SANA'A CITY WATER SITUATION

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Introduction

- The purpose of this presentation is to give an overview of the Water Situation of the Capital City of Yemen ‘ Sana’a’.
- And to present a very brief summary of the future alternative new sources for water supply for Sana’a that has been found out and strongly suggested. Probably the only means of facing inevitable scarcity in the next decades.

The Republic of Yemen

- **Geographical Data**

  - ***Location***: South of the Arabian Peninsula

  - ***Area***: 527,970 sq.km

  - ***Terrain***: narrow coastal plain backed by flat-topped hills and rugged mountains; dissected upland desert plains in center slope into the desert interior of the Arabian Peninsula.

  - ***Elevation***: Rises from 0 m at coastal plains to 3,760 m at the highest point of Jabal Nabi Shuaib close to city of Sana'a.

Yemen Statistical Data

- Population: 19.8 million
  - Urban: 23%
  - Rural: 77%
- Pop/Growth: 3.02%
- GNP (2004): US$ 517

Sana'a City Statistical Data

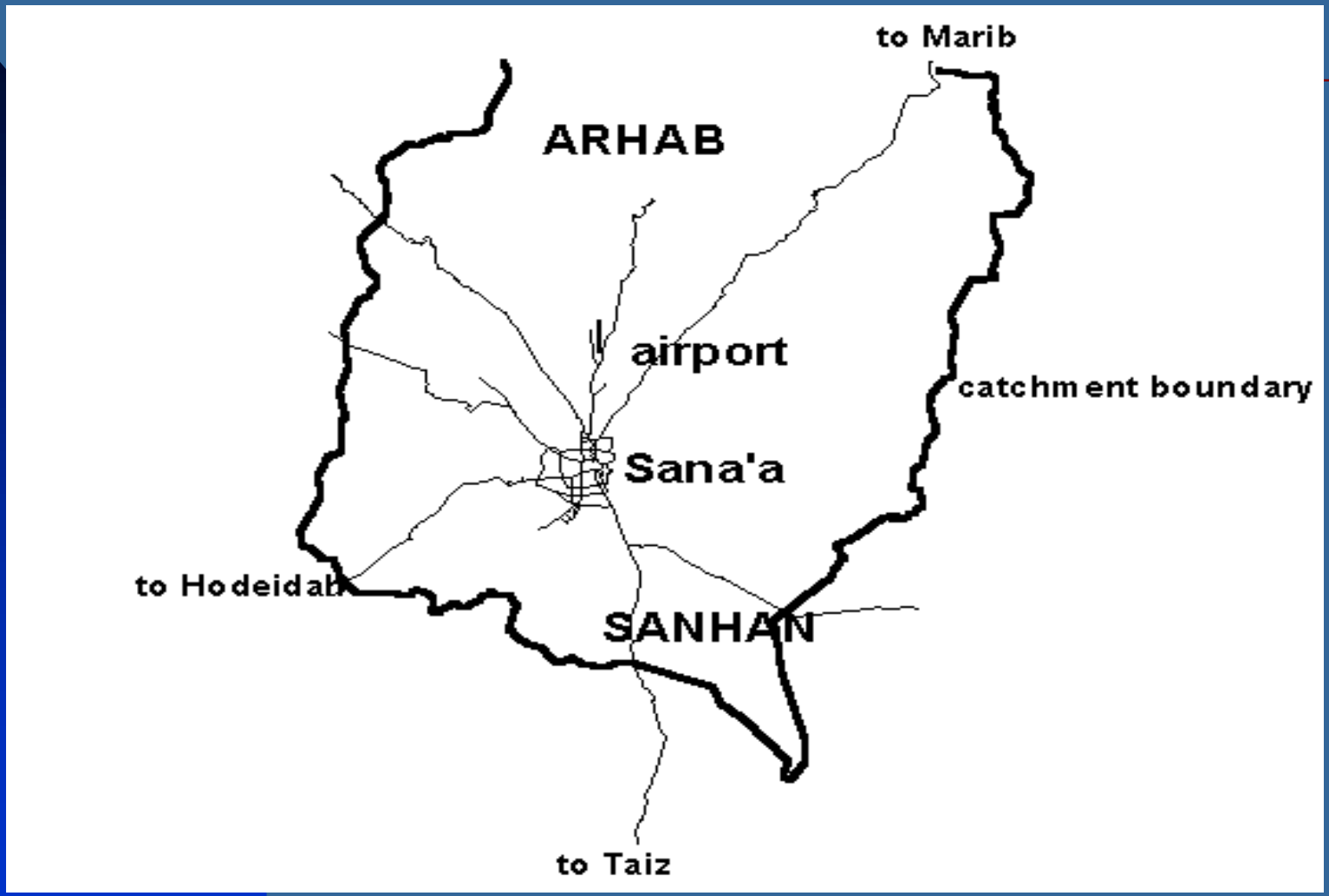
- Level above Sea: 2700 meters
- Population (2005): 1.75 million
- Population Growth: 5.5%
- Average Rainfall/year: 200–400 mm
- Water Basin Surface Area: 3250 sq.km

Yemen's National Water Situation*

- Annual Renewable Resources: 2500 MCM
- Annual Resources Use: 3400 MCM
- Annual Deficit 900 MCM
- Approx. Ground Water Level Drop: 6 m/annum

* Source: Water and Environment Center (WEC), Sana'a University, Yemen, 2002.

Sana'a Basin


to Marib
ARHAB
airport
catchment boundary
Sana'a
to Hodeidah
SANHAN
to Taiz

Sana'a City Water Situation*

- Total Ground Water Reserves: 2-3 BCM
- Annual Ground Water Abstraction: 260 MCM
  - Water for Irrigation 80%
  - Water for Domestic Purposes 20%
- Annual Ground Water Recharge: 52 MCM

* Source: Sana'a Water and Sanitation Local Corporation (SWSLC), Yemen.

Main Local Districts Within Sana'a Basin

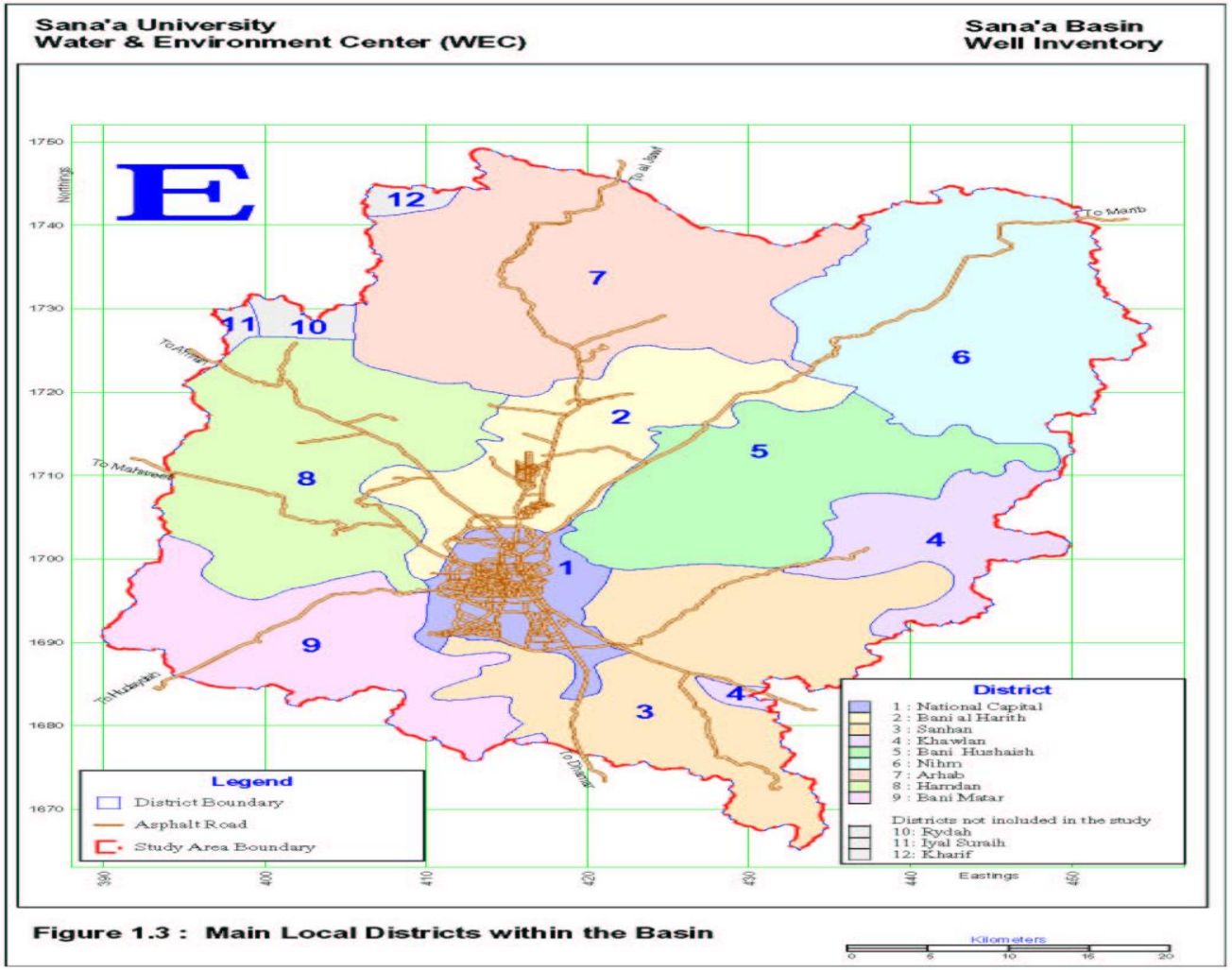


Figure 1.3 : Main Local Districts within the Basin

Sana'a Basin Water Situation*

- Water Basin Area 3,250 sq.km
- Water Points in Basin 13,426 points
  - 5321 Bore Holes
  - 7589 Dug Wells
  - 346 Dug/Bore
  - 146 Springs
  - 24 Dams/Pools (surface water)
- 87% of Wells for Irrigation the Rest for Drinking

* Source: WEC, Sana'a University, Yemen.

Density of Wells in Sana'a Basin

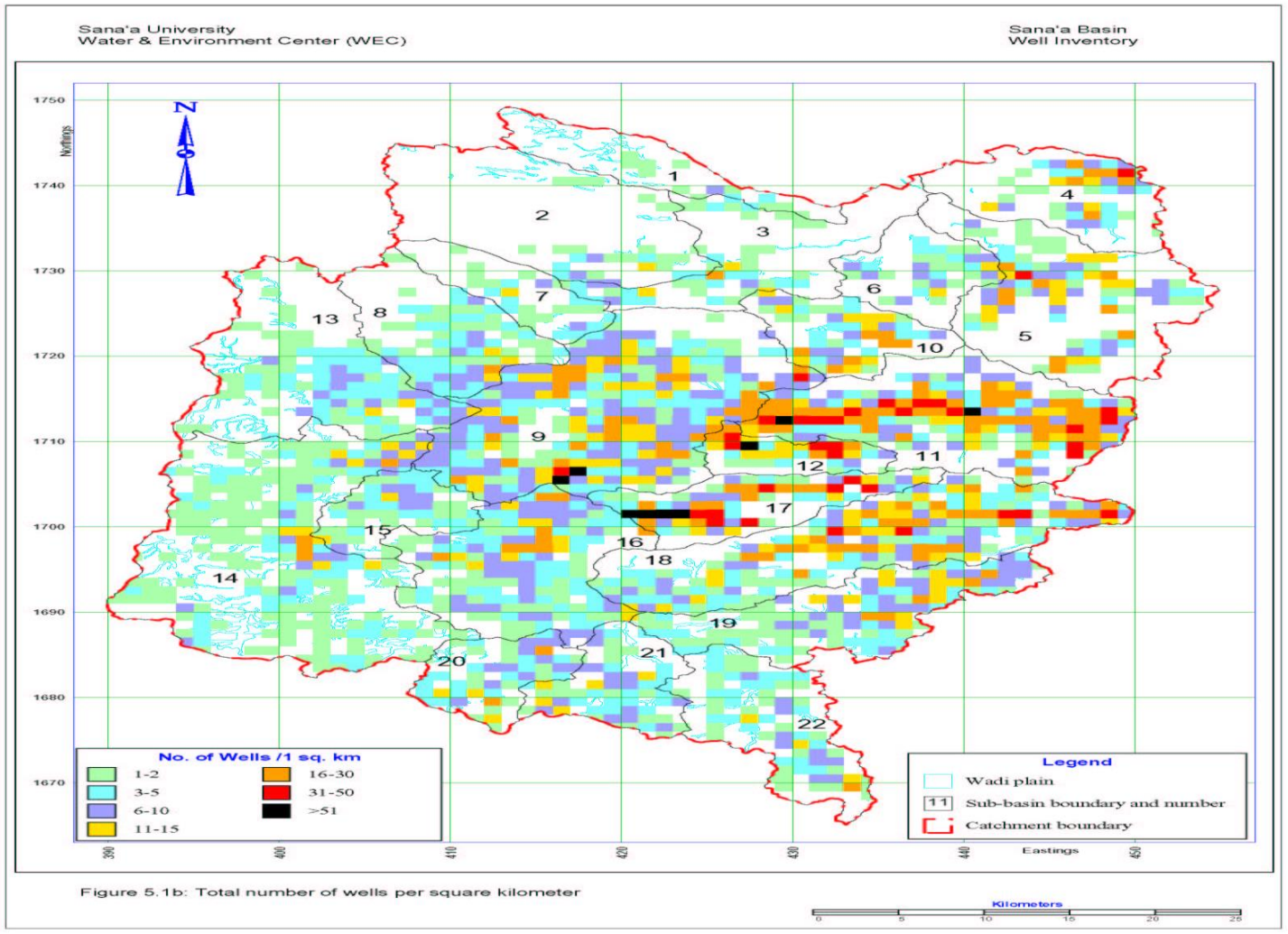


Figure 5.1b: Total number of wells per square kilometer

Sana'a Municipality Domestic Water Supply

- Total Annual Abstraction 52 MCM

  - Abstracted and Supplied
    by SWSLC* which represent (40%) 21 MCM
  - Abstracted and Supplied by
    by Private Water Suppliers (60%) 31 MCM

* SWSLC - is the Sana'a Water and Sewage Local Corporation and is the source for the above data.

Sana'a (SWSLC)* Municipality Water Supply (as of 2004)

Annual Water Abstraction	21 MCM
Annual Total Water Billed	13 MCM
Unaccounted for (about 38%)	8 MCM
No. of Water Connections	73,700
No. of Sewer Connections	40,400
Frequency of Water Supply	1 day/week
Average Consumption/Capita	70 Lit/day

* SWSLC – is Sana'a Water & Sewage Local Corporation and is the source of the above data.

Water Demand Projection for Sana'a City up to the Year 2025

Year	2000	2005	2010	2015	2025
Population (millions)	1.3	1.75	2.0	-	3.4
Total Domestic Water Demand (MCM)*	42	52	56	-	93
Total Domestic Water Demand (MCM)**	24	52	66	102	-
* Source: Water & Environment Center (WEC), Sana'a University, 2002. ** Source: Sources for Sana'a Water Supply, SAWAS Project, 1996.					

The Present Water Sources for Sana'a

- **The Tawilah Sandstone of Sana'a North**
  - This aquifer is heavily over pumped and 80-90% of the pumped water goes for Agriculture.
  - Annual Abstraction is about 200 MCM
  - Annual Recharge is about 3.5 MCM
  - This aquifer is estimated to loose its present production capacity by the year 2010.
- **The Aquifers of the Tertiary & Quaternary Volcanic**
  - Most private wells contributing to the water supply of Sana'a been drilled here in the urban area of Sana'a South. These aquifers partly replenished by return flow of the domestic waste water, making them more and more polluted in the process.

New Sources of Water for Sana'a*

- ***The Volcanic Rocks of Sana'a South*** – Well field of 10 wells, located about 10km south of Sana'a
- ***Tawilah Sandstone of Sana'a South*** – Well fields of 21 wells, in Asabaeen Park within the City of sana'a.
- ***Tawilah Sandstone East of Shibam*** – Well field of 20 wells, located 45km East of Sana'a.
- ***The Kholan and Wajid Sandstones*** – Well field, located 45km North of Sana'a.
- ***Wadi Kharid Surface Water development*** – Dam to be built with 70 meters high to collect run off water volume.

* Sources for Sana'a Water Supply, SAWAS Project (project implemented under bilateral program of Technical Cooperation between Yemen and Netherlands between 1987 and 1996), Sana'a/Delft, 1996.

New Sources of Water for Sana'a (continued)

- ***Wadi Surdud Surface water Development*** – Constant base flow of water, water need to be pumped 150km with level about 2600 meters.
- ***Water resource of Marib Dam*** – Dam about 130km from Sana'a, water need to be pumped to Sana'a.
- ***Sea Water Desalination*** – Nearest to Sana'a is the Red Sea in Hodiadah, 150km from Sana'a and need to be pumped 2700 meters.

New Sources of Water for Sana'a (continued)

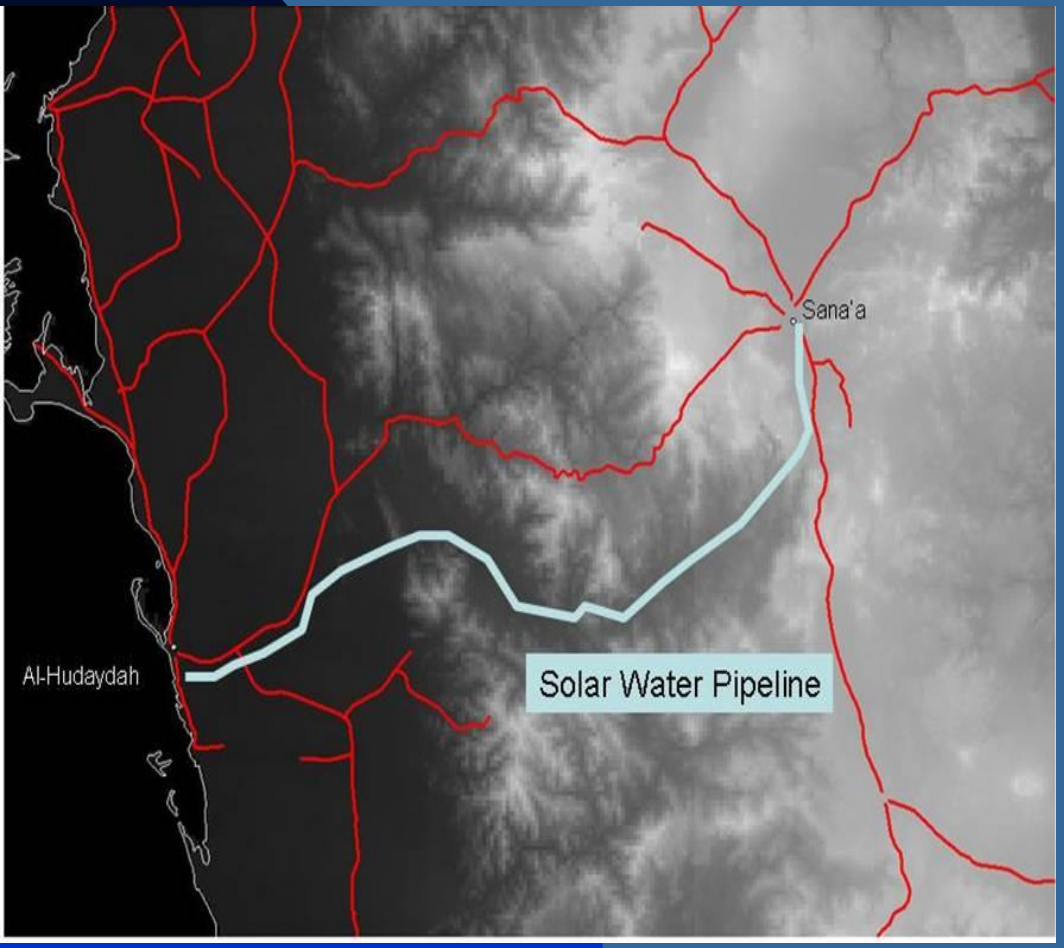
Source of Water for Sana'a	Estimated Yield		Estimated life Time	Remarks
	l/s	MCM/yr	Years	
Sana'a South Wells	100	3.2	5 -10	Conventional Well field; limited life time
Asabaeen Park Wells	330	10.4	20	600-800m deep
East Shibam Wells	300	9.5	30	Conventional Well field; gravity transmission
Kholan Arhab Wells	100	3.2	Unspecified	High tech solution
Kharid Dam	250	7.9		Difficult construction
Wadi Surdud	500	15.8		Difficult construction
Marib Dam	500	15.8		Long pumped transmission
Red Sea Water Desalination	>500	>15.8	No limit	High tech long transmission

Yemen Electricity Situation

- Total Installed Capacity 890 MW
  - National Grid Capacity 660 MW
  - Non-Grid Capacity 230 MW

- Ministry of Electricity Planning to Install 450 MW by the Year 2007 to the National Grid. A Further 300 MW is Planned to be Installed by the End of the Decade.

Concluding Remarks



- The present water situation of Sana'a looks very serious indeed.
- The future alternatives investigated shows that most of them will not be sustained beyond 25-30 years into the future.
- The Red Sea Desalination alternative looks the best sustainable and long lasting alternative source of water supply for the city of Sana'a.
- The need to consider RE as source of power for the desalination at the same time is very strongly recommended.

Old City of Sana'a (1)

Old City of Sana'a (2)

Old City of Sana'a (3)

Old City of Sana'a (4)

Old City of Sana'a (5)

Thank You for Your Attention