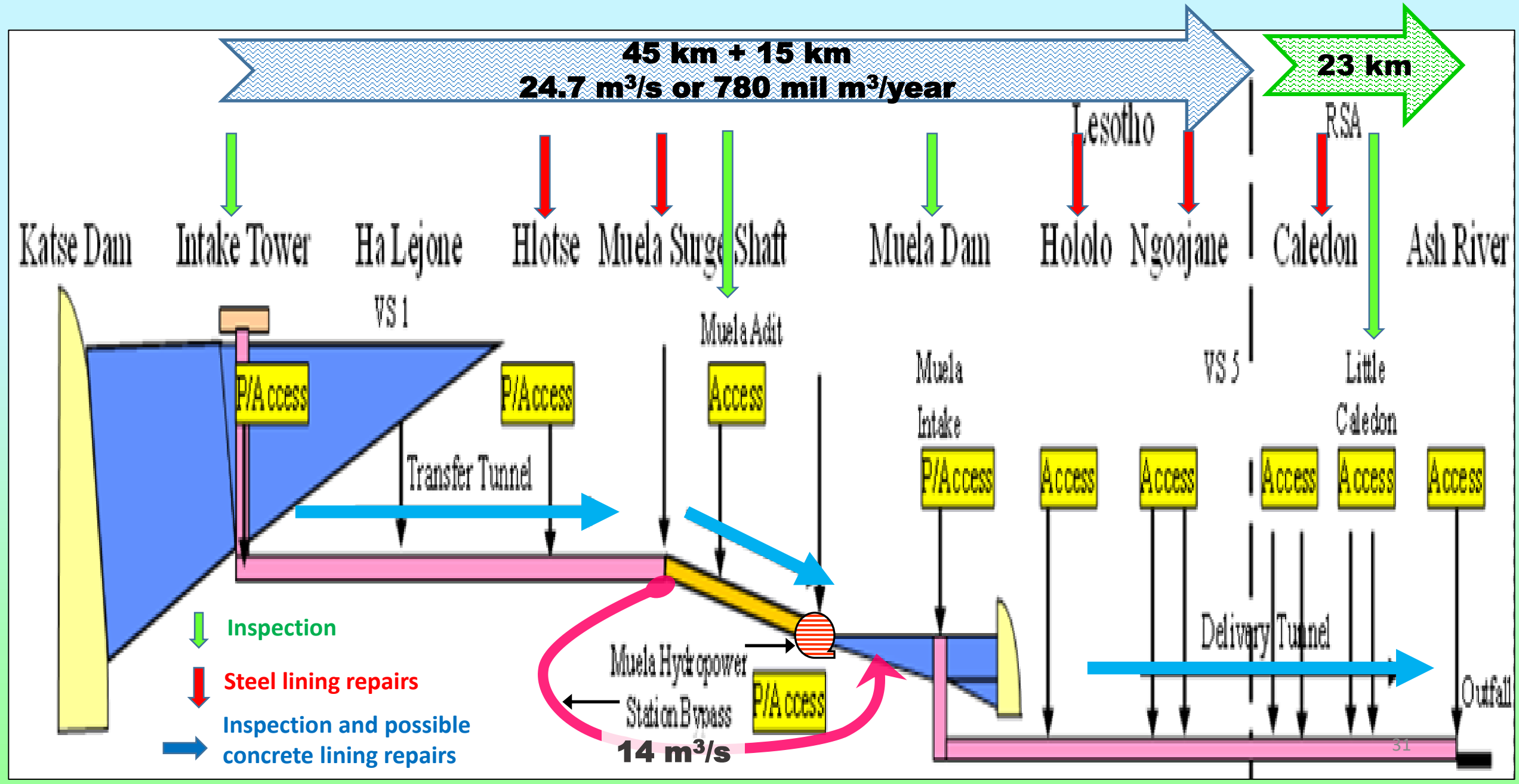
RSA WATER SUPPLY CHALLENGES

1. **SA water consumption: 217 liters/person/day**
   World average: 173 l/pp/day
2. **Average to poor maintenance by municipalities - 20% losses thru old municipal infrastructure. Replacement strategy !!!!**
3. **Poor to no sewage treatment – releases into rivers – we cannot afford to improve water quality by flushing system with expensive water from augmentation scheme (eg LHWP)**
4. **Continuous crisis management vs longterm plans leads to unnecessary drain on financial resources**
5. **Gauteng prov's nonrevenue water is above 46%.**
6. **Shortterm water transfer from Lesotho reduced from 780 billion litres per annum to 700 billion litres. Other dam levels OK!!**
7. **Lead time to implement any large water augmentation scheme is 12-15 years**
8. **Climate change, impact on rainfall, re-calibrate water forecasts**



Source : Randwater Annual Report 2023

LHWP TUNNEL OUTAGE : SYSTEM COVERED FROM KATSE –> 'MUELA –> ASH RIVER



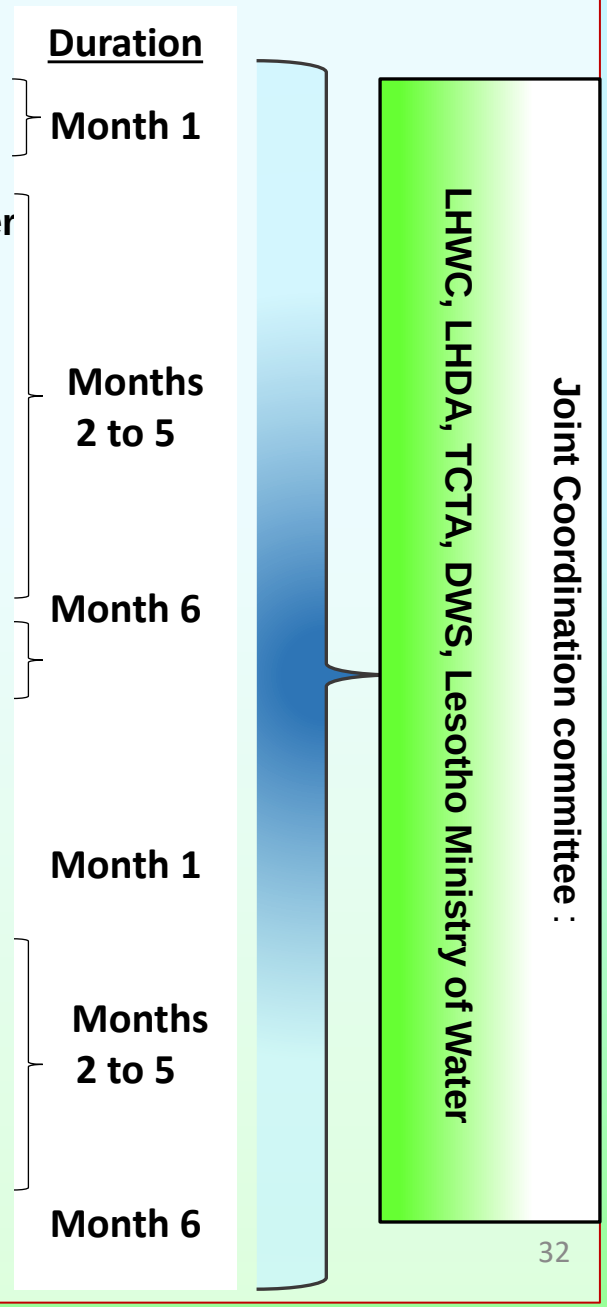
Scope of Work and Durations

LHDA Scope of Work

1. Dewatering of Transfer & Delivery Tunnel South on the 1st Oct 2019 (1 Month)
2. Open bulkheads: remove debris & clean steel lining
3. Inspection by clients of Tunnels, Katse and Mohale Intake Structures and Hydropower
4. Do extensive repairs to steel linings and re-instate corrosion protection
5. Possible minor repairs to concrete lining
6. Regular planned and emergency inspections by various External Panel of Experts
7. Replace and-or refurbish equipment, Intake gates, repairs to Muela Surge shaft,
8. Inspection by clients of Tunnels, Intake Structures and Hydropower works
9. Transfer Tunnel filling and Commissioning
10. 'Muela Dam Filling, Delivery Tunnel Filling

TCTA Scope of Work

1. Dewatering of Delivery Tunnel North (Caledon River Crossing to Ash River Outfall).
2. Inspection by various Panel of Experts at various stages
3. Replace and-or refurbish equipment
4. Repairs to Corrosion protection
5. Possible minor repairs to concrete lining
6. Tunnel filling




THANK YOU
QUESTIONS ?