4th BEIRUT WATER WEEK
Technological Tools and Financing Mechanisms for IWRM: Complementing Hydro-diplomacy
&
Climate Change Adaptation Efforts
20-22 February, 2013
Notre Dame University-Louaize

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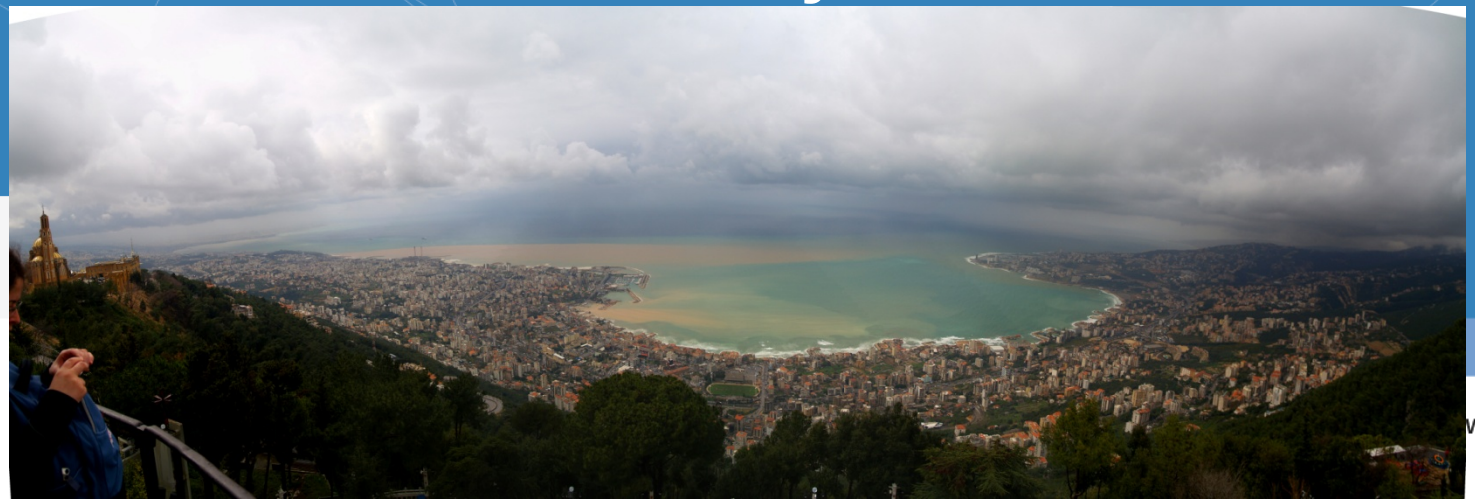

world

Water Control and Management Study for Jordan and Future Options

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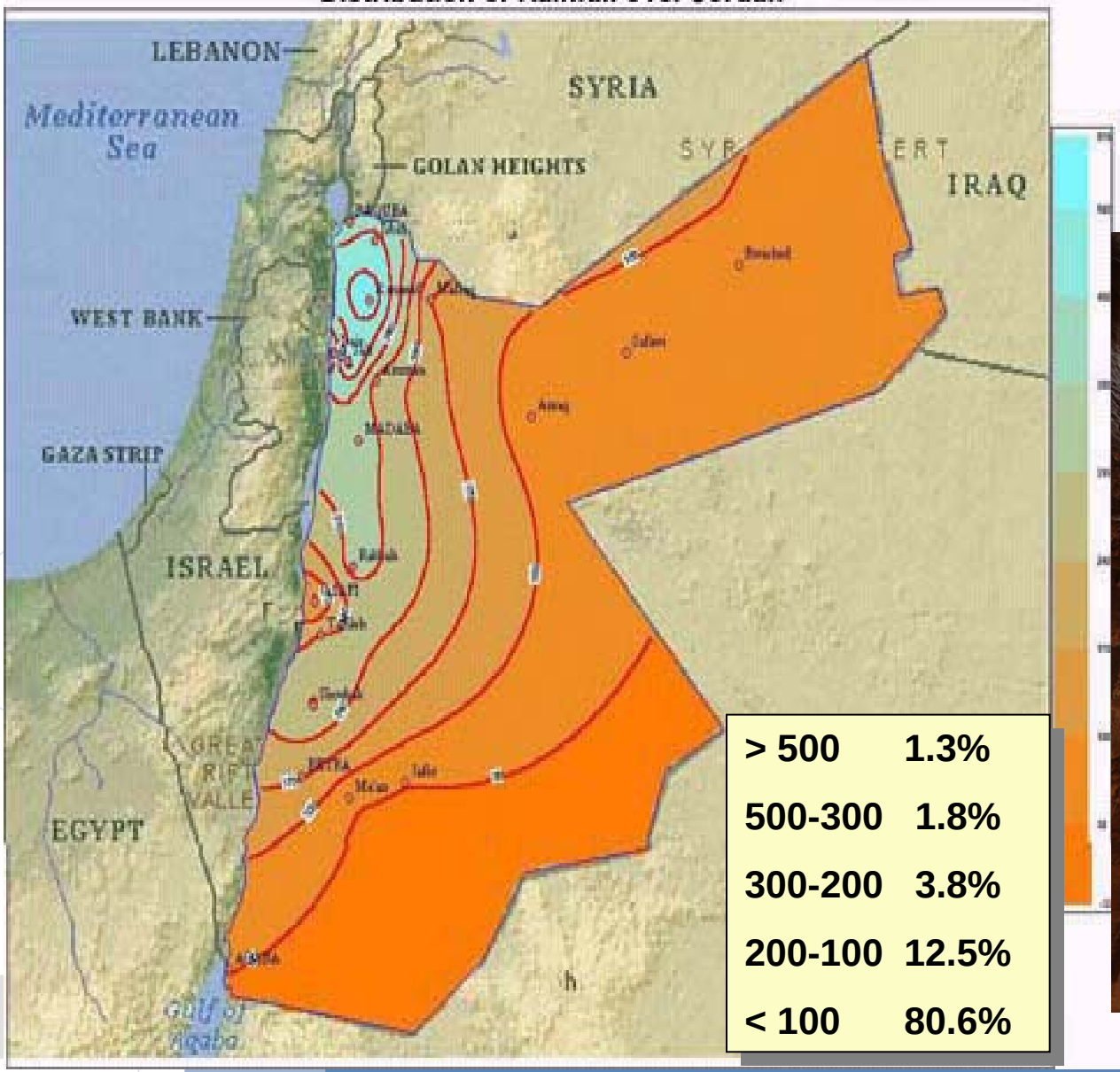
Distribution of Rainfall over Jordan



> 500	1.3%
500-300	1.8%
300-200	3.8%
200-100	12.5%
< 100	80.6%

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Rainfall and Runoff

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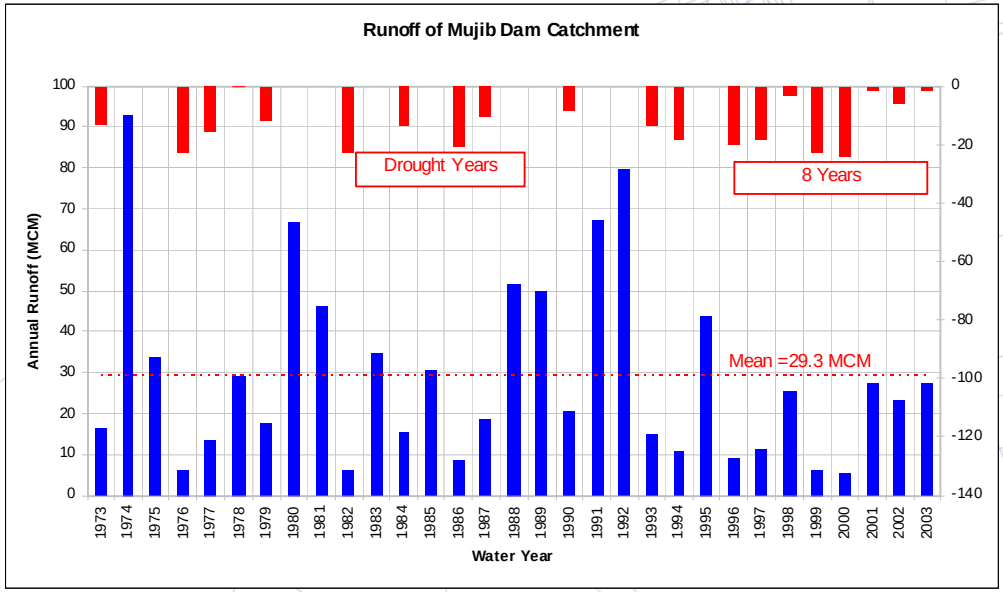
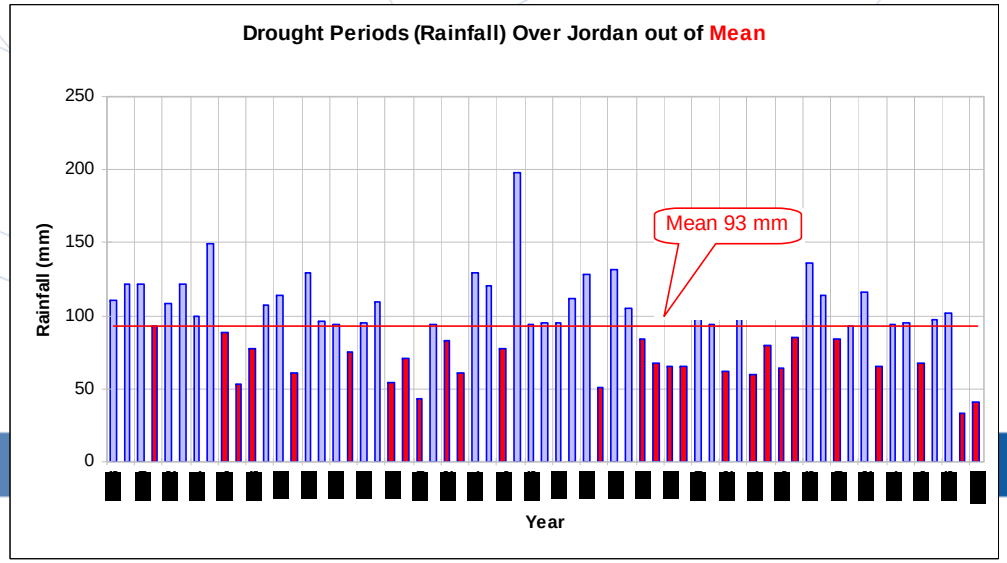




Record Values of Jordan Climate

- Maximum Temp. 48.6 ^{o}C Ghor Safi 5/7/1998
- Minimum Temp. -14 ^{o}C Shoubak 17/1/1992
- Grass Min. Temp. -17 ^{o}C Shoubak 12/2/1975
- 24-hr Rainfall 160 mm Baqura 3/1/1990
- Seasonal Rainfall 1168 mm Ras Muneef 1991/92
- Wind Speed 150 km/hr Ras Muneef 3/2/1992

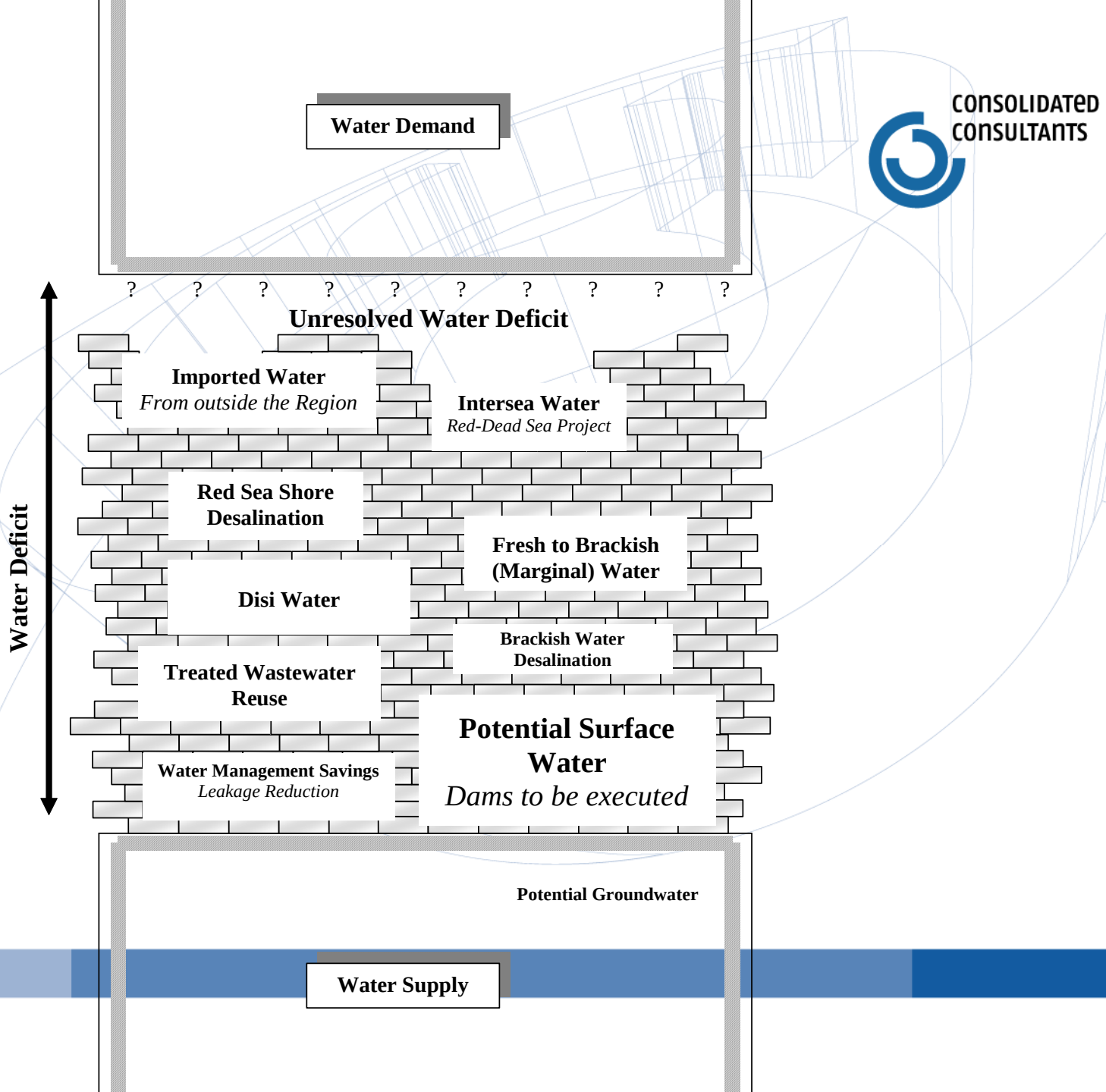
National Water Resources

Development of national water resources will contribute to bridging the water gap but still insufficient to cover the growing water deficit in the region. Therefore additional new water has to be provided to cover the gap which continues to exist even after this development.

Non-Conventional Water Resources

These include water imports from outside the region either by sea or land and desalination of sea water which are the two basic options for supplementing the available conventional water in Jordan and the region. These include:

- Import of water from neighbouring countries by constructing pipelines/canal systems;
- Import of water by sea using tankers or medusa bags; and
- Seawater desalination.


Water Demand
? ? ? ? ? ? ? ? ? ?
Unresolved Water Deficit
Water Deficit
Imported Water
From outside the Region
Intersea Water
Red-Dead Sea Project
Red Sea Shore Desalination
Fresh to Brackish (Marginal) Water
Disi Water
Brackish Water Desalination
Treated Wastewater Reuse
Potential Surface Water
Dams to be executed
Water Management Savings
Leakage Reduction
Potential Groundwater
Water Supply

Assessment Criteria

The following major aspects and implications:

- Technical aspects;
- Economic/financial aspects;
- Environmental impacts;
- Socio-economic implications; and
- Political implications.

A balanced analysis of all aspects that are relevant for each option will be the prerequisite for the assurance of sustainability of potential decisions and projects.

National Water Resources

The options and sub-options represent measures and solutions in order to use all available resources efficiently. Each source was classified as fresh or fresh to brackish according to the quality, considering 1000 ppm (parts per million) as a barrier.

- Development of Surface Water Resources
- Development of Groundwater Resources
- Water Demand Management
- Treated Wastewater Reuse
- Brackish Water Desalination

Water Resources Strategy

The process to propose a country's water resources strategy (Water Resources Strategy issued by Ministry of Water And Irrigation, 1997) includes the following three steps:

- Identifying the locations of the new water resources to be developed as well as those of the existing ones;
- Defining the major demand centres; and
- Studying the conveyance of the surplus water to the deficit areas.

Overall Availability of Developed National Water Supply

(MCM/yr), 2000 to 2040

Resources	Year		
	2000	**2010**	**2040**
Groundwater (renewable and non-renewable)	354	386	482
Surface Water	380	499	574
Treated Wastewater	99	163	523
Brackish Water	2	20 (50)	70
Demand Management	5	15	20
Total	**840**	**1083**	**1669**

Unit Water Costs for the Developed Quantities up to the Year 2040 at 5% Discount Rate

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Local options	Developed/Saved Quantities MCM	Investment Cost MUS $	Unit Cost US $/m^3
Conventional Options:			
- Surface Water	228	663	0.23
- Groundwater*	128	239	0.27
Supply and Demand Management:			
- Rehabilitation Projects & Using Saving Devices	194	306	0.21
- Irrigation Development	63	46	0.28
Treated Wastewater	470	2221	0.52
Brackish Water Desalination	70	450	1.05
Total	**1153**	**3925**	**0.40****

* Including 100 km conveyance around the wells.

** Weighted unit cost according to developed quantity.

Water Demand Planning Assumptions

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Year	2000	2010	2040
Population (Million)	4.95	6.00	14.00
Domestic water use/demand, m^3/c/yr	74	72*	86
Industrial water use/demand, MCM/yr	86	129	170
Irrigation water use/demand, MCM/yr	902	900	900

* The gross domestic demand in the year 2010 was reduced due to reduction of losses.

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Water-Demand,-Supply and Gap for Base Scenario (MCM/yr)

Year	2010	2040
Domestic	488	1209
Industrial	129	170
Irrigation	900	900
Total demand	1517	2279
Supply	1083	1669
Deficit (%) of Demand	-434 (28.6%)	-610 (26.8%)

Unit Water Costs for Three Options

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Option	Sub-option	Quantity MCM/yr	Delivery Point	Unit Cost US $/m³	Total Unit Cost to Amman
Seawater Desalination	Single RO Desal. Plant	50	Med Coast	0.68	0.97
	Red-Dead Intersea	850	Dead Coast	-	1.01
Water Import by Sea	Used Tankers	200	Med Coast	0.83	1.12
	New Water Tankers	200	Med Coast	1.12	1.41
	Large Vinyl Bags	200	Med Coast	0.55	0.84
Water Import by Land	Pipeline from Turkey	150	Lower Jordan River	1.44	-
			Amman	1.65	1.65
		200	Lower Jordan River	1.36	-
			Amman	1.54	1.54
	Pipeline from Iraq	150	Lower Jordan River	0.94	-
			Amman	1.13	1.13

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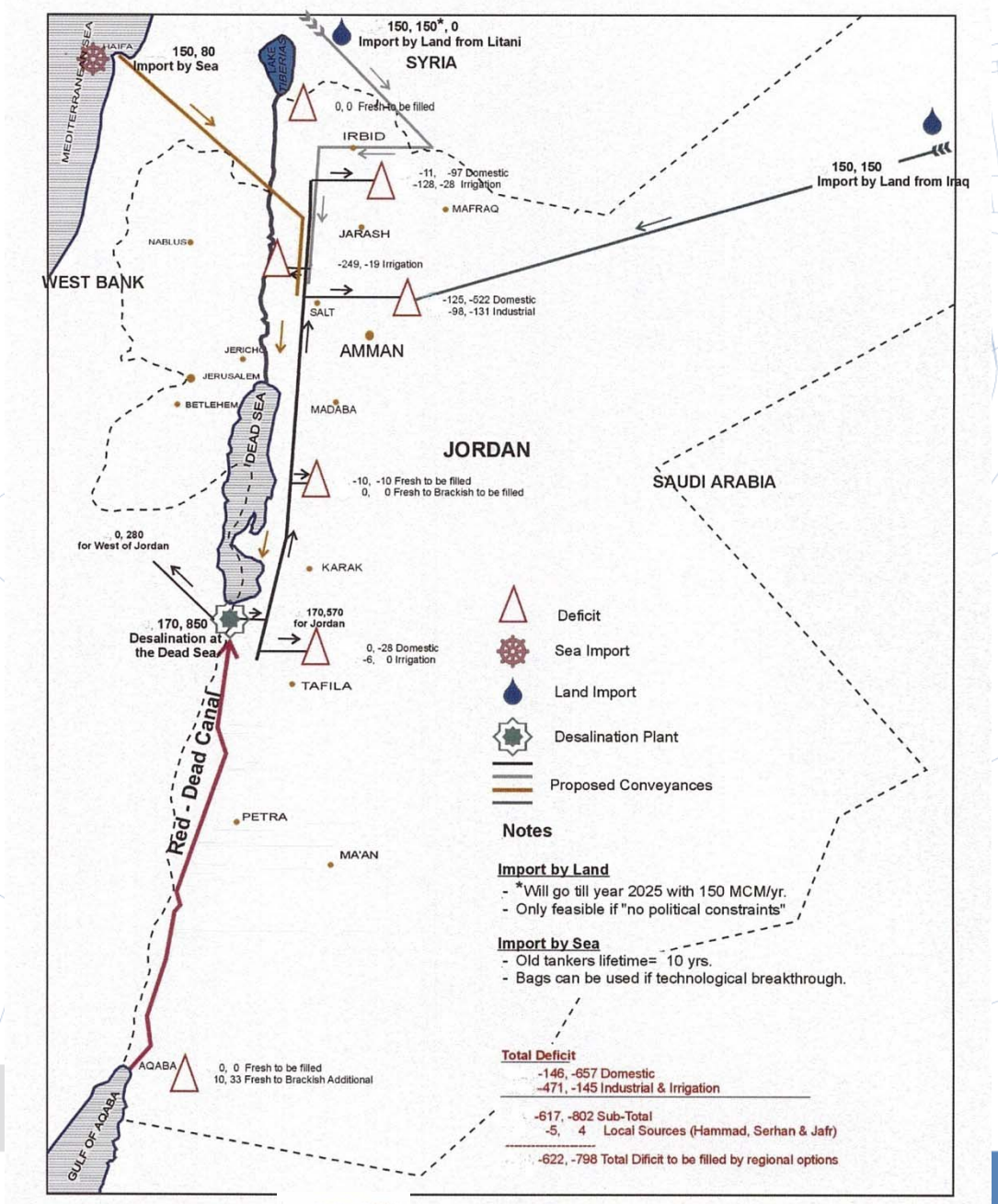

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Deficit and Location of New Developments

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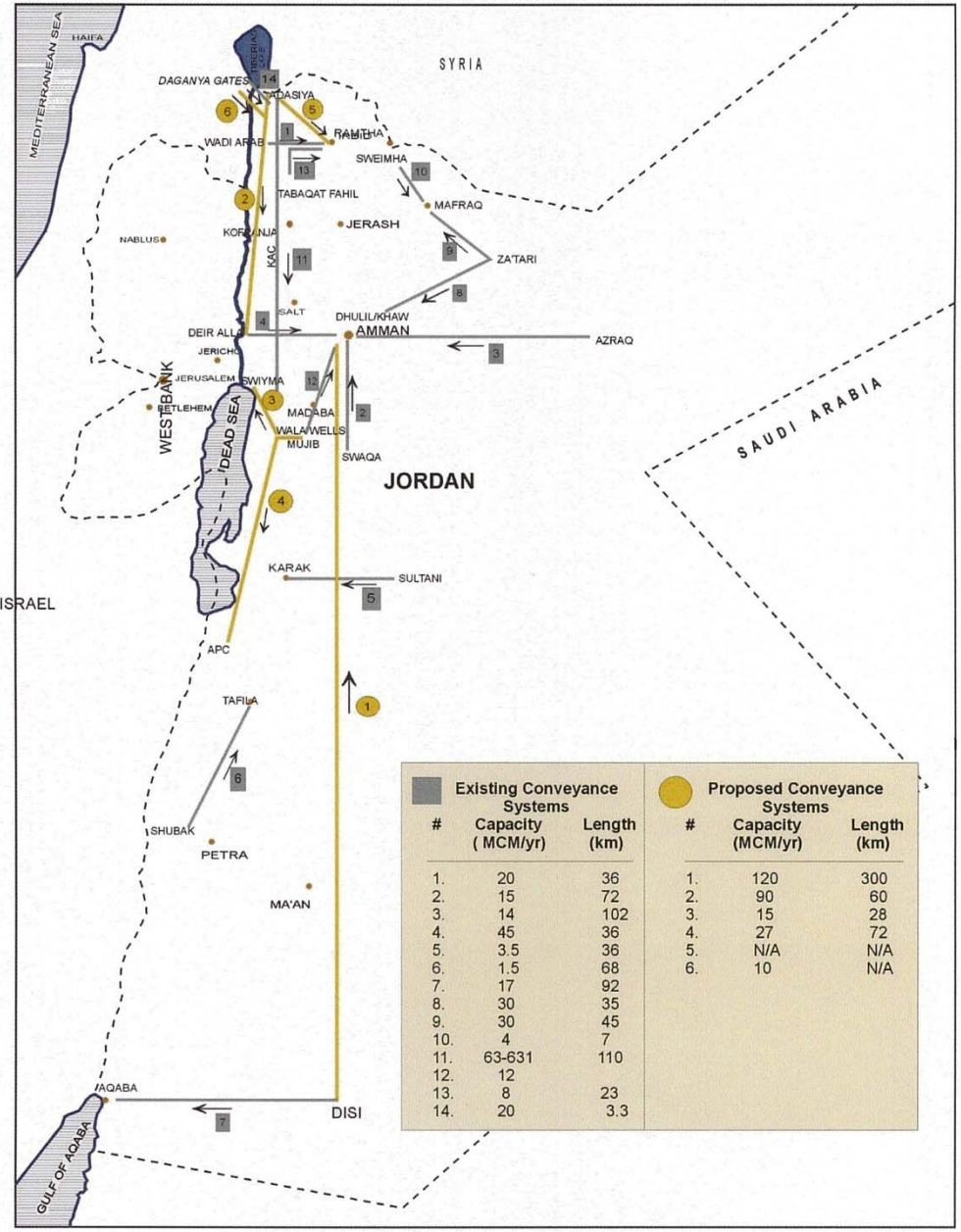

#	Existing Conveyance Systems Capacity (MCM/yr)	Length (km)
1.	20	36
2.	15	72
3.	14	102
4.	45	36
5.	3.5	36
6.	1.5	68
7.	17	92
8.	30	35
9.	30	45
10.	4	7
11.	63-631	110
12.	12	
13.	8	23
14.	20	3.3

#	Proposed Conveyance Systems Capacity (MCM/yr)	Length (km)
1.	120	300
2.	90	60
3.	15	28
4.	27	72
5.	N/A	N/A
6.	10	N/A

Existing and Proposed Conveyance Systems

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Recommendations

- It is of utmost importance to mobilise the required funds to implement the local options. Of special importance for Jordan at this stage is to have the Red-Dead project. It is also recommended to develop seashore desalination plants.
- Updating the regional gap by improving the existing information systems and formulating a regional water information system should be continued.
- It is essential to mobilise the required funds to develop the local water resources in Jordan, in parallel to the regional options.

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Thank You

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