



# Wastewater Treatment & Reclamation



hydrology  
water supply  
Command & Control  
development  
effluent

desalination  
technologies water resource management  
models  
research & development  
wastewater treatment  
drillings  
water quality  
integrative management resources rain enhancement

**Water should not be taken for granted  
We make it happen!**



# Effluent Reuse Projects in Israel for Agricultural Irrigation

*Presented by : Mr. Avi Aharoni, Mekorot  
Head Department of Wastewater Treatment and Effluent Reuse*

**Workshop on Wastewater treatment and effluent reuse  
Shafdan, 9-12 July 2012**

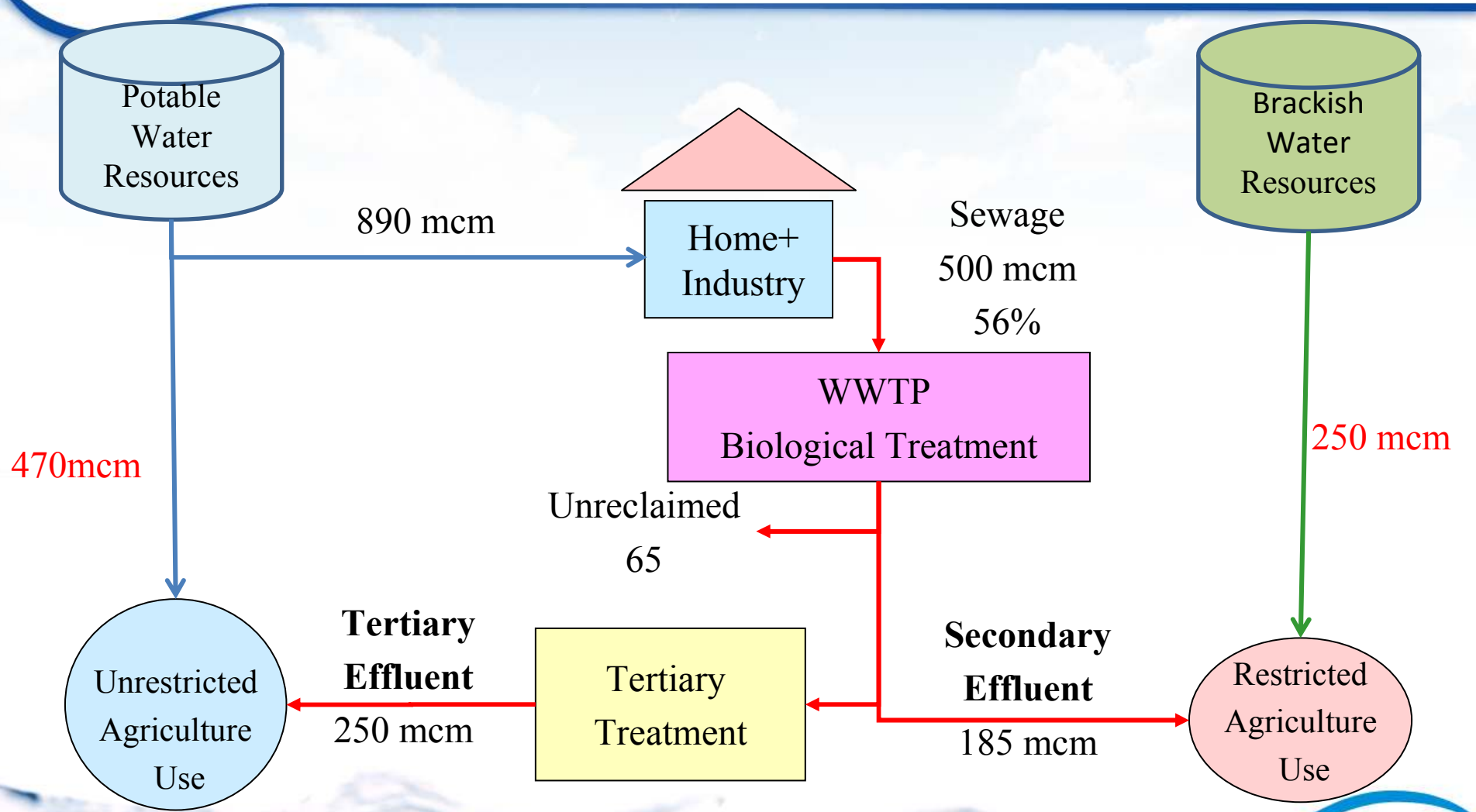




**30% of Israel's Agricultural Crops Come From the Negev**

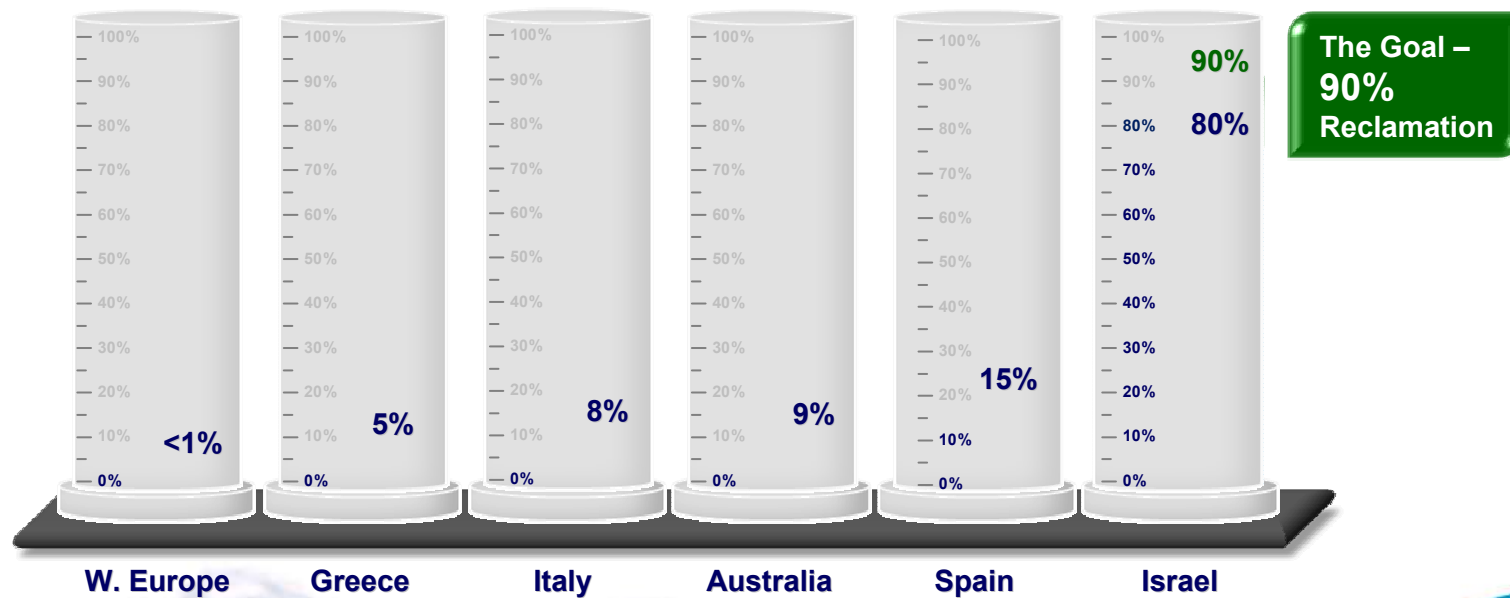


# Annual Water Use & Reuse in Israel

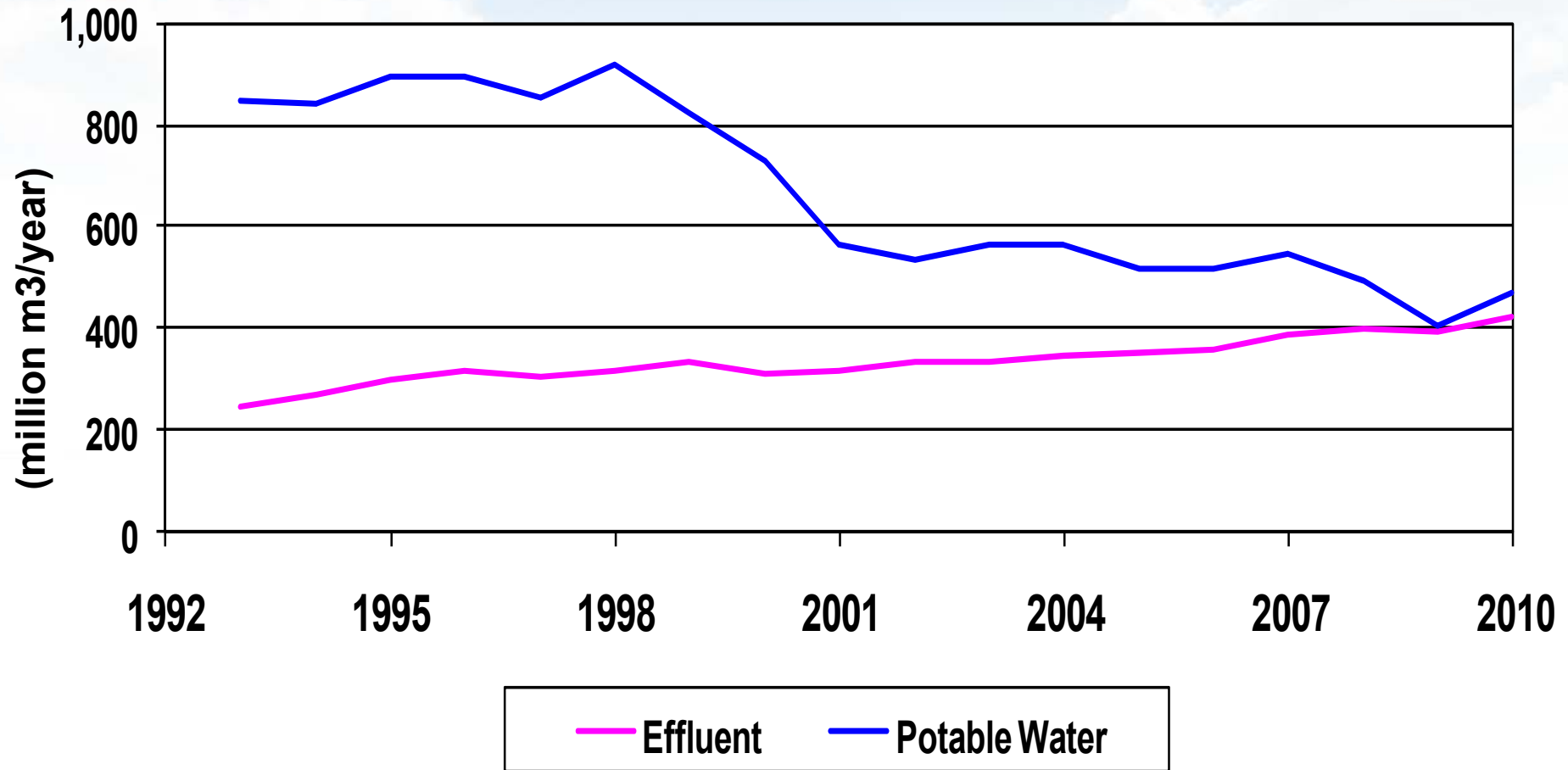


# Effluent Reclamation

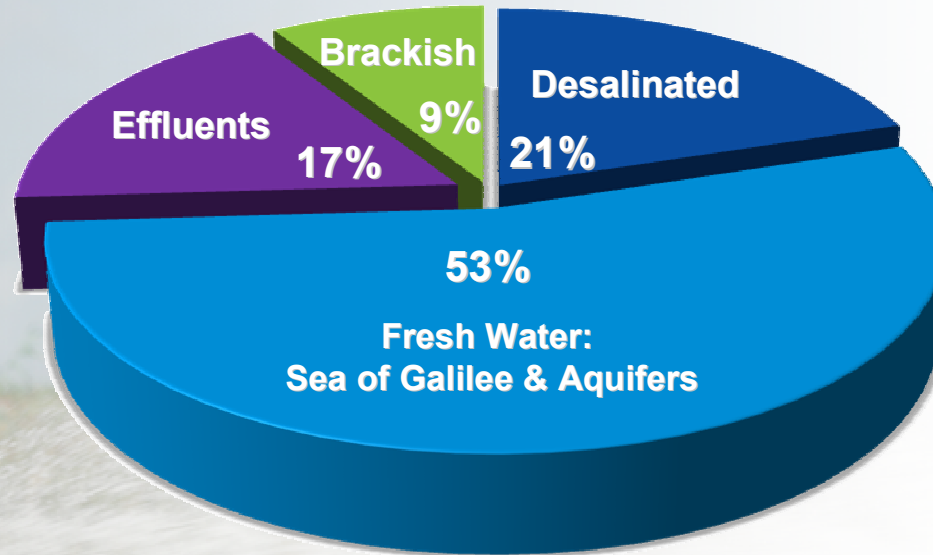
- Reclamation of above 80% of all the effluents in Israel for agricultural irrigation.
- Ability to supply all the agricultural requirements



## Agriculture Water Consumption



# Mekorot – Israel National Water Company Supplies 70% of the Water in Israel



**1.4 Billion MCM water per year**

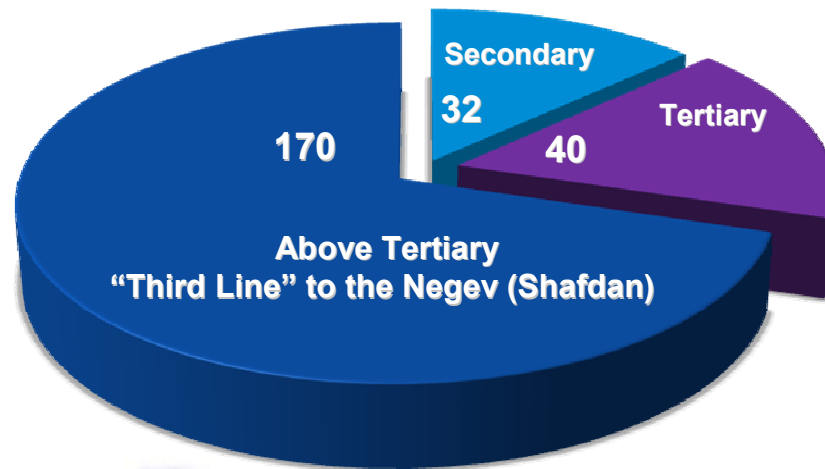
Updated for 2011



## Effluent Reclamation at Mekorot

- The State of Israel reuses approximately 80% of the treated wastewater
- Mekorot supplies 60% of the reclaimed effluents mainly for agriculture
- Treatment of various levels of quality

### Breakdown of Reclaimed Effluents:



Total: 242 MCM





# THE NATIONAL WATER CARRIER (NWC) SYSTEM

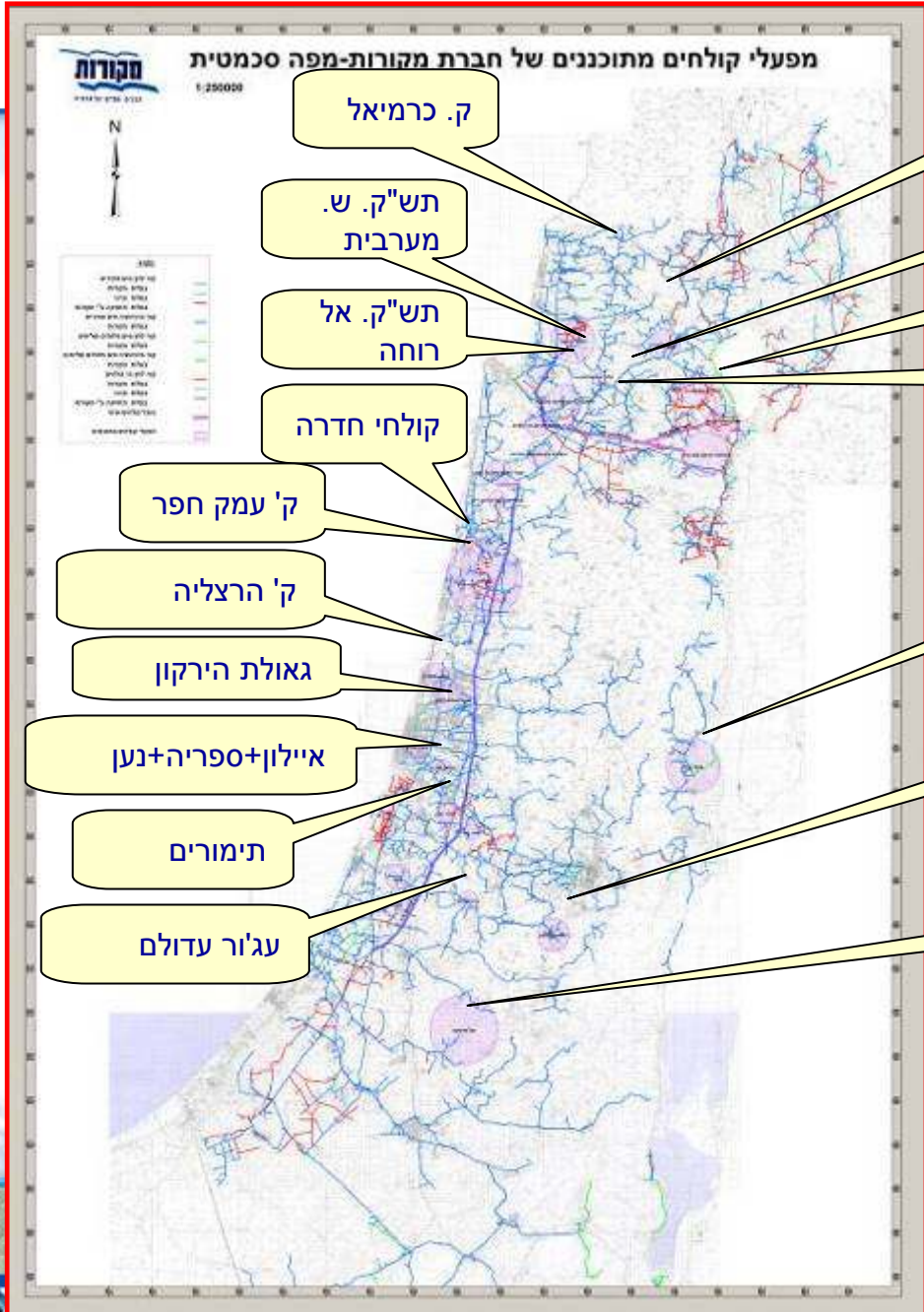


Deliver water from the wet north to the dry south

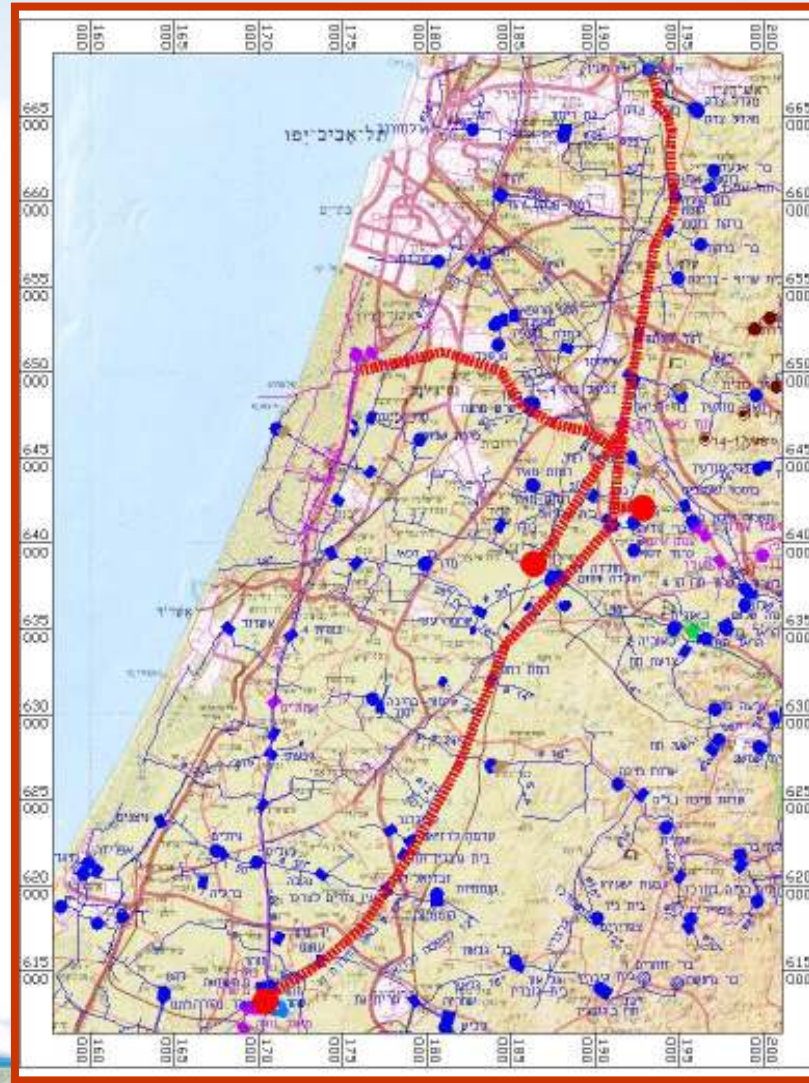
1. Yarqon springs – 1950s
2. Sea of Galilee– National Water Carrier-1960s  
Head – 350 m.
3. Third Line – Reclaimed Water – 1980s



Reuse projects  
(on going and  
planned) of  
Mekorot in  
Israel



# Planned Southern Effluent Pipeline



# Storm water collection



# Cooling and stripping



Faran 20  
52°C



Shizafon wells  
50°C



- *Automatic remote control in 3,000 installations from 9 control room across the country*
- *Operates the water supply system*
- *Uses a variety of communication technologies / Telemetric System*
- *Online optimization for energy savings*



# Shafdan Plant & “Third Line” Supply System

- Largest wastewater treatment plant in Israel
- Treats most wastewater in the center of Israel
- Supplies approx. 170 million m<sup>3</sup> of reclaimed water per year for unrestricted irrigation in the Negev – a semi arid area in South of Israel
- Quality of reclaimed water above tertiary is suitable for unrestricted irrigation



## Reclaimed Water Desalination

In order to achieve the goal of 90%  
Mekorot invests in R&D of innovative technologies  
for desalination of secondary effluents up to drinking water level





## Issues influencing the effluent reuse in Israel

**Water and Sewage Master Plan** for all the country (In preparation)

Use of the **Replacing Potential** of effluent (instead of fresh water in agriculture) as an answer for the fresh water shortage:

- Need for effluent transfer systems from the production to the consumption sites – **National Effluent Pipeline**
- Gape between production to consumption periods – **Seasonal Reservoirs**
- Promoting technologies to stand on **new effluent reuse regulations**
- Irrigation with effluent: Cope with **Safe Distance Limits** of fresh water sources
- Expanding the reuse beyond the agriculture – parks, gray water, industry, membrane treatment to rehabilitate salinated aquifers



## Water and Treated Wastewater Tariffs for Agriculture in Israel (\$cent/M3)

	Fresh Water	Third Line	Tertiary Eff.	Secondary Eff.
First Quota	55	28	26	23
Second Quota	63			
Third Quota	78			
Up to 10% exciding from the Quota	1.17	41	32	29
More than 10% exciding from the Quota	1.83	59	39	35

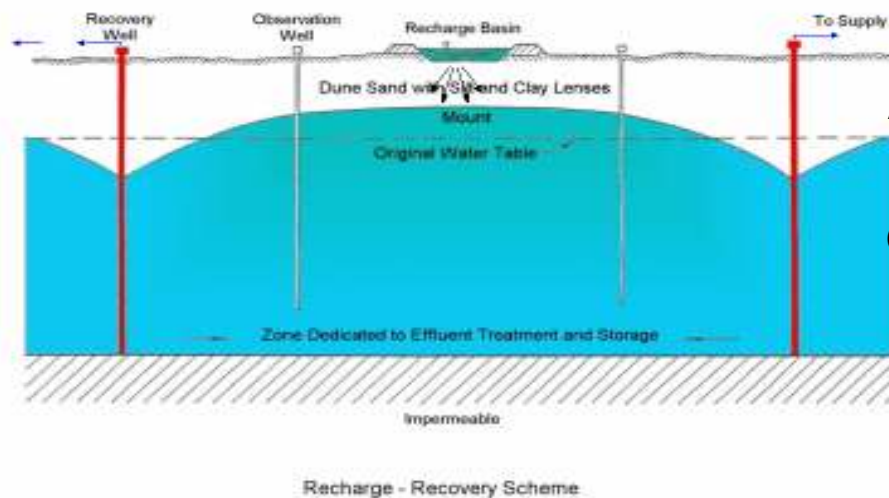


# Dan Region WWTP and Reclamation ( Shafdan)

*Treating 140 MCM/Y - 2.5 Million P.E*



Cross Section of Soil and Aquifer



Vadoze Zone  
Aerobic/Anoxic

Ground Water

Recharge - Recovery Scheme

## Operation of Soil Aquifer Treatment (SAT) in Shafdan

SAT basins – Each are divided to sub-basins



View from a sub-basin at the beginning of the filling cycle and a soil treatment machine



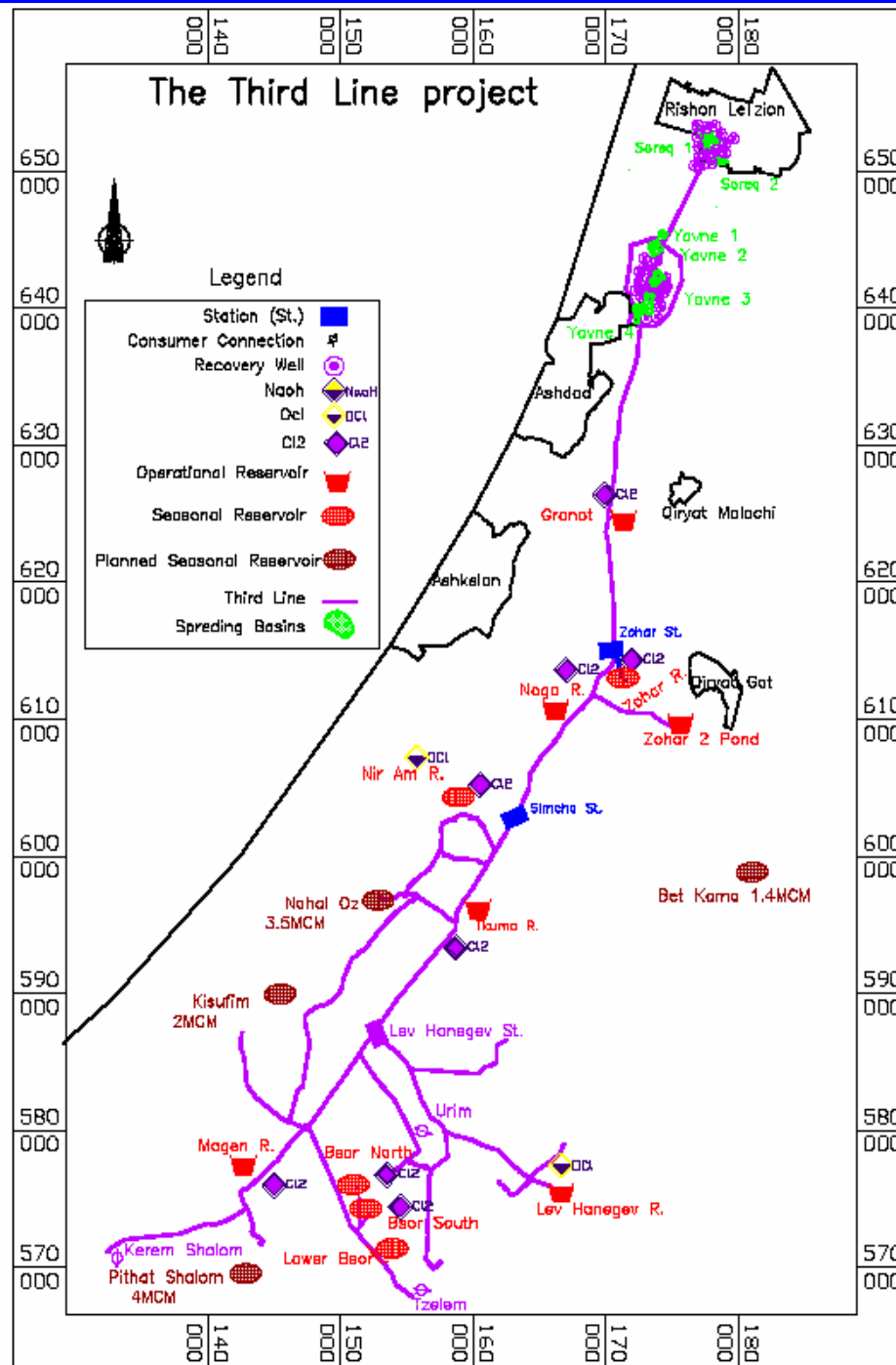
# SAT FIELDS



## Water quality data of the SAT process in Shafdan

		Raw sewage	Sec. Eff	After SAT	Drinking stand.	New Effluent Standards
BOD	ppm	430	8	<1		10
COD	ppm	1060	40	10-20		100
TSS	ppm	380	8	<0.1		10
TN	ppm	65	20	5-10		25
NH4	ppm	35	6	0.1		10
UVabs	cm-1 *10*3	450	212	25		
DOC	ppm	60-90	12-18	1-2		
Pt	ppm	8-12	1-2	<0.02		5
Det	ppm	4-13	<0.2	<0.1	1	2
T.Coli	N/100ml	1.1E8	5.6E5	0	3	
F.coli	N/100ml	1.2E7	1.8E4	0	0	10
MN	ppb	50	25	30-500	500	200
Fe	ppb	1,100	80	10-100	1000	2000

# The Third Line project



## Distribution system of reclaimed water from Shafdan to Negev

- Long pipeline
- Up to 25,000 M3/H
- Pump stations
- Operational reservoirs
- Seasonal reservoirs



## Operational

Range of volume: 50,000 – 200,000 cm



## Seasonal

Range of volume: 1.5 - 4 Mcm



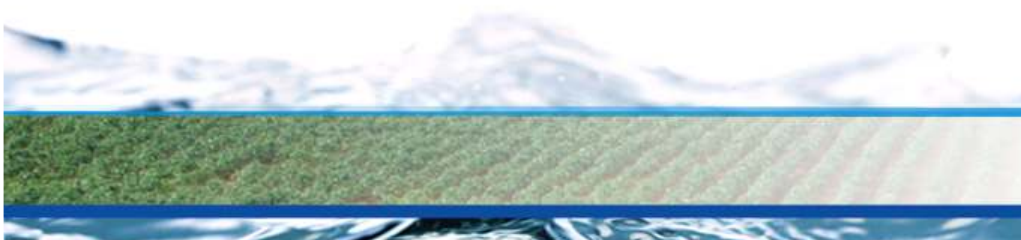


## Kind of crops irrigated with the Third Line water

- Oranges •
- Carrot •
- Potatoes •
- Potato •
- Cue Cumber •
- Flowers •
- Wheat •
- Onion •
- Lettuce •



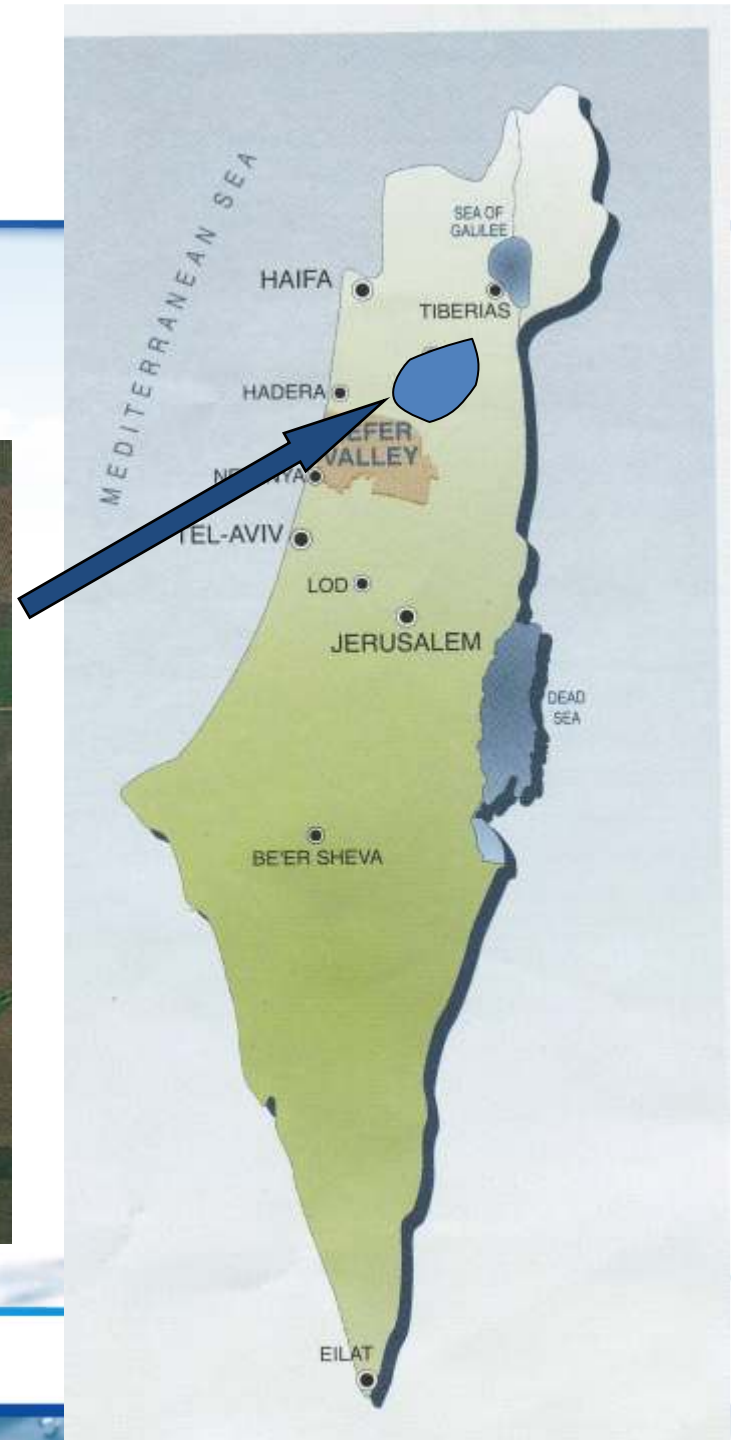
## Agriculture in the far south of Israel - Arava





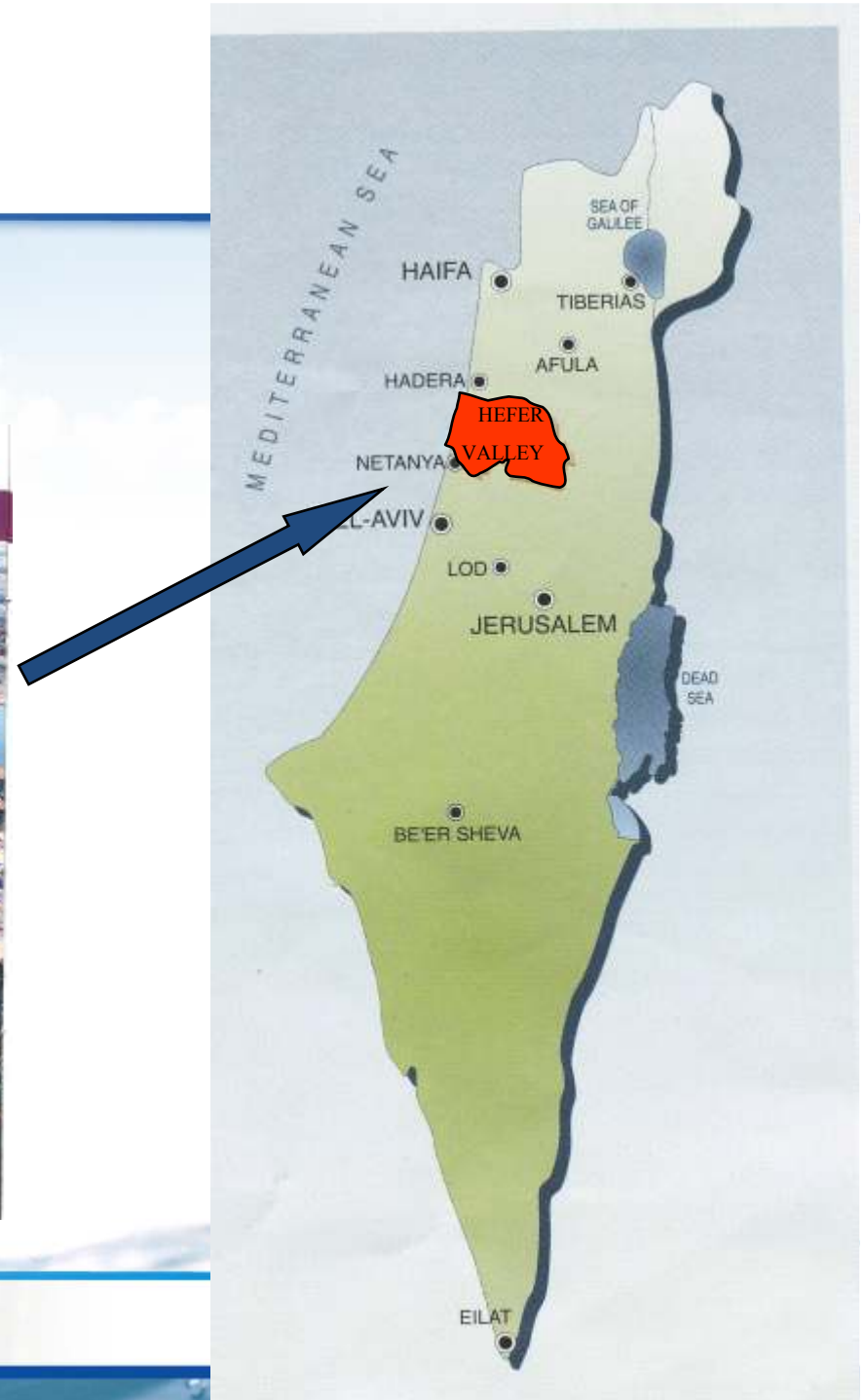
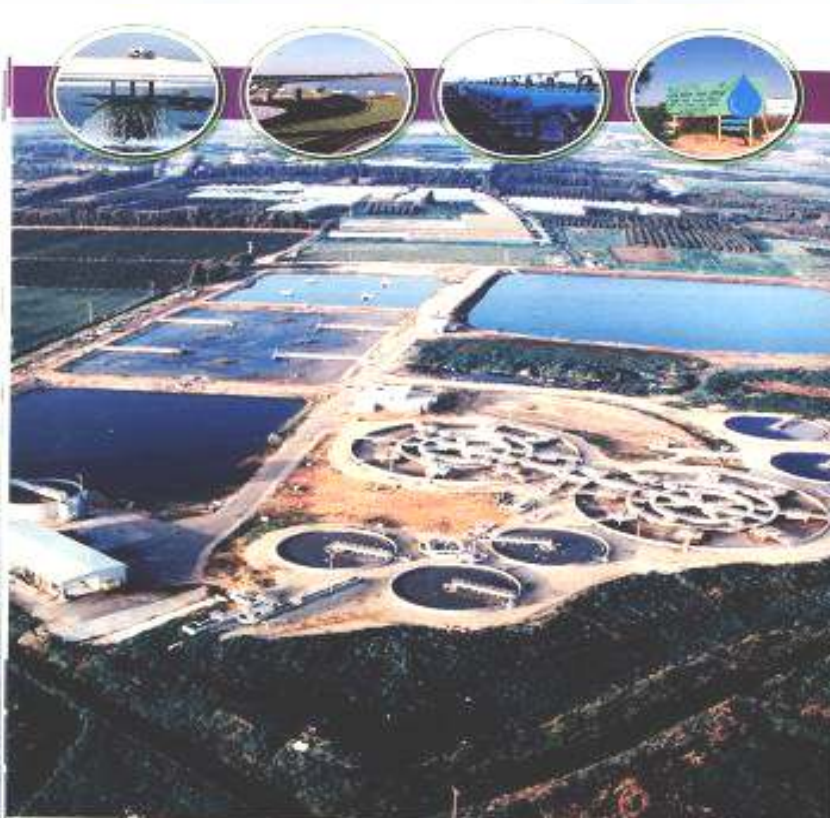
# “Hakishon” Project

30 Mcm/Year



# “Hefer Valley” project

20 Mcm/Year



## Solutions for operation problems in effluent reuse systems

- Algal and Zooplankton blooms in reservoirs: Fish control, chemical treatment, mobile float for control of the drawing water level, cover of reservoirs
- Biofilm - Clogging irrigation systems: “Shock chlorination” and pipes washouts
- Sand filters clogging: Optimization of the regimes of filtration and backwash , and flocculation dosages
- Slower rates of recharge capacity ( SAT): Change of the regime of flooding and drying, valves in water level of the recharge basins automation
- Sand and Manganese in the irrigation systems in Third Line System: Control of the recovery wells regime, hydrocyclons, sand detectors



# Biological and Chemical Treatment against algae and zooplankton in effluent reservoirs

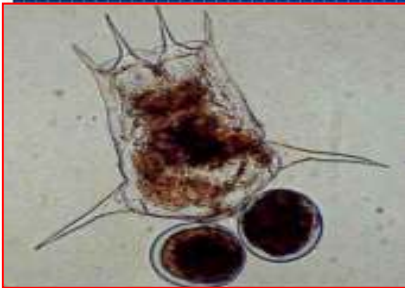
**Rotifer**



**Copepod**



**Common Fish**



**Daphnia**

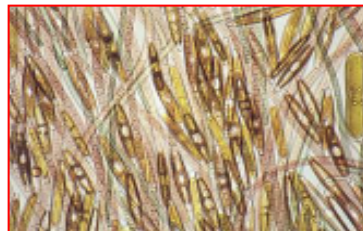


**Daphnia**



**Big Head Silver Carp**

**Navicula**



**Nitzschia**



**Synedra**



**Cyclotella**



# Net Filtration



# Monitoring Clogging Irrigation Systems





# Sand detector



# Hydrocyclon for sand measurements



# Floating cover in reservoirs against algal blooms and reducing evaporation



# Irrigation Methods

## Moving Line



## Sprinklers



## Drip irrigation



## Sprayers



# Renewal of Yarqon River



# Tel Aviv "Yarqon" River Rehabilitation Project



# Israeli water reuse policies and measures (1)

- ☞ From the Israeli Water Law:
  - All water resources in the country are public property
  - Water resources relate to all types including floods, sewage, brackish (and even seawater)
  - ☞ All types of water in Israel are measured (also flood water)
  - ☞ Only centralized allocation of water can ensure an optimal use of the limited water resources
  - ☞ Water Authority is an overall regulator (departments from other ministries transferred to the Water Authority)
  - ☞ The Water Authority trying to make efforts as much it is possible to use all the marginal waters



## *Israeli water reuse policies and measures (2)*

- ☞ There is an absolute separation between wastewater treatment (municipal responsibility) and effluent reuse ( Water Authority threw Mekorot and other Initiators – mostly for agriculture)
- ☞ The Water Authority will support establishment of effluent reuse projects ( up to 60% fund of the investment costs) to sustain water resources
- ☞ Water tariffs will depend on realistic costs – closed market
- ☞ Not to rely on national fund sources
- ☞ Cancel of all the discounts to different sectors





# Functions of the institutions

- **Water Authority** responsible to give:
  - Instructions for use water for all kinds and for all uses
  - To advertise the tariff regulations
  - To give the allocations for the consumers
  - Criteria for financial support
  
- **Health Ministry:**
  - The water quality criteria
  - Irrigation limits
  
- **Ministry of Trade and Industry :**
  - Defining the needs of water for industry
  - Promoting the develop of water technologies
  - Education and developing tools to save water
  
- **Ministry for Environmental Protection:**
  - Limits of area to keep for environmental uses
  
- **Ministry of Agriculture:**
  - The policy of kinds of crops to grow and the lands to use
  - Professional advice and guide to the farmers
  
- **Mekorot:** :
  - The institution that helps the Water Authority ( execution arm) to build reuse projects in places the private sector is not capable or has no willing to do that



## *capacity building*

- Water Authority creates the national water policy program:
  - amounts of water in all the resources,
  - estimations of water demand,
  - forecasts of water gaps ,
  - predictions about the effluents availability and its locations
  - meetings of the Water Authority with Mekorot, farmers and initiators to describe them the needs and the opportunities of support
- Support the initiator by incentives, help with funds to establish the reuse projects
- Guide of professionals from the Ministry of Agriculture during the season
- Advertisements



# Organizational framework for establishing water reuse project

- **The target:** To sustain the water resources by establishing reuse projects
  
- **Conditions:**
  1. Replace of fresh water rights of the farmers
  2. At least 60,000 M3/Year
  
- **The procedure:**
  1. Submission of application to **preliminary committee**
  2. Review of the application – feasibility study, amount of fresh water will be saved, hydrological considerations, contamination prevention, combination with the regional design
  3. Recommendation of the committee to the **Director of the Water Authority** to approve
  4. Grant of the Water Authority for the **General Design** (up to 100,000 \$ and no more then 75% of the cost)
  5. Submission of the General Design to the **judging committee** and approval
  6. Submission to **cost committee** of :
    - a. paper of **investments and costs data** of the project.
    - b. paper of **fund resources**.
    - c. approval paper of **surface water committee** for establishing **seasonal reservoir**
  7. Approval or rejection of the project by the **cost committee** :
    - a. Recommendation for grant for **Detailed Design** (up to 200,000 \$ and not more then 75% of the costs)
    - b. Recommendation for grant for the investments up to 60% by the **cost committee**
  8. Approval of the project by the **Director of the Water Authority**



## Conditions for approval of 75% support

- 1.5 Mcm/Year
- 90% of the water will be supplied to more than 7 Km distance from the effluent source
- At least 150 m' Head



## *public perception on water reuse*

- Good confidence of the public by advertising the effluent quality criteria by the Health Ministry that there is no risk from that water to the people
- The awareness that it is already done for decades
- Supervision and control of the ministries when using this water
- Annual submission of application of the farmers to receive licenses of irrigation permits from the Ministry of Health – The crops, the source of water and its quality, the lands for irrigation
- Incentives of the Water Authority for using treated wastewater for irrigation in the agriculture – allocations - 1: 1.2 , tariffs, funds
- Ministry of Agriculture : Making the policy for the crops to grow, guiding, training and accompanying the farmers during the season



***Thank you***



# איכויות מים וקולחים להשקיה חקלאית

יחלוק וולקשא (םיינוינש)	יחלוק לאימרכ (םיינושילש)	זוכיר וקב ישילשה	נקתמ הלפתה וולקשא	ימ םיחודיק	םימ םייליע (תרנכ)	תודיחי	רטמרפ	
9.5	4					ppm	BOD	חצ"ב
13	3	0.66				ppm	TSS	מ.םיפחרמ
8	3	0.53	0.5	0.1-0.5	יאמ-01	NTU	TURB	תוריכע
	1	<1	0	0	0	n/100ml	FMF	יתאוצ ילוק
	2			0.1-0.5	0.1-0.5	ppm		רתונ רולכ
		3.8				ppm	DO	סמום וצמח
	0.09	0.19	0.2 - 0.3	0-0.3	<0.1	ppm	B	נורוב
260	180	235	20 - 15	50-400	220-280	ppm	CL	דירולכ
1.65	1.55	1.4	0.3 - 0.2			dS/m	EC	מ.תילמשח
	36	23	0			ppm	MG	םויזנגמ
	163	152	10 - 9			ppm	NA	ורתנ
30	17	0.04				ppm	NH4	הינומא
0	13	20		>70 *		ppm	NO3	הקנח
5	8.6	0.1				ppm	PO4	יללכ וחרז
	3.7	3.6					SAR	
המישר יפל								תודיכ תוכתמ
דע יתשל אל םיחודיקב 140גמ "ל*								