The Evolution of Water Management in Israel: The Conspicuous Absence of Water Markets

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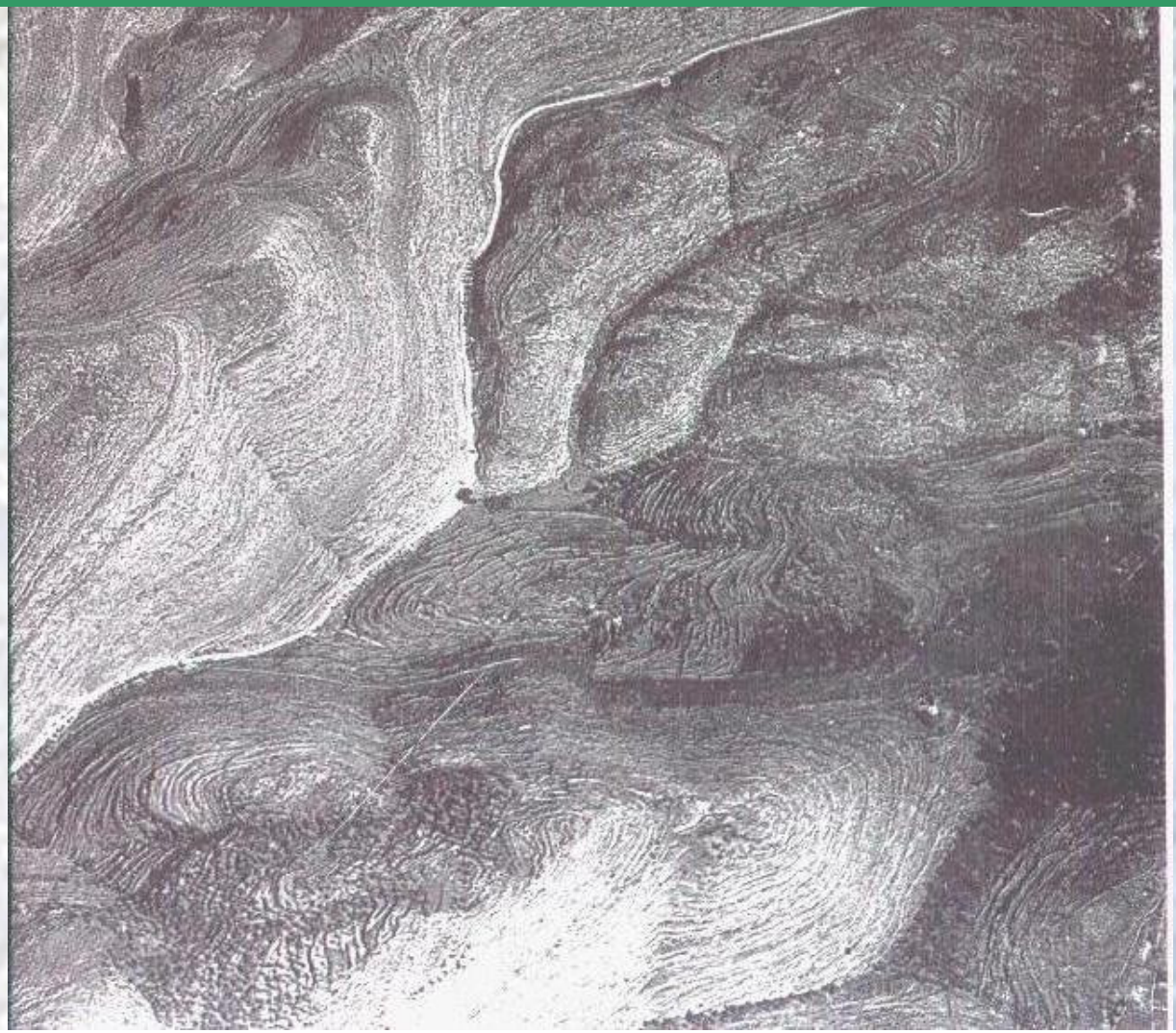
Ben Gurion University

Zaragoza, 30 July 2008

Greening the Drylands

Jerusalem Hills – circa 1918



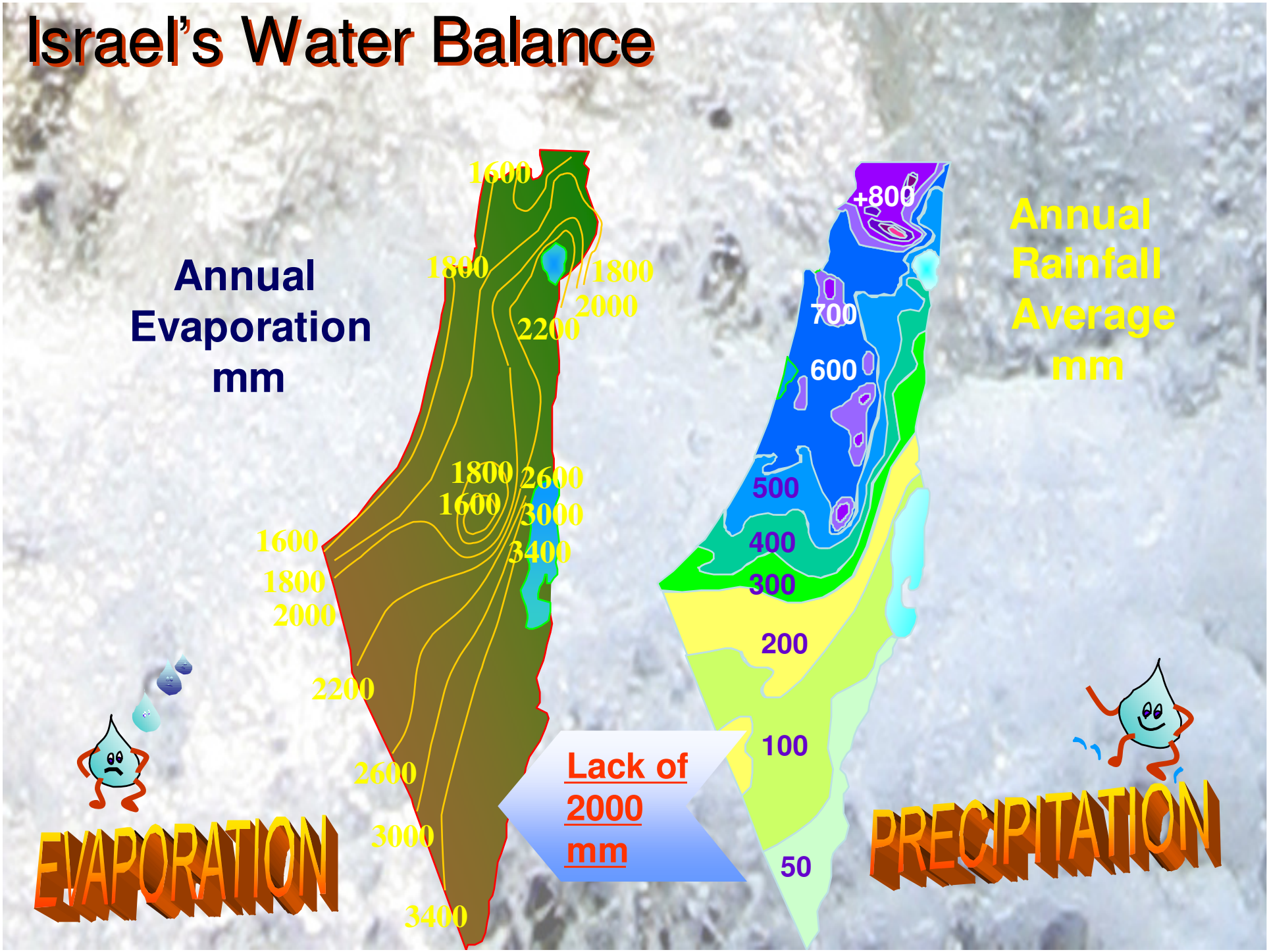
Greening the Drylands

Jerusalem Hills

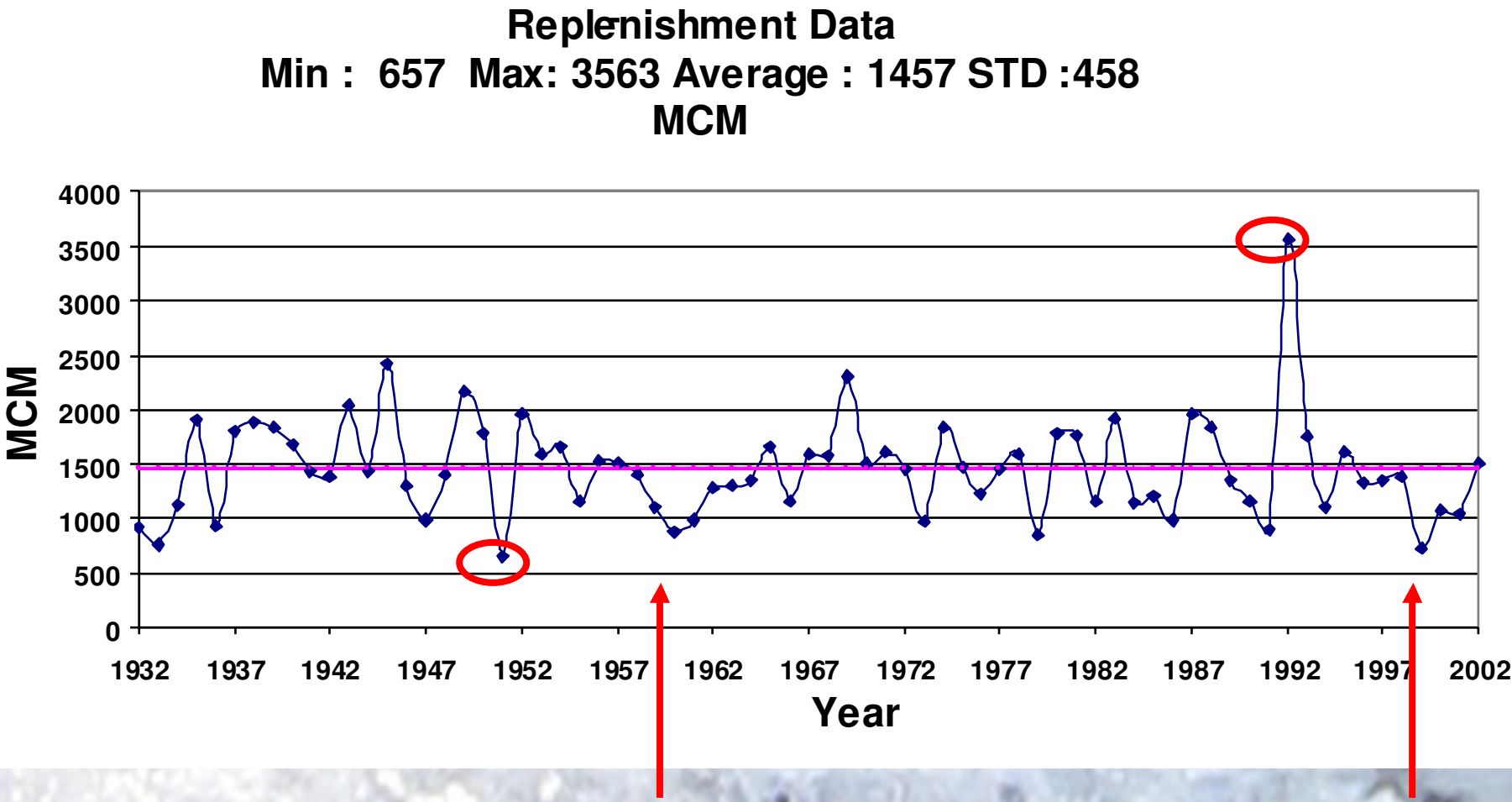
TODAY'S TALK

- Drought or New Hydrological Reality?
- Israel's Curious Water Management History
- The Death of Water Subsidies
- A Transboundary Regional Water Market?

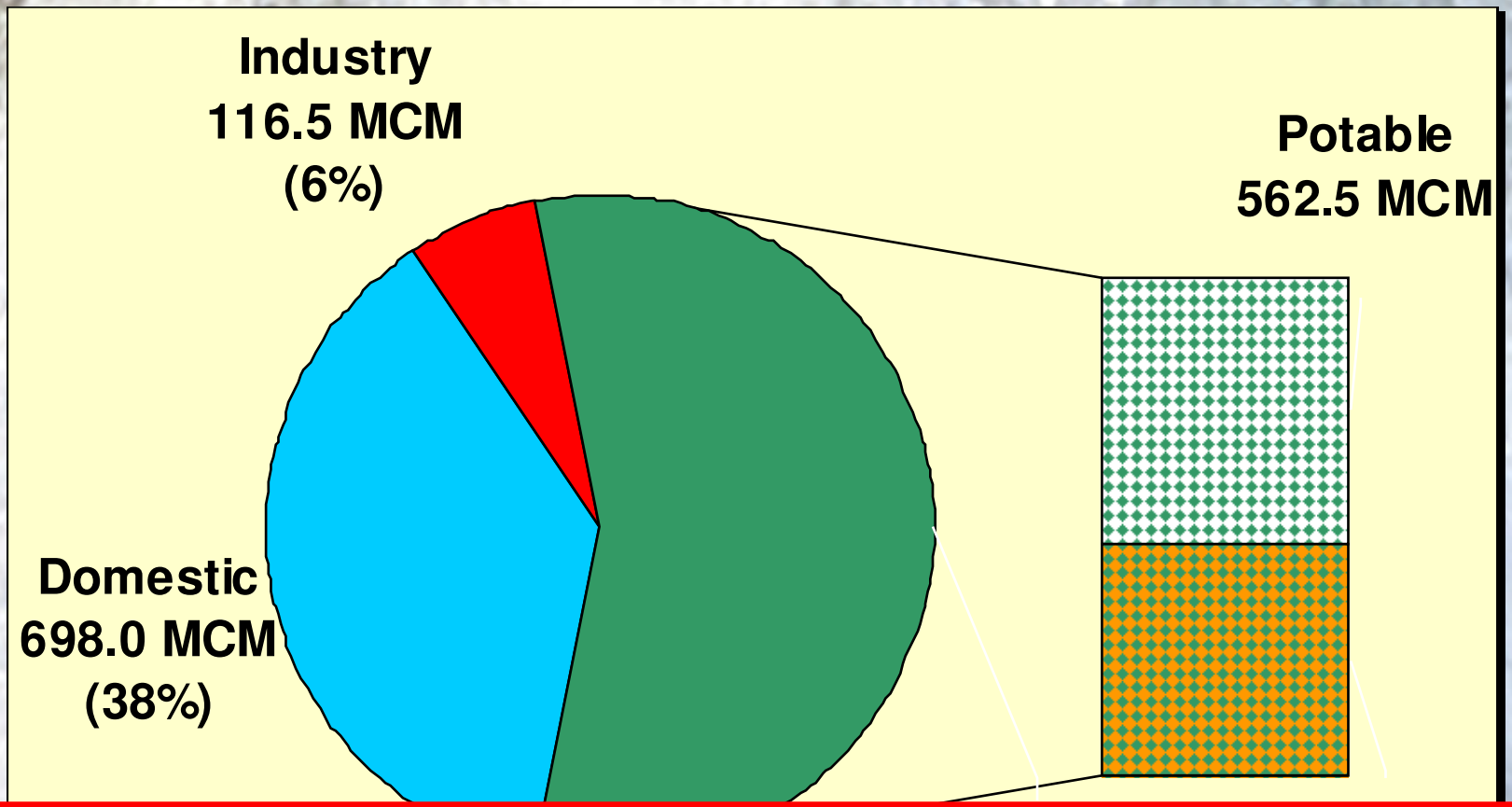
Israel's Water Balance



Rainfall: Chronic Instability



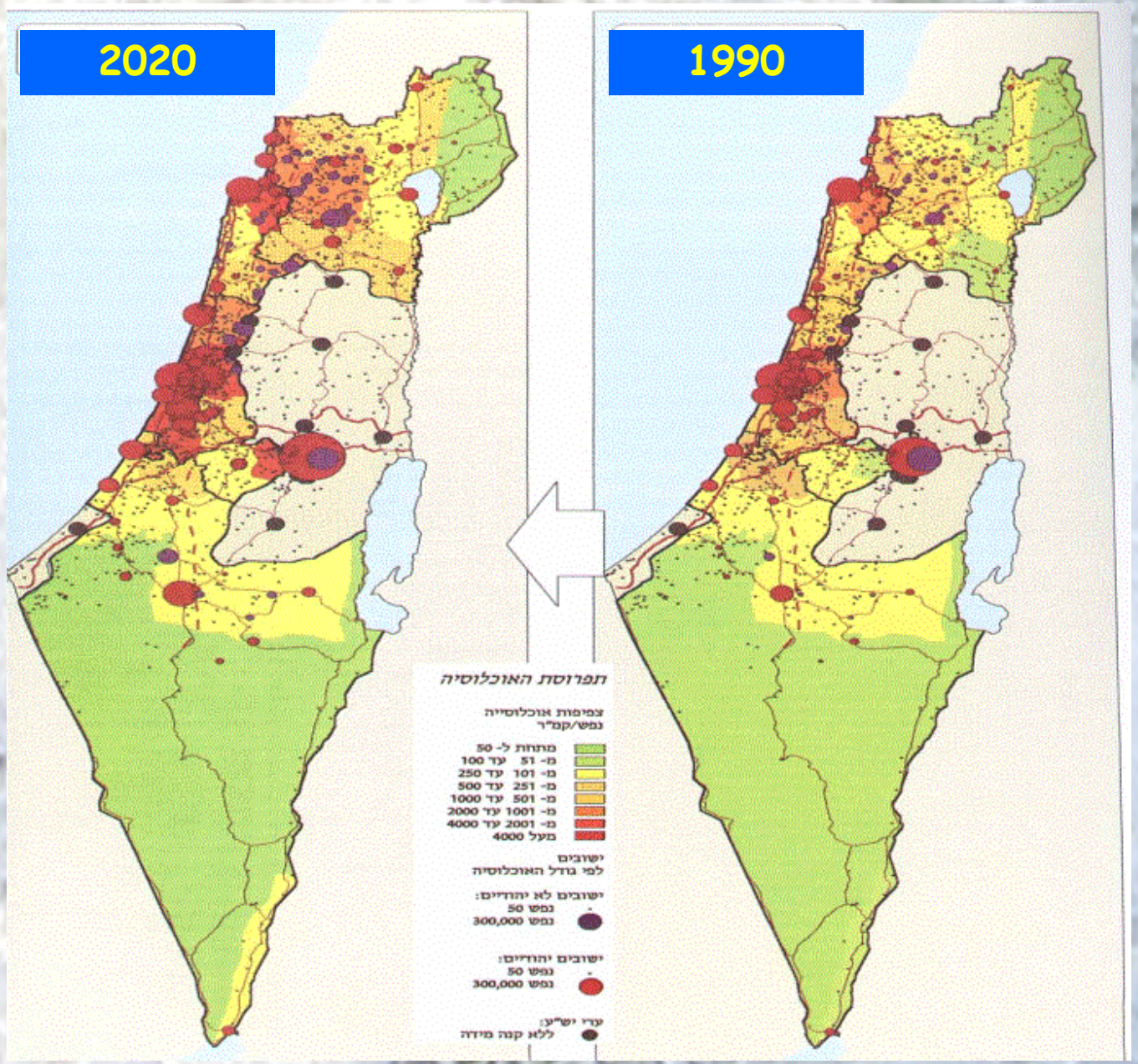
Water Demand per Sectors 2006



Annual demand grows:

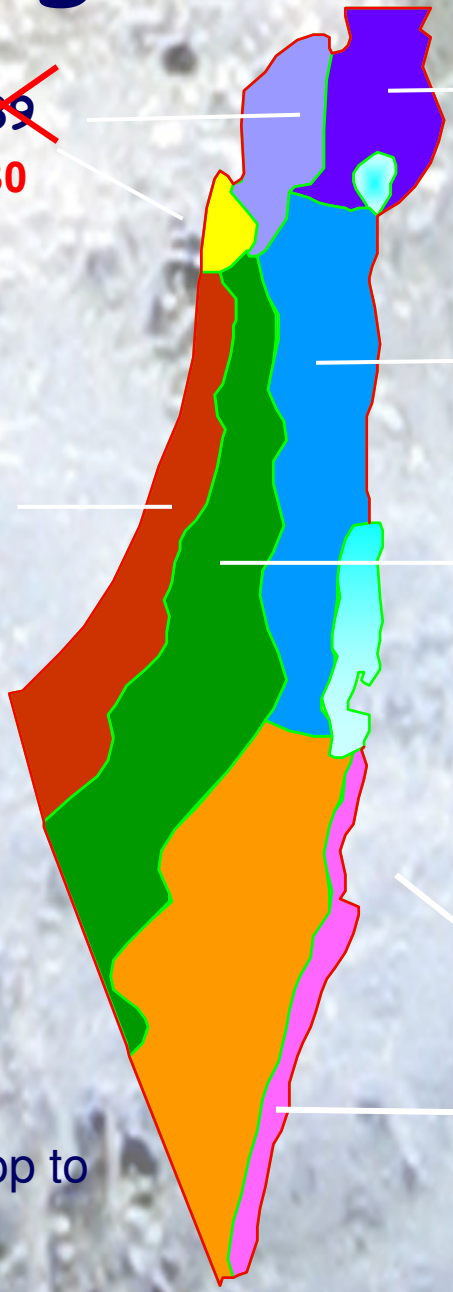
20 MCM/YEAR

POPULATION GROWTH



The Hydrological Price of Peace in The Middle East

Israel's Shrinking Water Supply



Western Galilee Aquifer ~~139~~ 130

Kinneret basins ~~559~~ 469

Eastern basins 130

Coastal Aquifer ~~295~~ 285

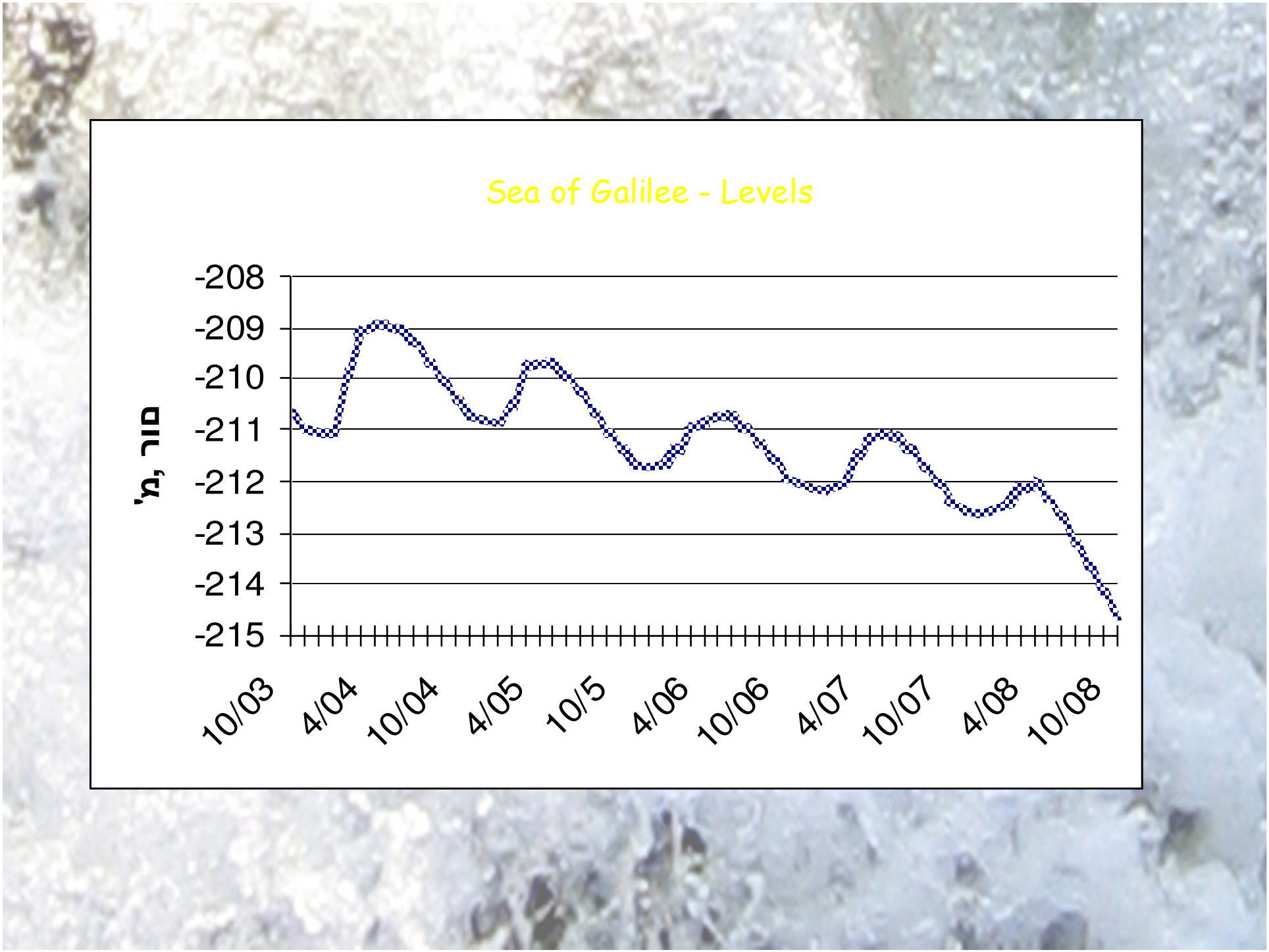
Mountain Aquifer ~~316~~ 291

Negev Basin 70

Arava Basin

Total annual natural production (recharge) ~~1509~~ 1355

w/o southern aquifers quantities drop to ~~1,175~~


Sea of Galilee - Levels
-208
-209
-210
-211
-212
-213
-214
-215
מטר, מ'
10/03
4/04
10/04
4/05
10/5
4/06
10/06
4/07
10/07
4/08
10/08

RED LINES:

Below which – hydrological damage begins

BLACK LINES

Below which damage is rapid and possibly irreversible

Sea of Galilee, 2002

Present Drought Picture

Average rainfall drop in past 16 years: 1,350 to 1,175 mm3

Probability of 4 consecutive extreme drought years: 2%

High Likelihood for coming 5 years of falling below red lines.

How does it affect traditional Water Management Strategy?

(1) National Water Carrier Phase

- Construction – 1956 – 64
- *80% of Infrastructure Investment*
- Provided 66% of country's water
  (80% for irrigation)

Main Water Supply System

(2) Waste Water Reuse Phase

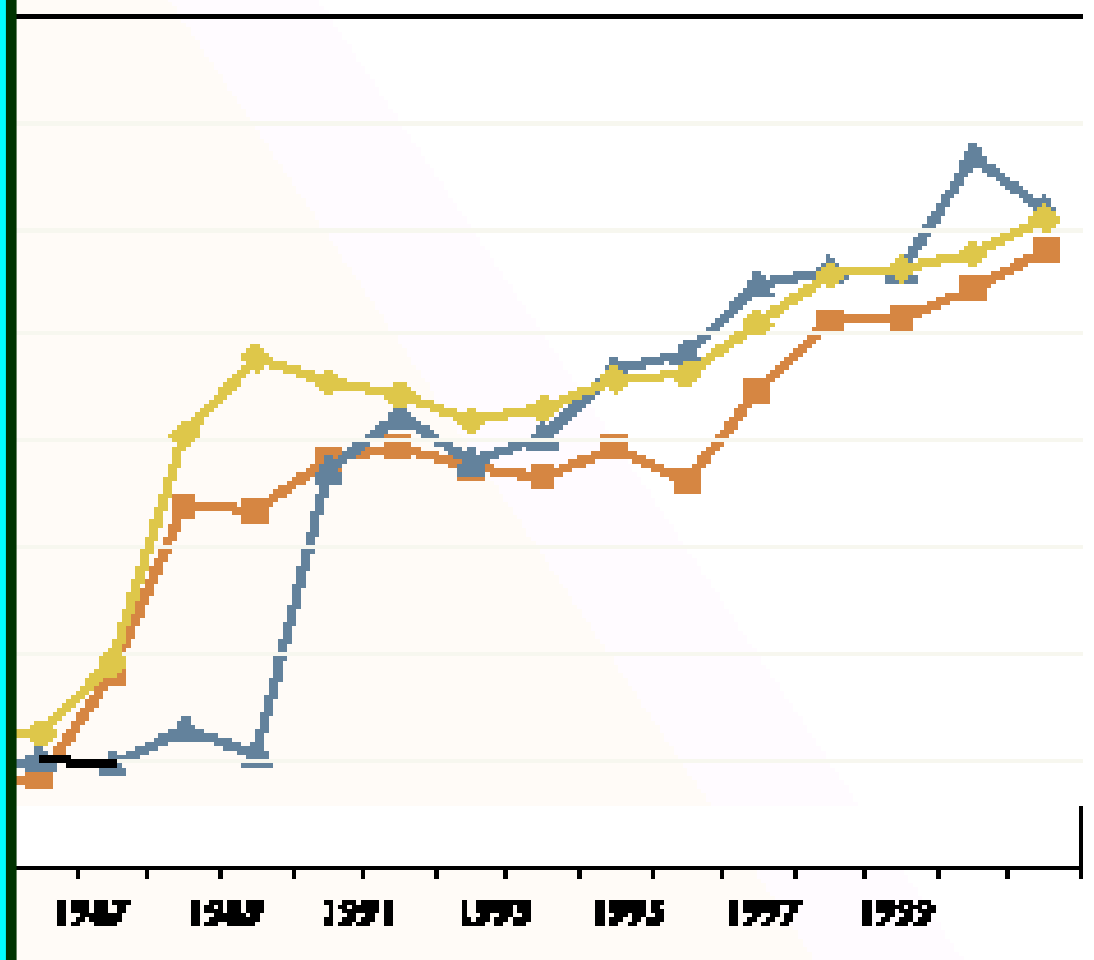
The Jerusalem Wastewater Treatment Plant

Number of Large WWTP's in Israel:

- 1998 - 15
- 2002 - 28
- 2005 - 32

~ 85% of the total amount of wastewater are treated to at least a secondary level

Growth in Sewage Recycling from Aviv Region for Desert Agriculture



Wastewater treatment in Israel 2008:
Facts and Figures

- ✓ Effluents = 450 Million M^3/year
- ✓ >72% of effluents reclaimed for irrigation
- ✓ 28% discharged to rivers or sea

- ✓ By 2010: Reclaimed Effluents = 50% of all water to Israeli Agriculture

Environmental Impacts of wastewater reuse

Water Sources & Public Health

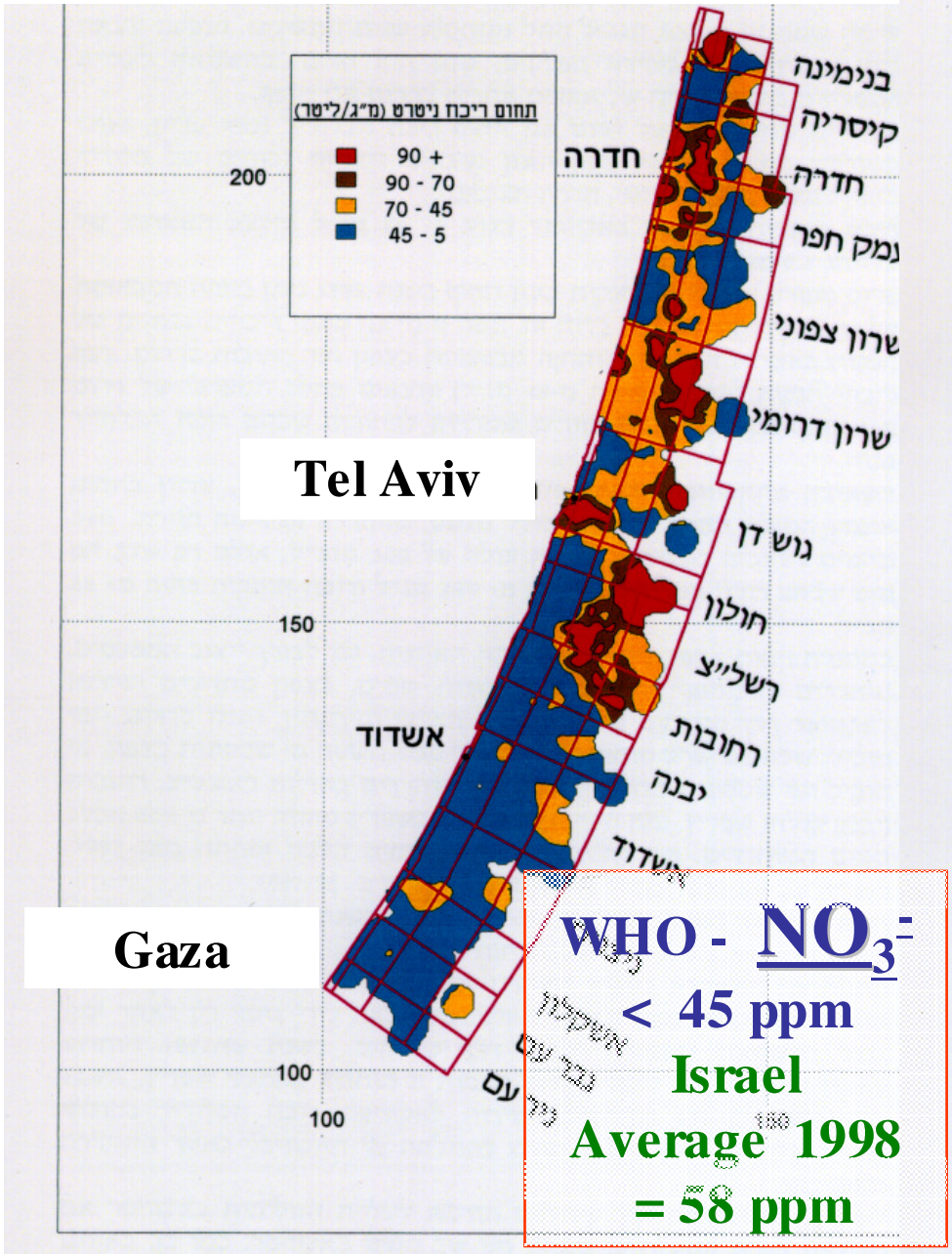
- Organic pollutants
- Nitrogen, Phosphorus
- Chlorides
- Toxic compounds (heavy metals, organochlorines, etc.)

Plants & Soil

- High Salinity
- Sodification of the soil (SAR)
- Excess Boron
- Excess Nitrogen & Phosphorus

Water Quality - Coastal Aquifer

(Israel Hydrological Service)



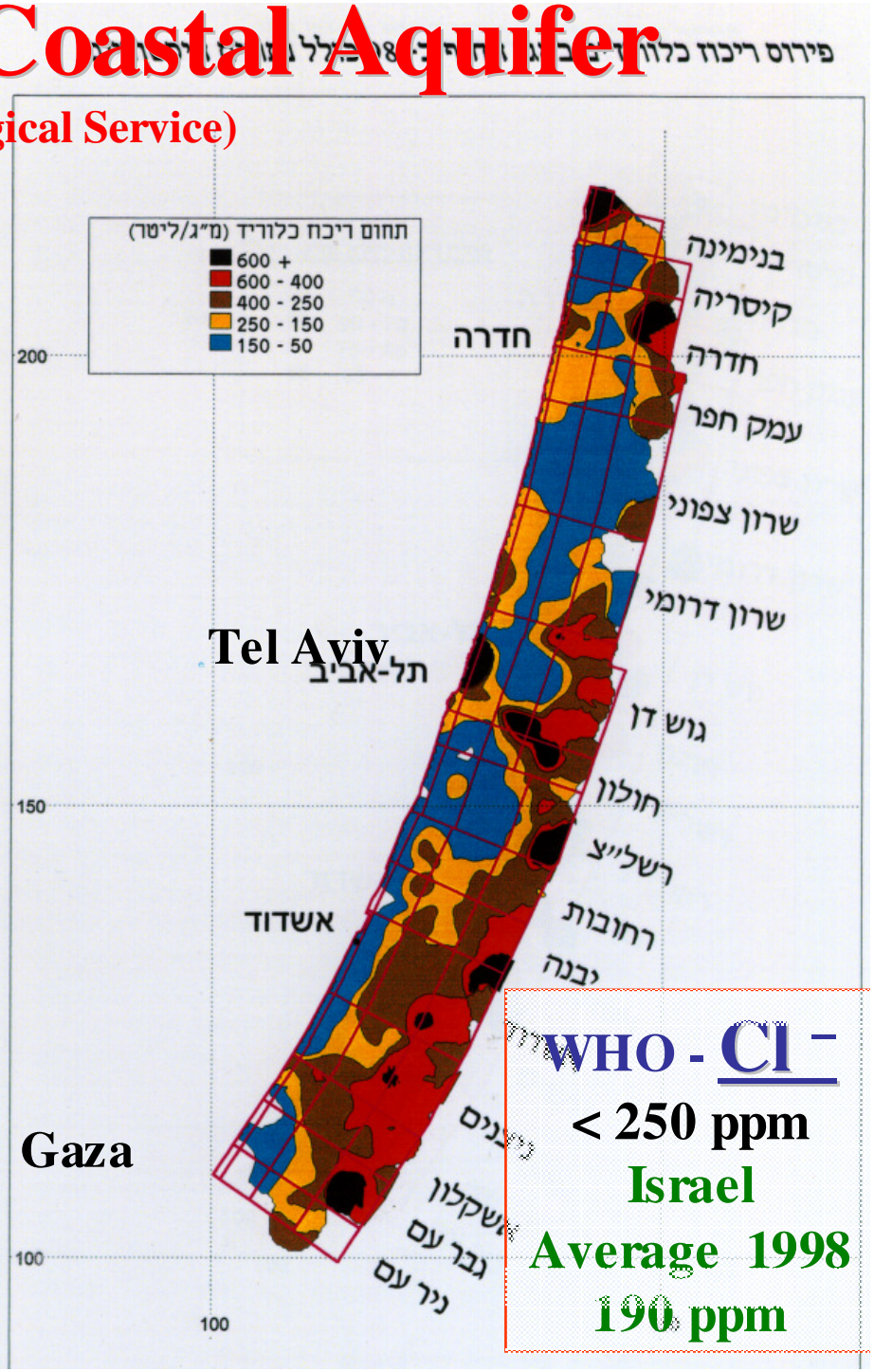
WHO - NO_3^-

< 45 ppm

Israel

Average 1998

= 58 ppm



WHO - Cl^-

< 250 ppm

Israel

Average 1998

190 ppm

Stream Pollution, Eutrophication

Boron and plant growth

Toxicity

Toxicity

Toxicity

Deficiency

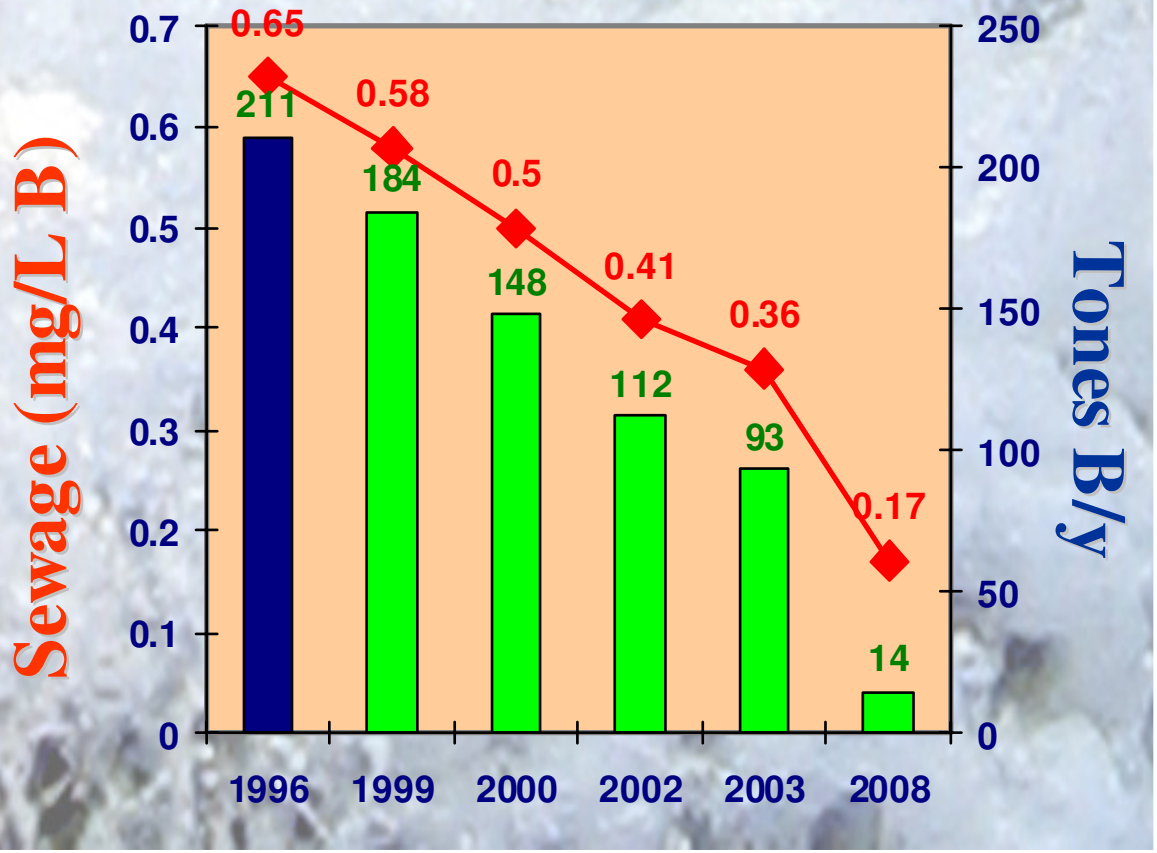
From: J. Tarchitzky

Deficiency

The Solution:
Reduction of Boron in detergents

New Israel Standard for Boron in detergents, 1999

"Compact" anl liquid formulas – more environmentally friendly



Sustainable Effluent Reuse: (Stage 2)

Old 20/30 (BOD5/TSS.) Standard
Use for agriculture is restricted
replaced by:

New, stringent standards for effluent quality

New Israeli standards for effluent quality

- ***Includes - 37 parameters***

- ***Considers:***
  Environmental, Agricultural, Public Health & Hydro-geological Aspects

Proposed effluent quality standards - Salts

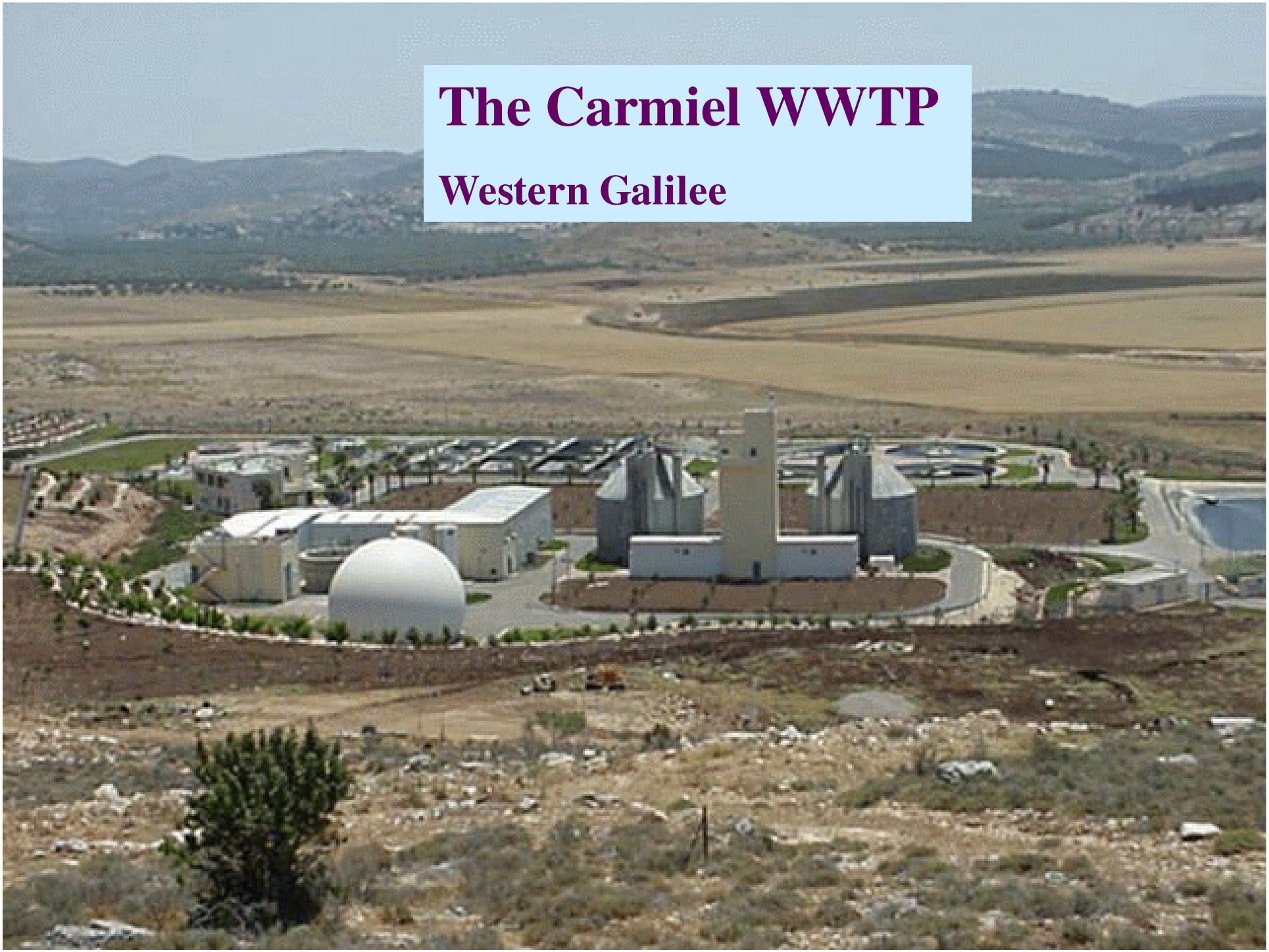
Parameter	*Units*	Irrigation	Stream
Electrical Conductivity	*dS/m*	1.4	
SAR	*(mmol/L)* *0.5*	5	
Chloride	*mg/L*	250	400
Sodium	*mg/L*	150	200
Boron	*mg/L*	0.4	
Fluoride	*mg/L*	2	

Treatment at the source

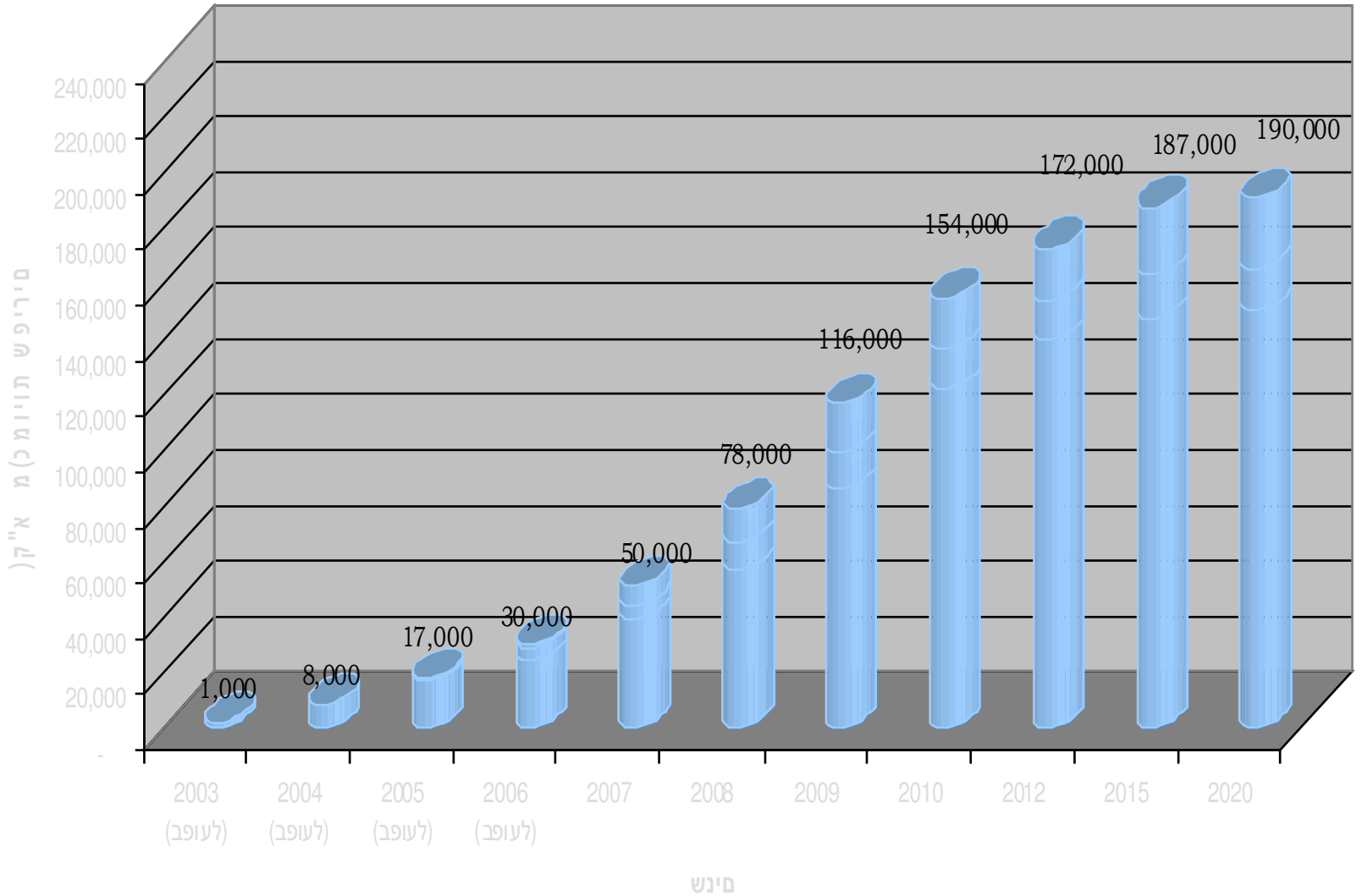
Cannot be treated at the WWTP

Proposed effluent quality standards - Heavy Metals

Parameter	*Units*	Irrigation	Stream
Arsenic	*mg/L*	0.1	0.1
Mercury	*mg/L*	0.002	0.0005
Chromium	*mg/L*	0.1	0.05
Nickel	*mg/L*	0.2	0.05
Lead	*mg/L*	0.1	0.008
Cadmium	*mg/L*	0.01	0.005
Zinc	*mg/L*	2	0.2
Copper	*mg/L*	0.2	0.02
Manganese	*mg/L*	0.2	
Cobalt	*mg/L*	0.05	
Vanadium	*mg/L*	0.1	
Iron	*mg/L*	2	


The Carmiel WWTP
Western Galilee

High Quality Waste Water Treatment Production



(3) Drip Irrigation Phase
Water Conservation Measures

- 1950s – Invented due to low cost plastics
- 1965 Netafim Co. started: Kibbutz Hatzerim.
- Today > 500 million dollars in annual sales.
- Used world-wide from marijuana growers in California to vegetables in Afghanistan.
- Voted Israel's "best invention."

Drip Irrigation: Benefits

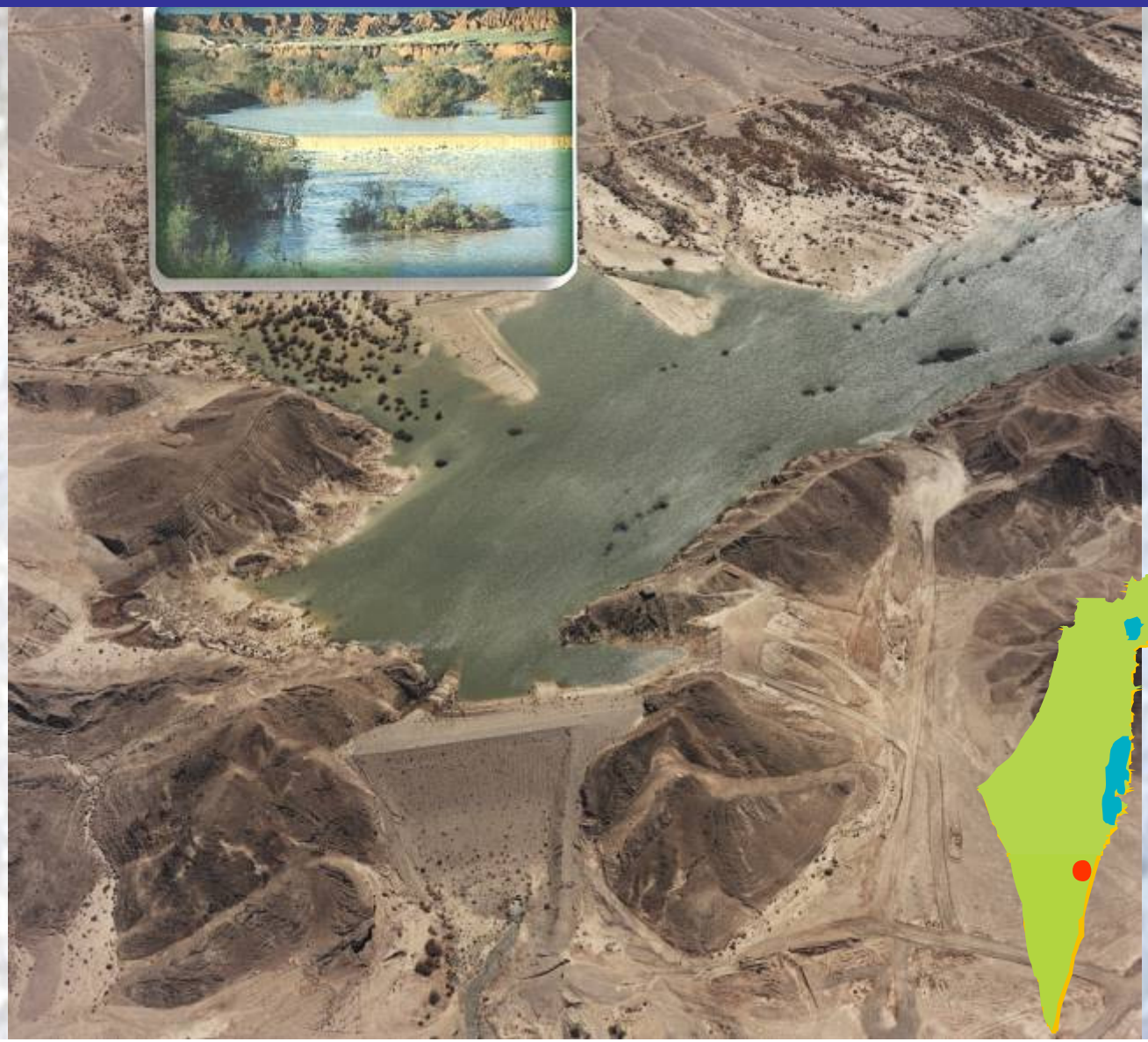
- Evaporation is reduced relative to sprinklers
- Can irrigate steep landscapes.
- Eliminates drift during wastewater reuse.
- Allows for precise chemigation.
- Delivers to the root zone.
- Automation = optimization
- Water use per yield drops!!!

Subsurface drip irrigation: The Next Generation

Conserves water while:

- controlling weeds,
- minimize runoff and evaporation,
- increase longevity of laterals and emitters,
- ease use of heavy equipment in the field, and
- prevent human contact with low-quality water.
- Labor saving (avoids seasonal installation).

(4) Water Reservoir Phase



Floodwater can be used for 2 purpose:

1. To improve quality and quantity of ground water by replenishing and aquifers.

2. To impound floodwaters for direct supply to irrigation systems in nearby fields.

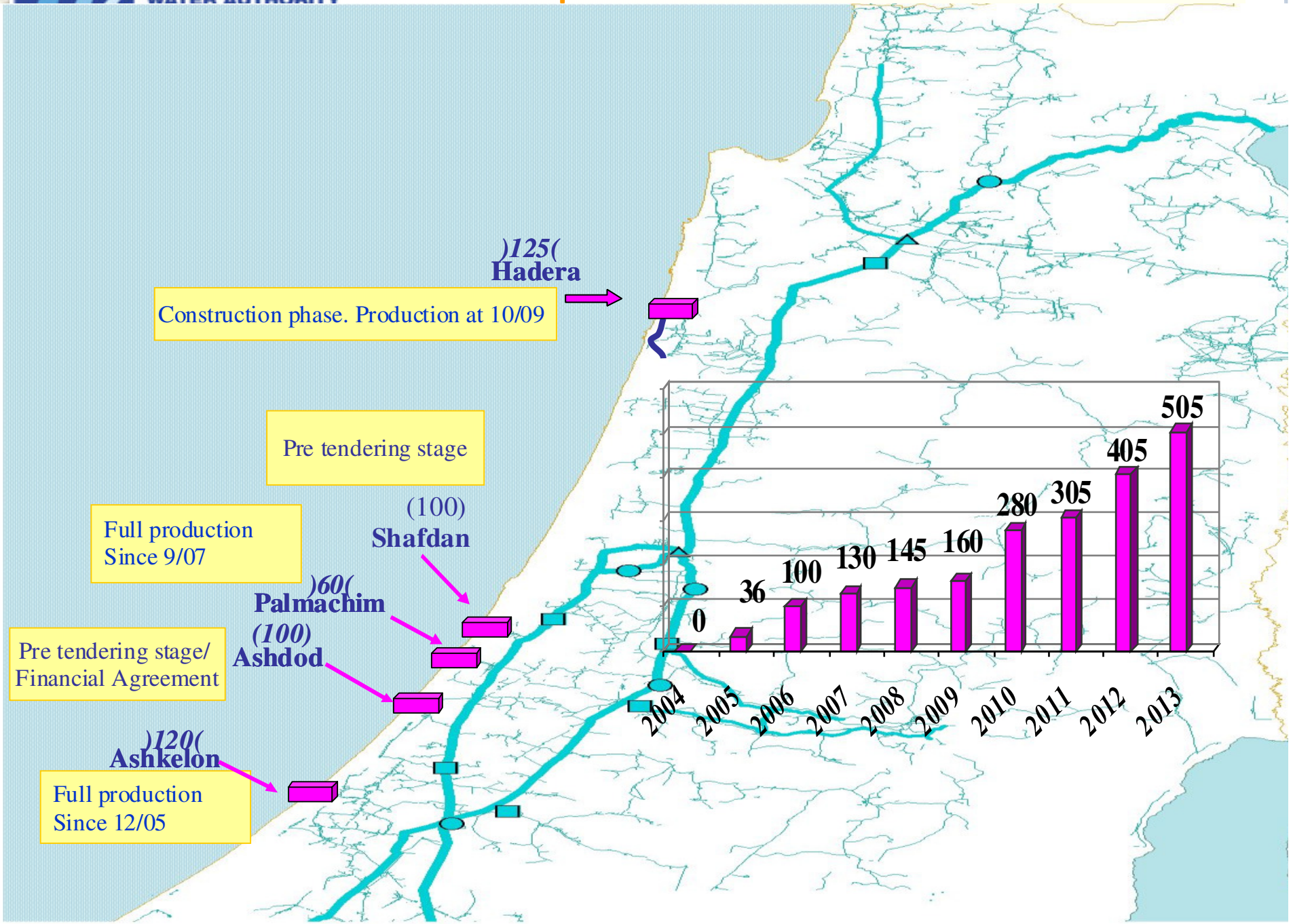
IDAN Runoff Reservoir

Today: Wastewater Storage is focus

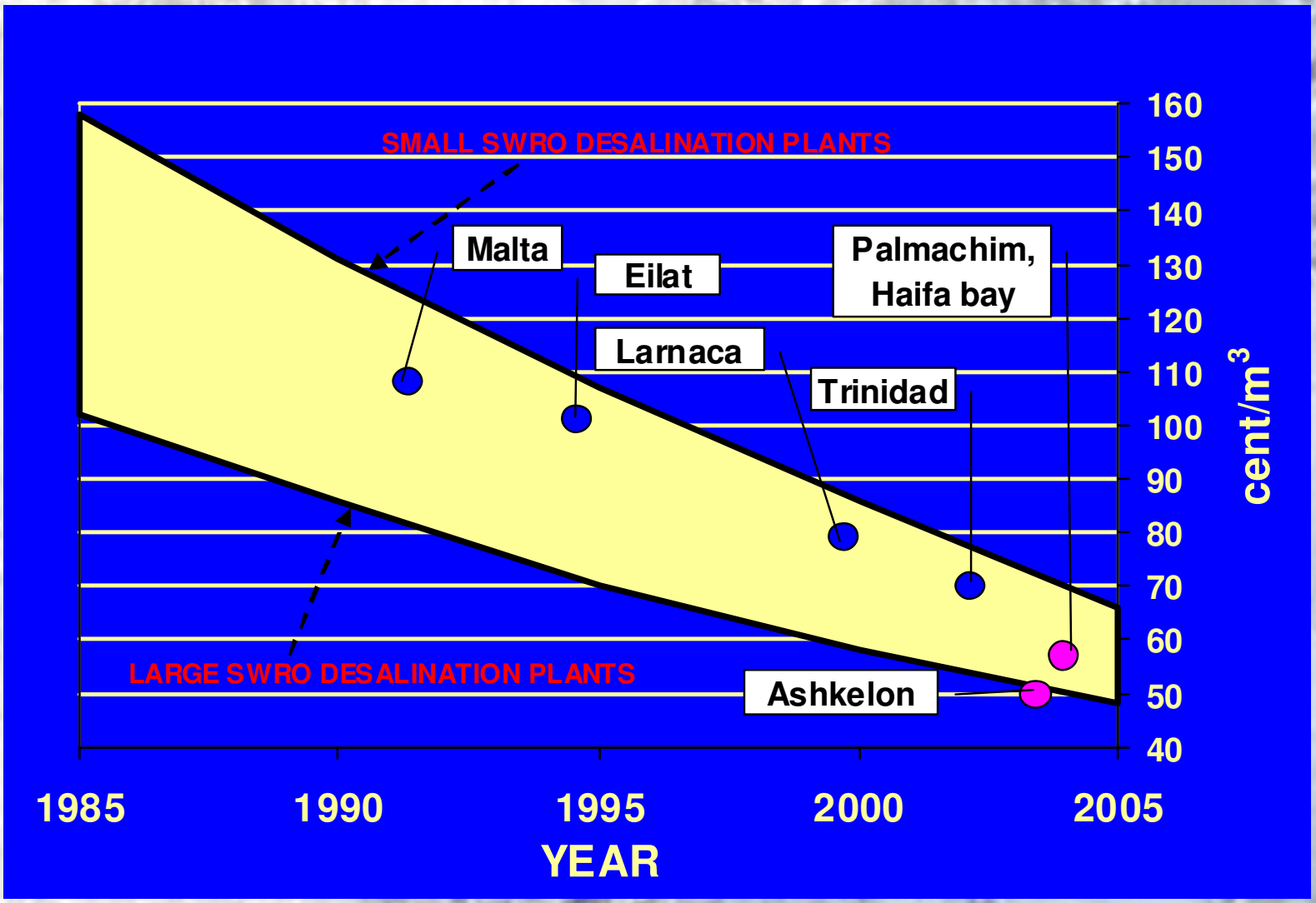
(5) Desalination Phase

WATER AUTHORITY

Development of Sea Water Desalination Plants

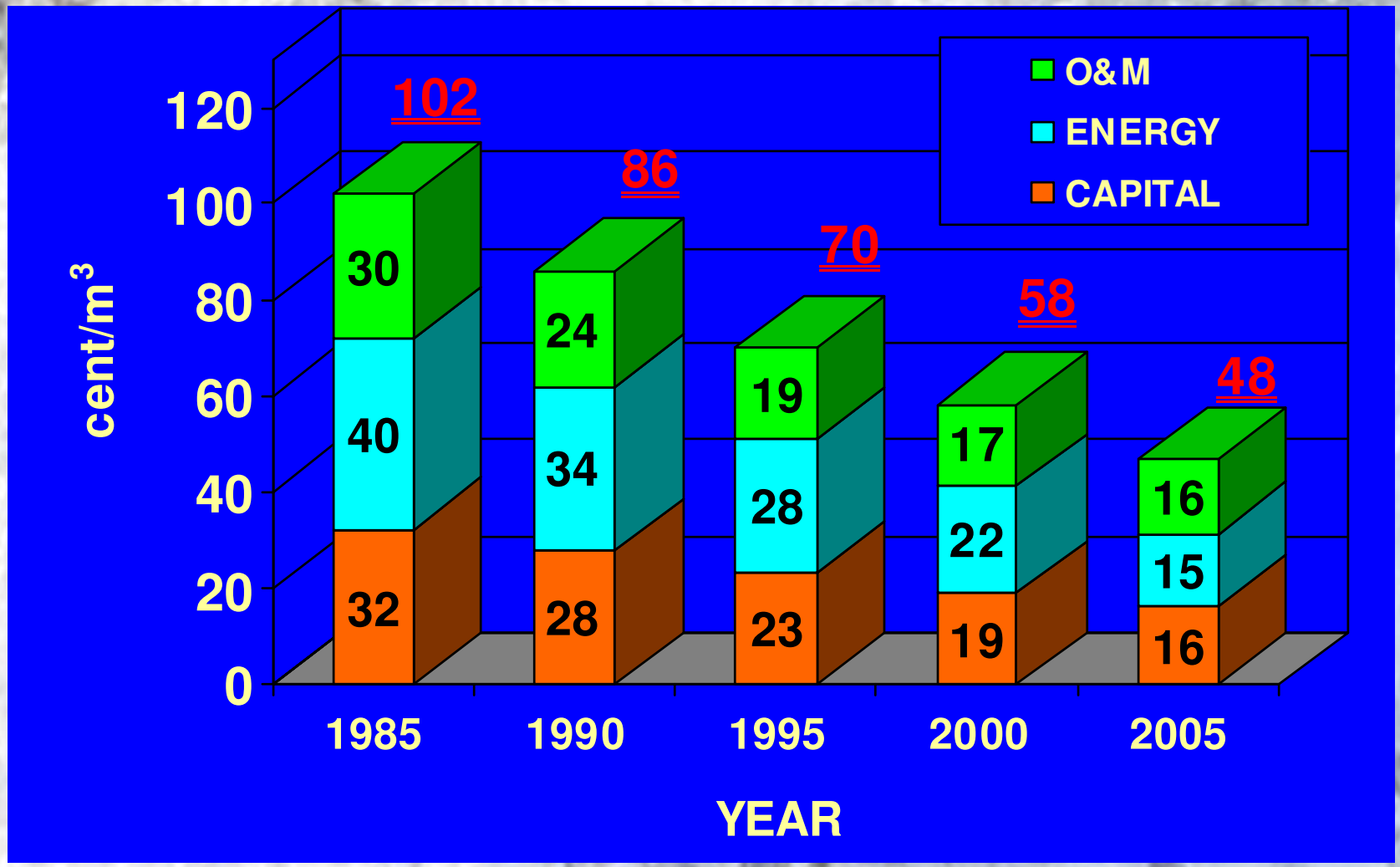


DESALINATED SEA WATER COST RANGE



Source: Israel Water Commission

TYPICAL LARGE SCALE SWRO DESALINATION WATER COSTS



Source: Israel Water Commission

Desalination – Ashkelon Plant

Manufactured water 2002 - 2010
MCM/YEAR

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sea water desalination	-	-	-	40	110	130	140	270	315
Recycle system	-	-	-	-	-	15	35	35	35
Additional amounts of potable water	1	8	15	60	140	200	230	360	455
Treated waste water	295	332	359	390	441	461	471	491	509

Emergency Upgrade: : 750 mcm by 2020

600 mcm immediately: cost: 500 million €

Water Development Plan: required investments

2002 – 2010 (Million €)

• Desalination	1,600
• Sewage treatment & reuse systems	1,000
• Water supply systems	600
• Renovation & Improvements	800
TOTAL	**4,000,000,000 €**

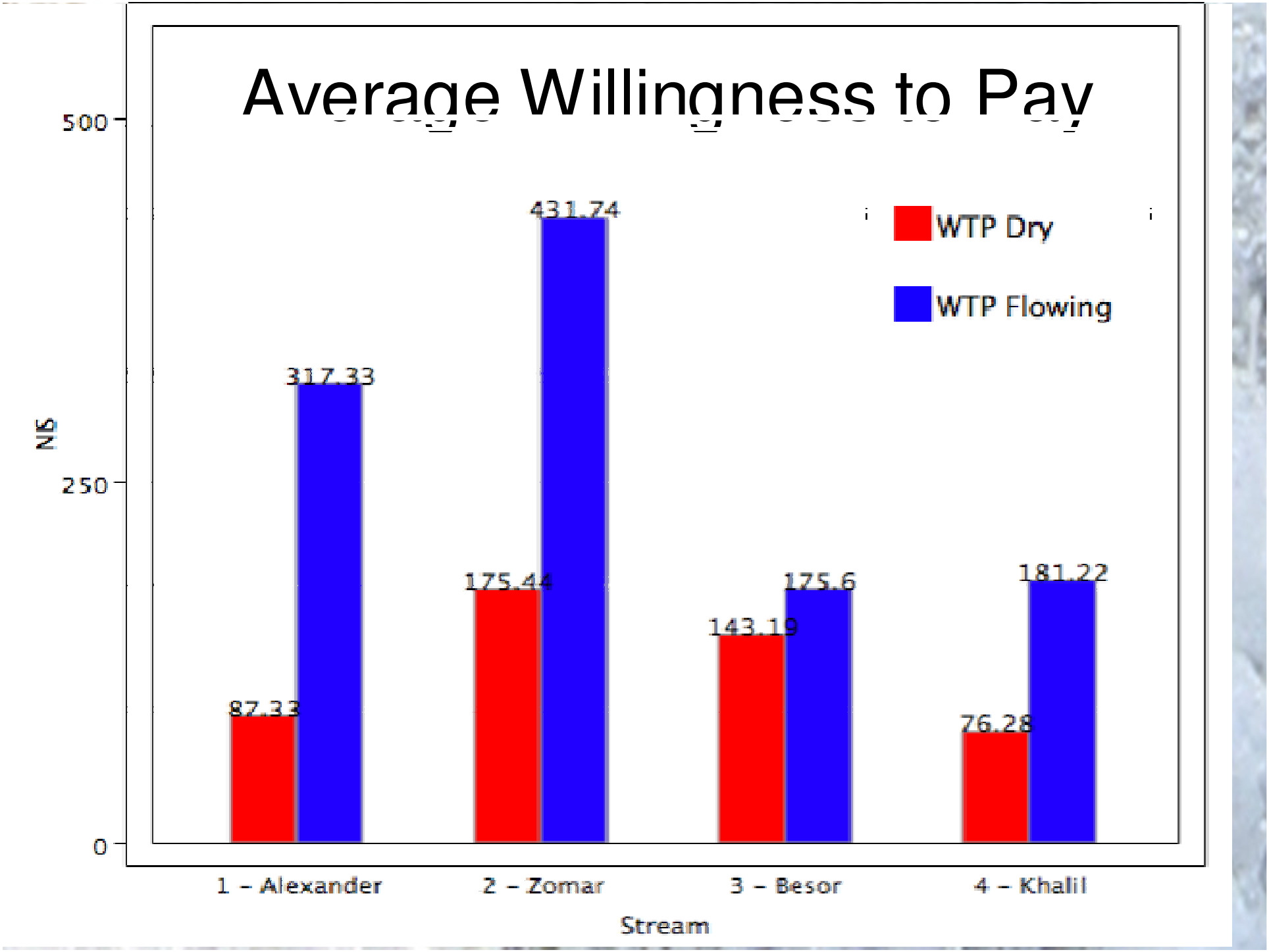
(6) Are We Entering a New Market-Based Phase?

Aug. 15, 2007 – End of Water Subsidies Era

Water Pricing – Israel 2008

	Domestic	Agricultural	Wastewater	Public Institutions
1st Price	€ 0.72	€ 0.24	€ 0.11	€ 1.08
2nd Price	€ 0.88	€ 0.29		
3rd Price	€ 1.41	€ 0.38		

Is the Middle East Ready for a Water Market?


Average Willingness to Pay
500
250
0
NS
WTP Dry
WTP Flowing
317.33
431.74
87.33
175.44
143.19
175.6
76.28
181.22
1 – Alexander
2 – Zomar
3 – Besor
4 – Khalil
Stream

Prevailing views about Water Markets

Israeli Concerns	Palestinian Concerns
FOOD SECURITY	SYMBOLIC: NATIONAL AUTONOMY
IDEOLOGY "The Jewish Farmer"	LACK OF CONTROL
OPEN SPACE PRSERVATION	CULTURAL/HISTORIC

Zaragoza, 30 July 2008

CONCLUSIONS

- **Israel's water managers can claim real achievements.**
- **Environmentally – many mistakes.**
- **Water subsidies are history. Privatization is the future.**
- **Command & Control seems to work.**
- **Pricing mechanisms will affect individual decisions.**
- **Markets are unlikely as "economic efficiency" has never been a paramount policy objective.**