



THE PEACE CONDUIT

The Red Sea - Dead Sea (RSDS) Conduit

**A New Techno-Economic Concept
for a Regional Project with
Jordanian Orientation**

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The Vision

Saving the Dead Sea

Making drinking water available at affordable prices to Jordan, Israel and the Palestinian Authority

Building a symbol of peace and cooperation in the Middle East



The Dead Sea

- **Terminal lake (650 Sq. Km)**
- **Water level 415 meters bellow sea level**
- **Highly saline (more than 30% salts)**
- **Declining water level (more than one meter annually)**



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The Dead Sea Annual Water Balance

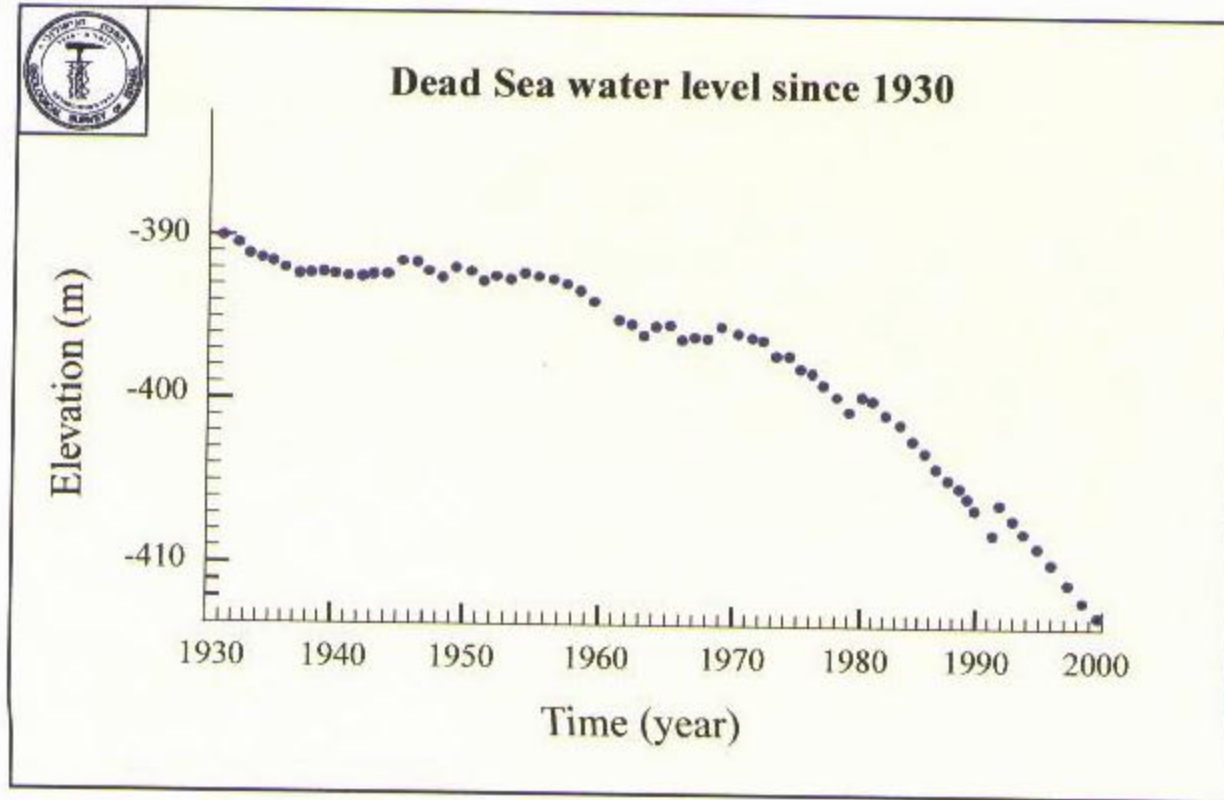
Inflow	-	400 MCM/yr
Outflow (Evaporation)	-	1,050 MCM/yr
(including the industrial operations net effect on evaporation)		
Net effect		Minus 650 MCM/yr

MCM – Million Cubic Meters

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The Dead Sea water Level



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The Dead Sea Surface Area

1950	950 Sq. Km (-390)
1975	800 Sq. Km (-398)
2000	640 Sq. Km (-414)
2020	565 Sq. Km (-434)

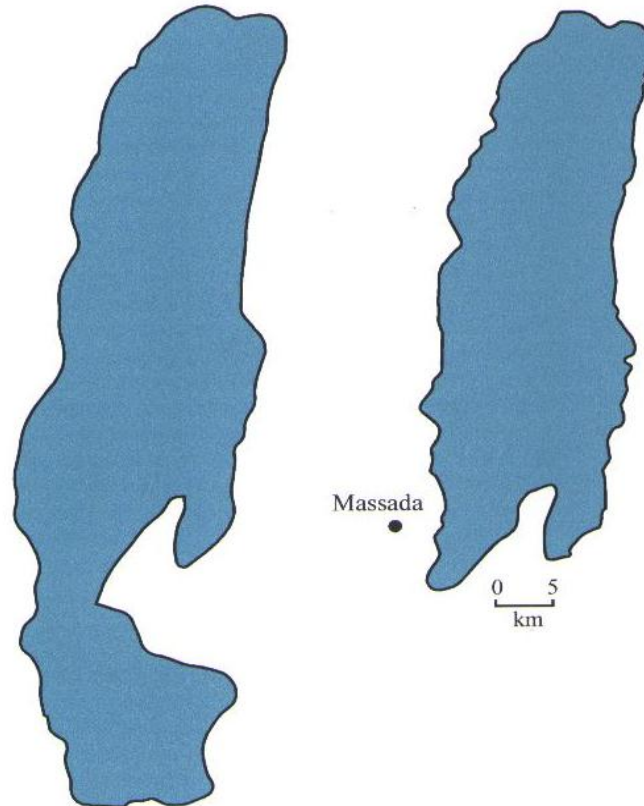
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The "Dying" Dead Sea

Beginning of the century:
Dead Sea Level: -390 m
Surface area: 950 km²
Volume: 155 km³

Today:
Dead Sea level: -414 m
Surface area: 640 km²
Volume: 130 km³





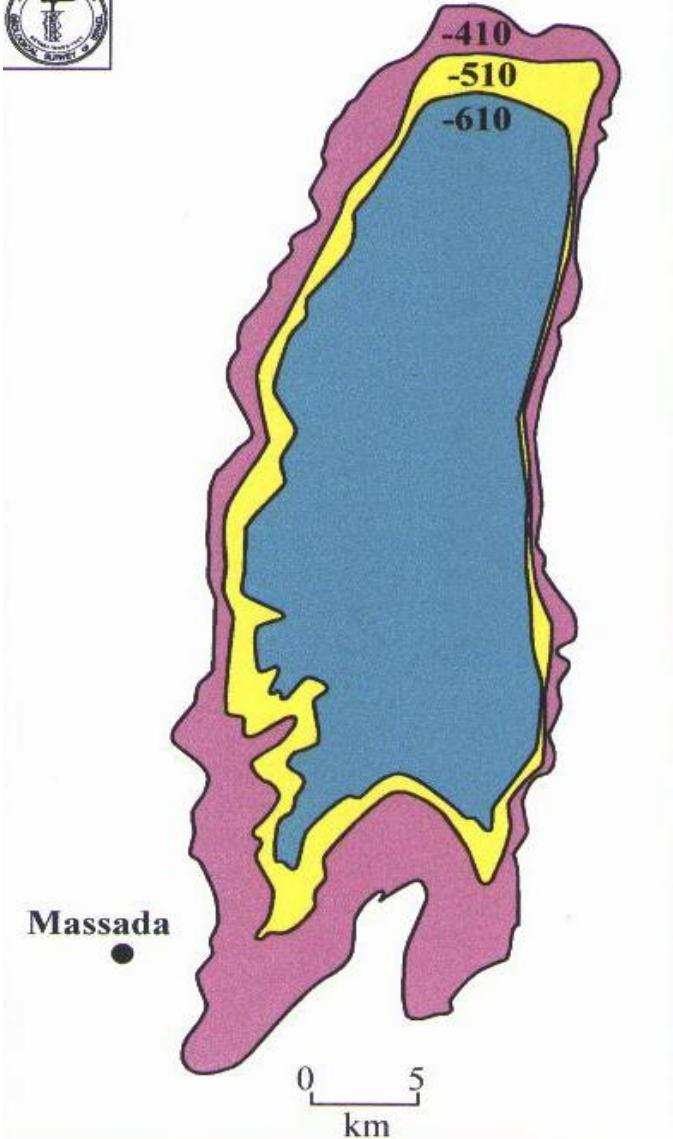
Changes in the Dead Sea Region

- **Receding seashores with resulting decrease in tourism potential**
- **Destruction of natural landscapes**
- **Decline in the level of underground water**
- **“Sink holes” - with resulting damage to infrastructure**

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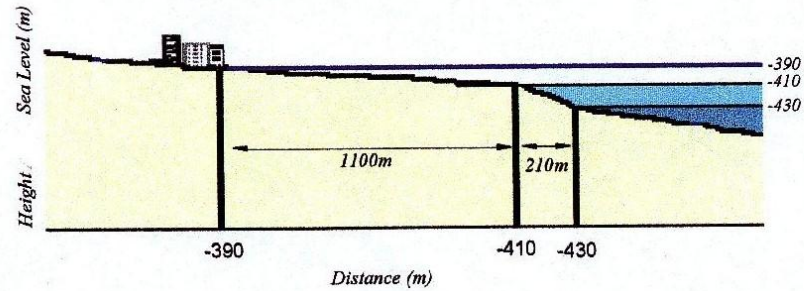
The Dead Sea Shores



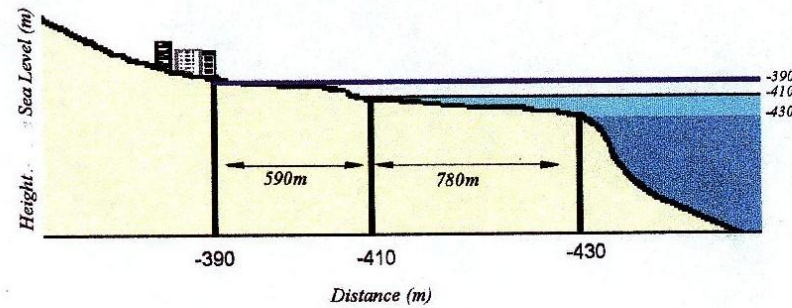
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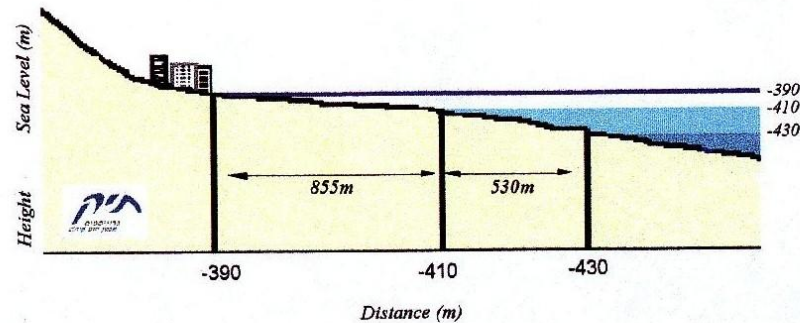
Receding Sea Shores



Kalya



Kidron



Mazor



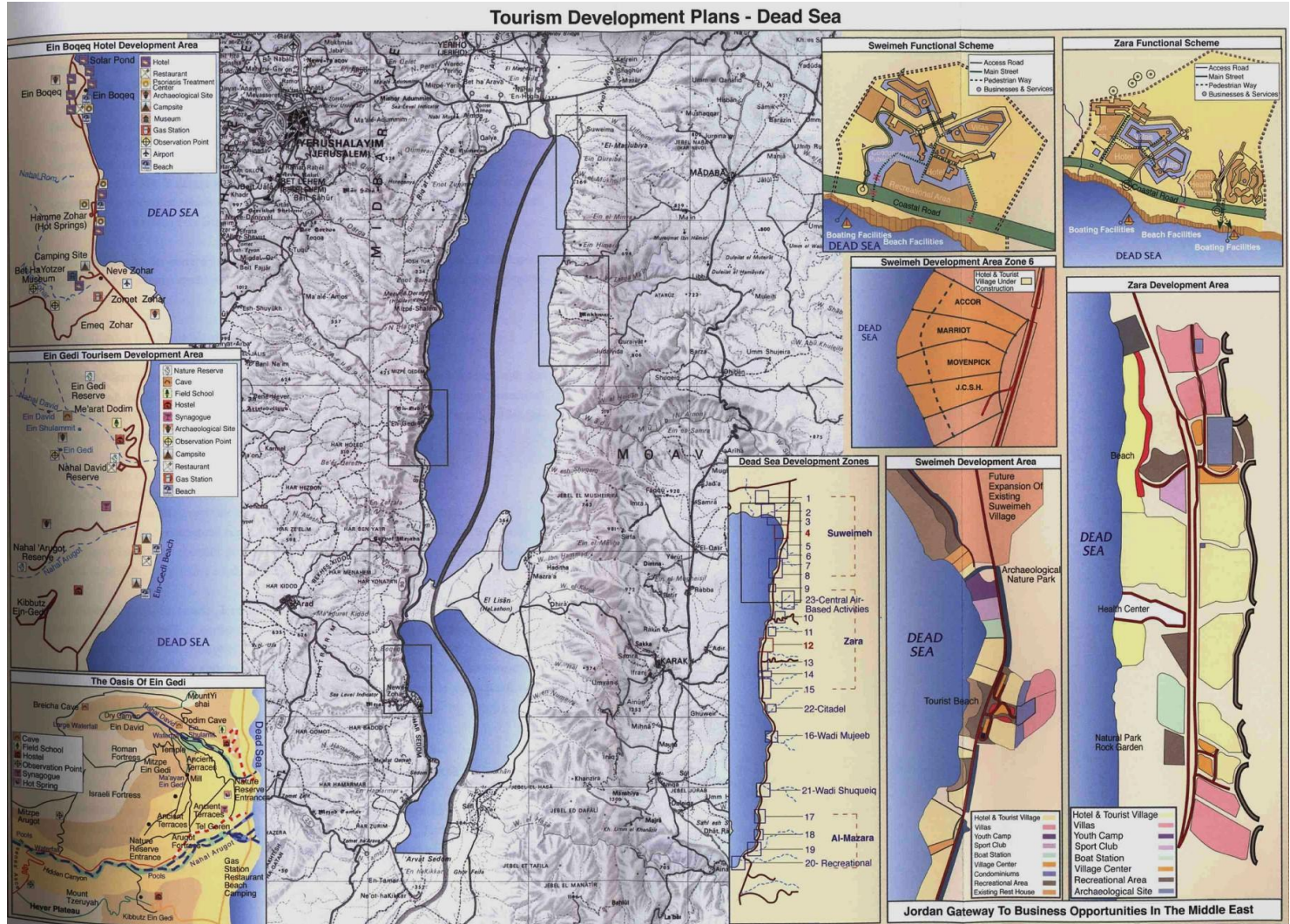
The Dead Sea Tourism

- **2000**
 - **4,500 Hotel Rooms**
 - **Visitors – 1.5 million**
 - **High room rates - \$80 per night and high occupancy rate - 70%**
 - **Employment - 4,500 workers**
- **2020 – Planned:**
 - **High – 40,000 rooms**
 - **Medium – 20,000 rooms**
 - **Employment - 20,000 workers**

Tourism Development Plans



Tourism Development Plans - Dead Sea



▶ The Objectives

Restore the natural environment

Provide a sustainable environment for tourism development

Maintain the working environment of the Dead Sea chemical plants

Exploit the natural head difference (400 meters) to desalinate seawater and produce energy



Project Configuration

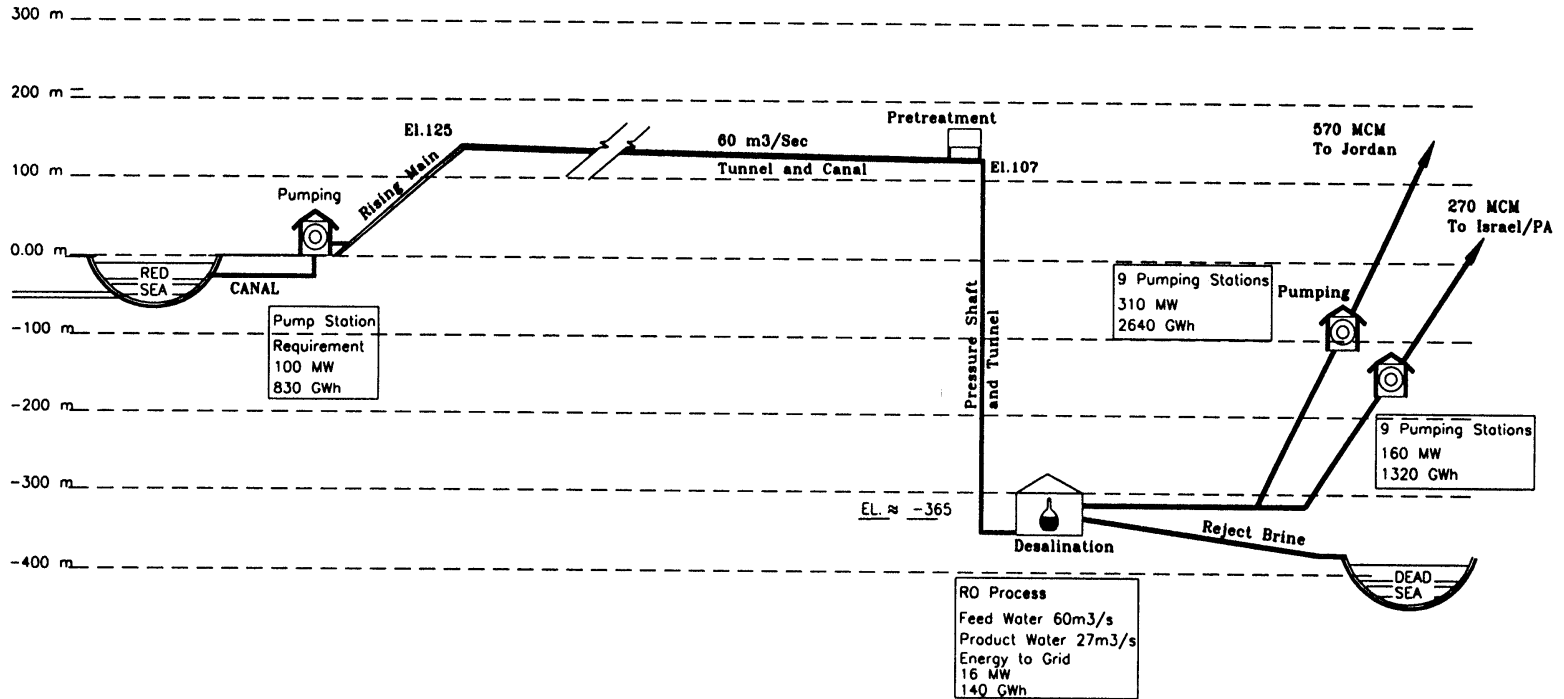
- **The Red Sea - Dead Sea Conduit**
- **Desalination/Power plants**
- **Fresh Water Conveyance system**



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RSDS Conduit Schematic

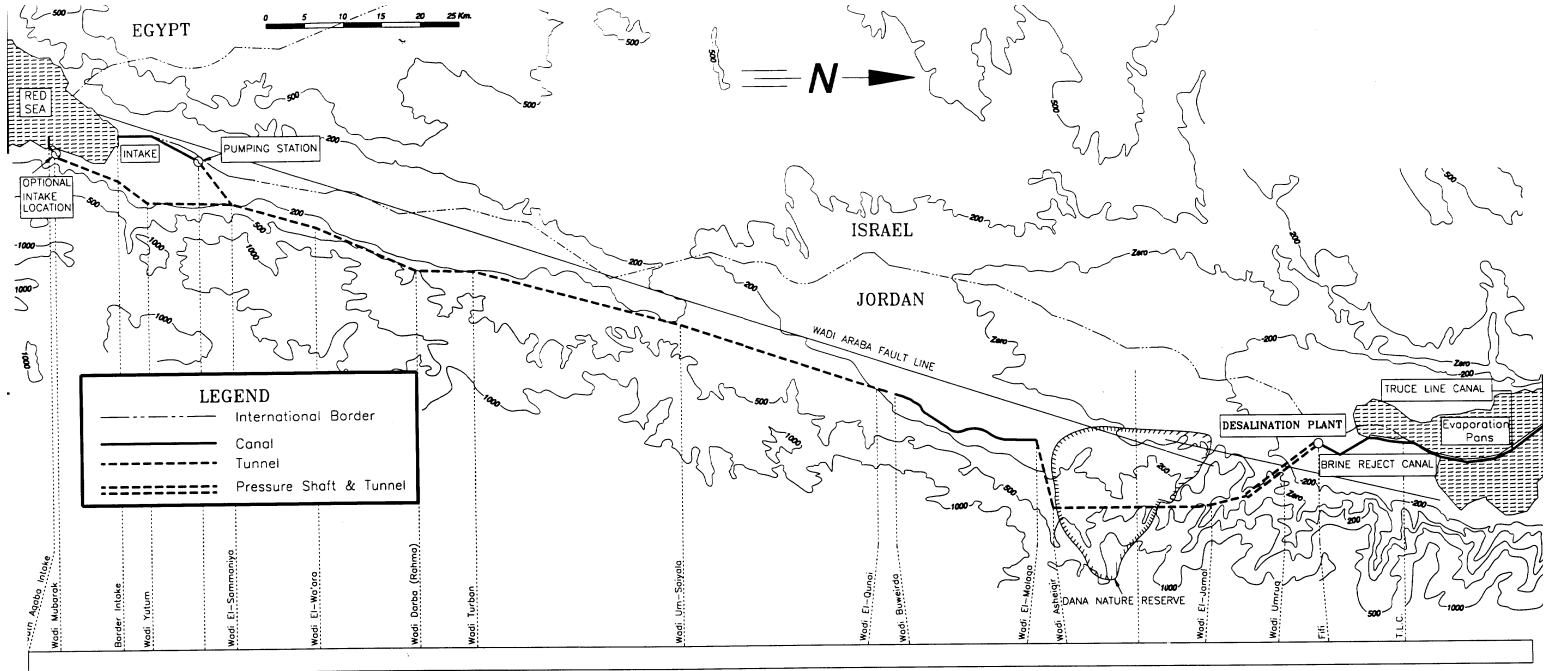
Final stage



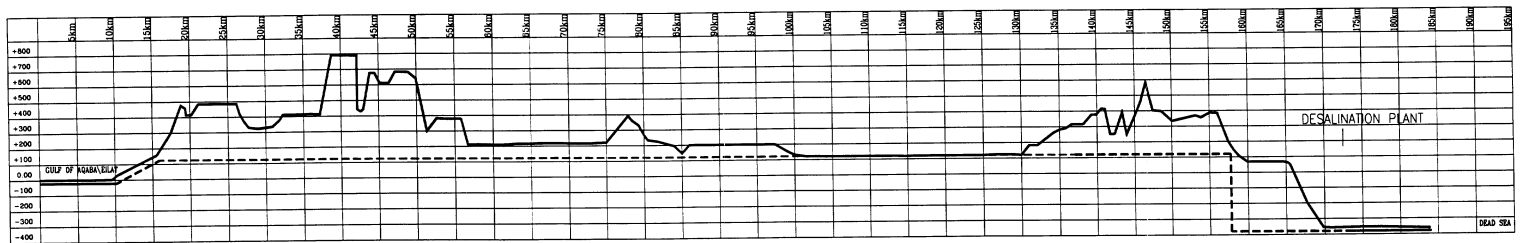
The HARZA JRV Group
 Jordan Rift Valley Integrated Development Study
 Red Sea - Dead Sea Canal Project
 RSDSC PROJECT SCHEMATIC

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Schematic Plan and Profile



PLAN VIEW



PROFILE

— CANAL
 - - - TUNNEL or PRESSURE CONDUIT

The HARZA JRV Group

Jordan Rift Valley Integrated Development Study
 Red Sea - Dead Sea Canal Project
 PLAN AND PROFILE
 REPRESENTATIVE PROJECT ALIGNMENT



The Red Sea Dead Sea Conduit (Schematic)

	Km	%
Rising Main	5	3
Tunnel/Pipes	121	67
Canal/Pipes	39	22
Penstock	5	3
Shaft and Tunnel	10	5
Total	180	100

Physical Characteristics of the Red Sea Dead Sea Conduit

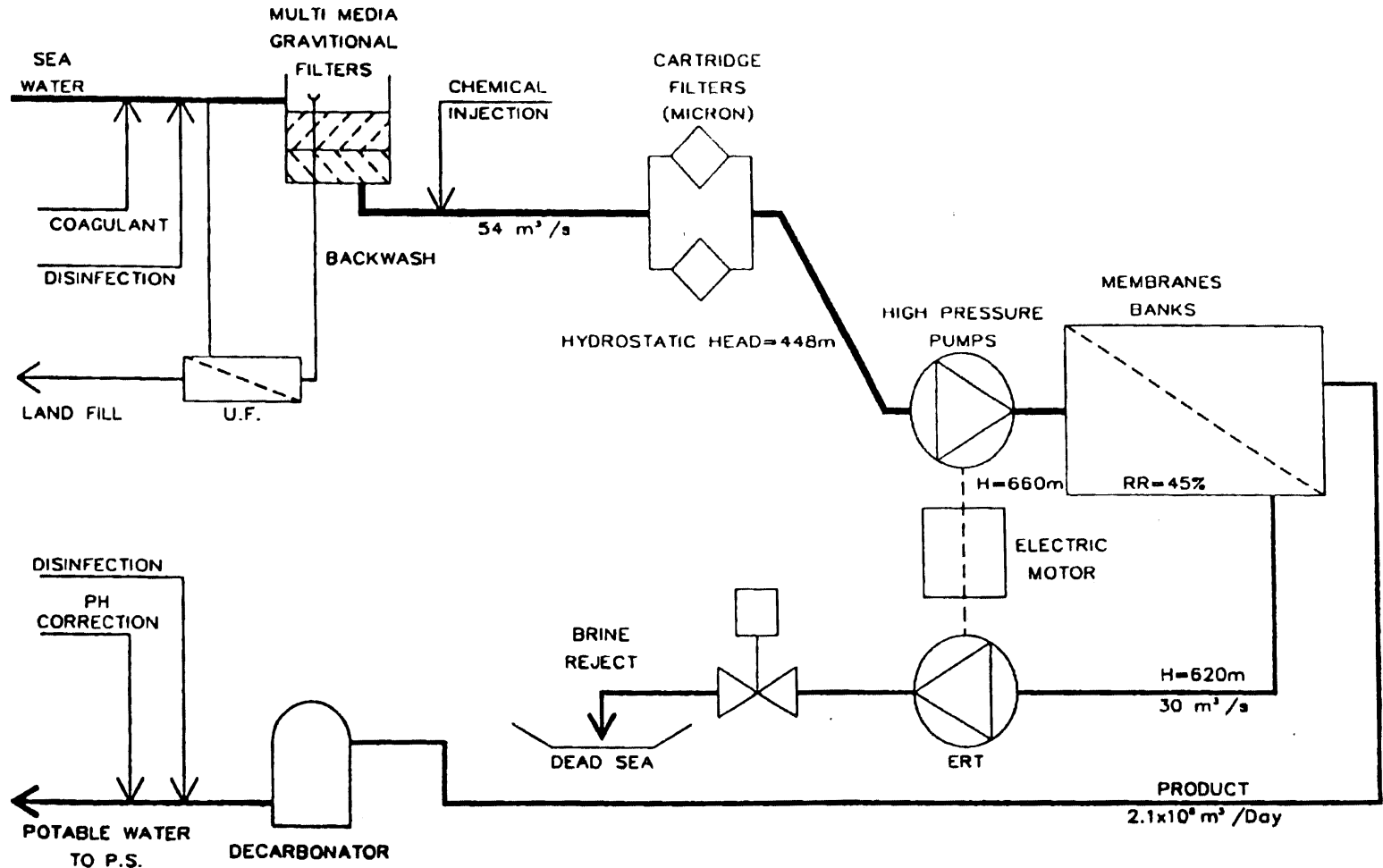
Final stage

Design Flow, Cubic meter/second	60
Pumping Head at Red Sea (Static), m	125
Rising Main Diameter, m	4.3
Free Flow Tunnel Diameter, m	8.0
Canal water Depth, m	2.9
Penstock Diameter, m	5.0



Desalination & Conveyance (1)

RO Desalination - Flow Chart – Final stage



Desalination & Conveyance (2)

- The desalination facility is a hydrostatically assisted Reverse Osmosis (RO) plant. The head is 448 meters.
- The facility will be built in stages according to demand development
- Total annual output (fresh water):
 - Stage I 100 MCM/yr
 - Stage II 350 MCM/yr
 - Final Stage 850 MCM/yr



Desalination & Conveyance (3)

Fresh water supply (annual MCM):

	<u>Stage</u>	<u>Stage I</u>	<u>Stage II</u>	<u>Final</u>
Amman	-	100	250	600
Dead Sea, Negev and Hebron mountains	-		100	250



Total Investment in Main Facilities

(\$ Millions)

Facility	Initial Stage	Stage I	Stage II	Final Stage
Conduit	550	- -	800	1,770
Desalination	-	250	620	1,380
Conveyance	-	200	930	2,060
Total	550	450	1,900	5,210



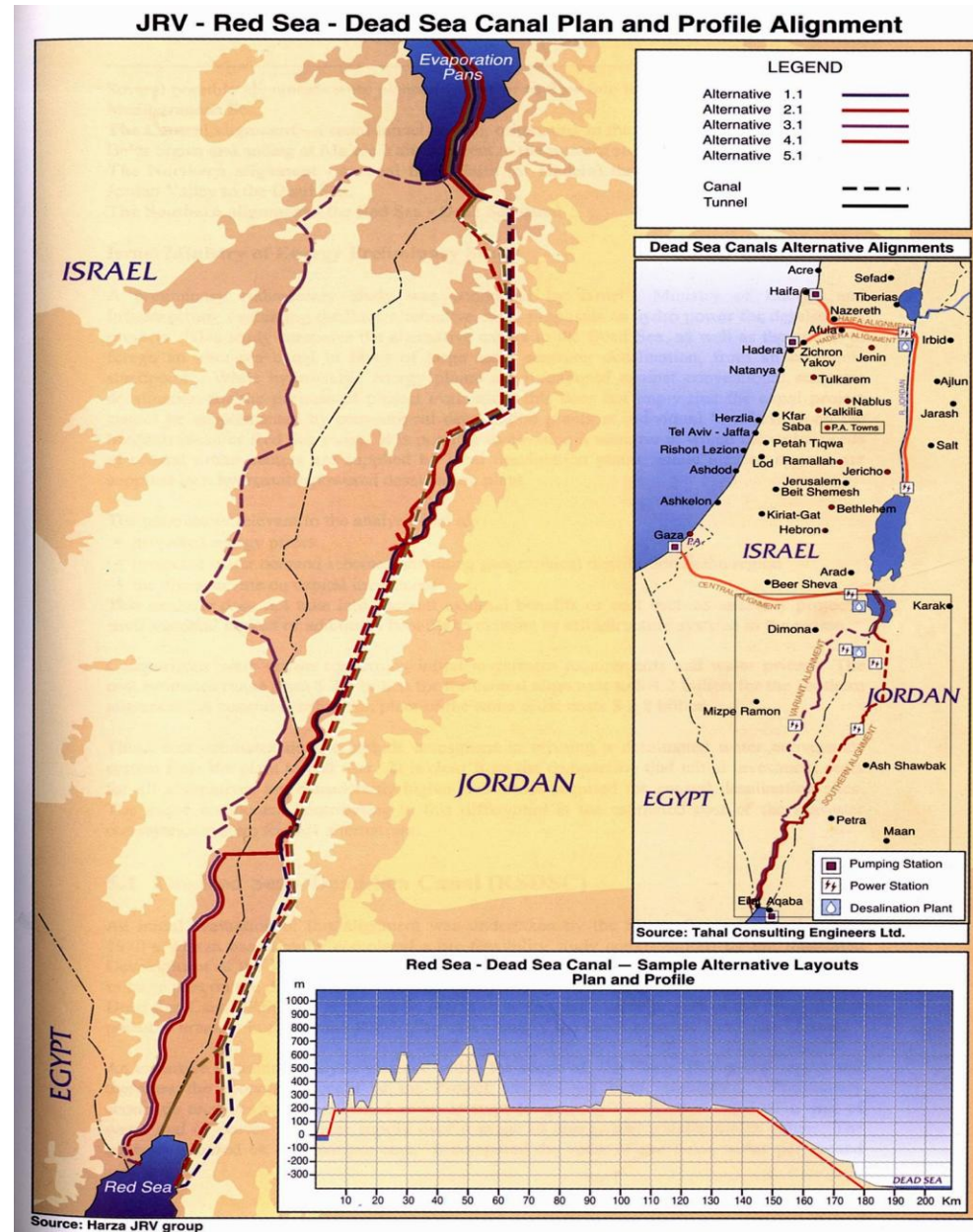
Capacity of Main Facilities (Millions of Cubic Meters)

Facility	Initial Stage	Stage I	Stage II	Final Stage
Conduit	650	650	1,200	1,900
Desalination & Conveyance Sea Water & Brine	-	100	350	850

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Alternative Alignments

- The Red - Dead option is selected for political and financial reasons
- The implementation of the RSDS Conduit does not exclude other conduits



Evaluation (1)

The dual objectives and sets of benefits

- **Saving the Dead Sea – Generating environmental and tourism benefits to cover the cost of the Red Sea Dead Sea Conduit**
- **Making drinking water available in Amman at a cost of one dollar per cubic meter (lower than the alternative cost of water in Amman in the year 2020)**

Evaluation (2)

- **Construction of the Conduit is technically feasible and the desalination technology proven**
- **The working environment of the Dead Sea chemical plants can be maintained by careful planning of the project**
- **The project offers better solutions to the Dead Sea problems and the provision of fresh water to Amman than Desalination at Aqaba and the Mediterranean**

Evaluation (3)

- **The Red Sea Dead Sea Conduit will be financed by donor countries. It will be built and operated by the private sector.**
- **The desalination/power plants and conveyance of fresh water will be built, operated and owned by the private sector.**

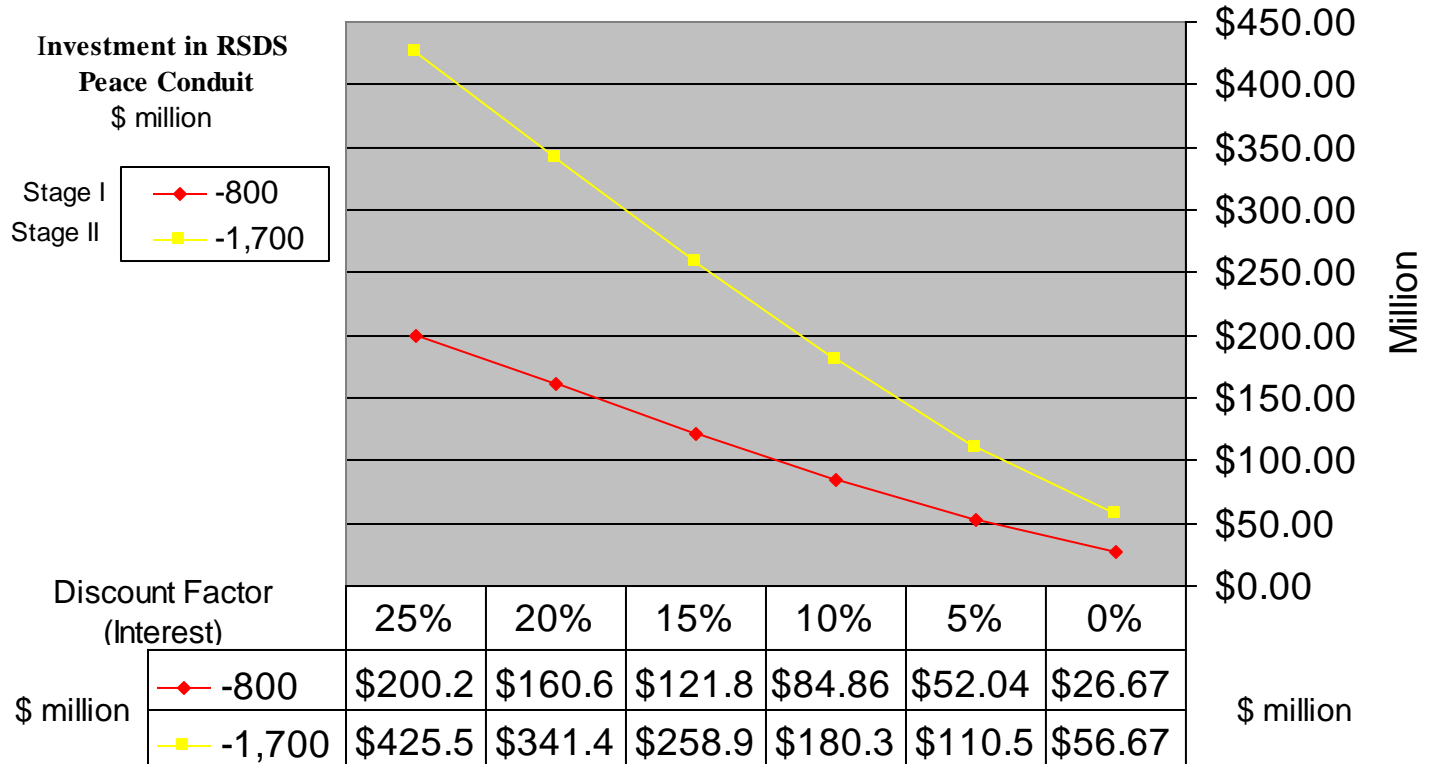
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The Red Sea Dead Sea Conduit

Capital Recovery Factor
(Annual Payment of Capital & Interest)

30-years



Evaluation (4)

The Economics of the Red Sea Dead Sea Conduit:

Save the Dead Sea Option (pipeline)
(650 mill. CM sea water per year)

•Investment \$ 500 - \$ 600 million

•Annual Capital Charges

(30 years, 1% interest) \$ 20 - 25 Million

•Operating Costs \$ 25 million

Total annual costs to be covered by user fees
(tourism & industry) \$ 45-50 million





Evaluation (5)

The potential annual financial contributions of tourism and industry to the the Red Sea Dead Sea Conduit can be:

- **\$50 million from \$5 fee on overnight use of 20,000 hotel rooms and/or infrastructure fees on hotels**
- **\$30 million from industry for the Dead Sea water (Royalties?)**
- **\$10 million from entrance fee to the Dead Sea Park (the Lowest Park on Earth**

The Capital costs of the Red Sea Dead Sea Conduits (30 years loan with 10% interest) can be covered



Potential Modifications (1)

- **Building only the Red Sea Dead Sea Conduit (saving the Dead Sea) with an investment of \$ 500-600 million**
- **Optimizing over time the triple objectives of filling the Dead Sea, seawater desalination and power generation**
- **Improvements in Conduit design and alignment**



Potential Modifications (2)

- **Extending the Red Sea Dead Sea Conduit from the southern part of the Dead Sea to the northern part of the Sea to reduce transport costs of water to Amman and avoid the possible negative affects of the brine discharge on the production process of the chemical plants in the south.**

What is Next? (1)

1. Studies:

- **The implications of the decline of the Dead Sea level**
- **The long term affects of the mixing of the Dead Sea and the Red Sea waters**
- **Modifications of the project concept, the Red Sea Dead Sea Conduit design and alignment**
- **Economic and financial analysis**
- **Full feasibility of the new concept**

What is Next? (2)

2. Soliciting International Support and Private Sector's Interest

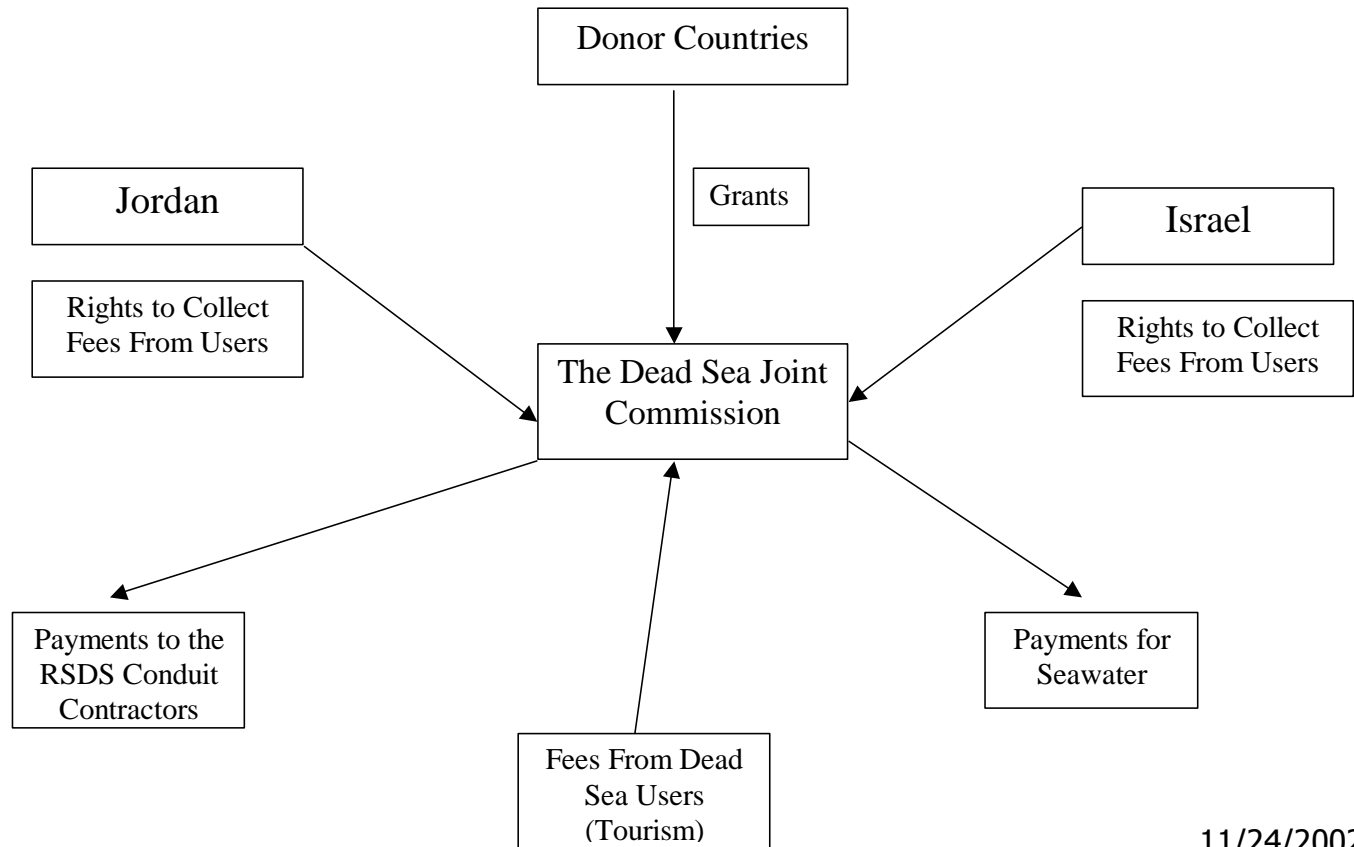
- **Governments**
- **Financial Institutions**
- **Contractors and Private operators**

3. Establish the Regional Regulating Body

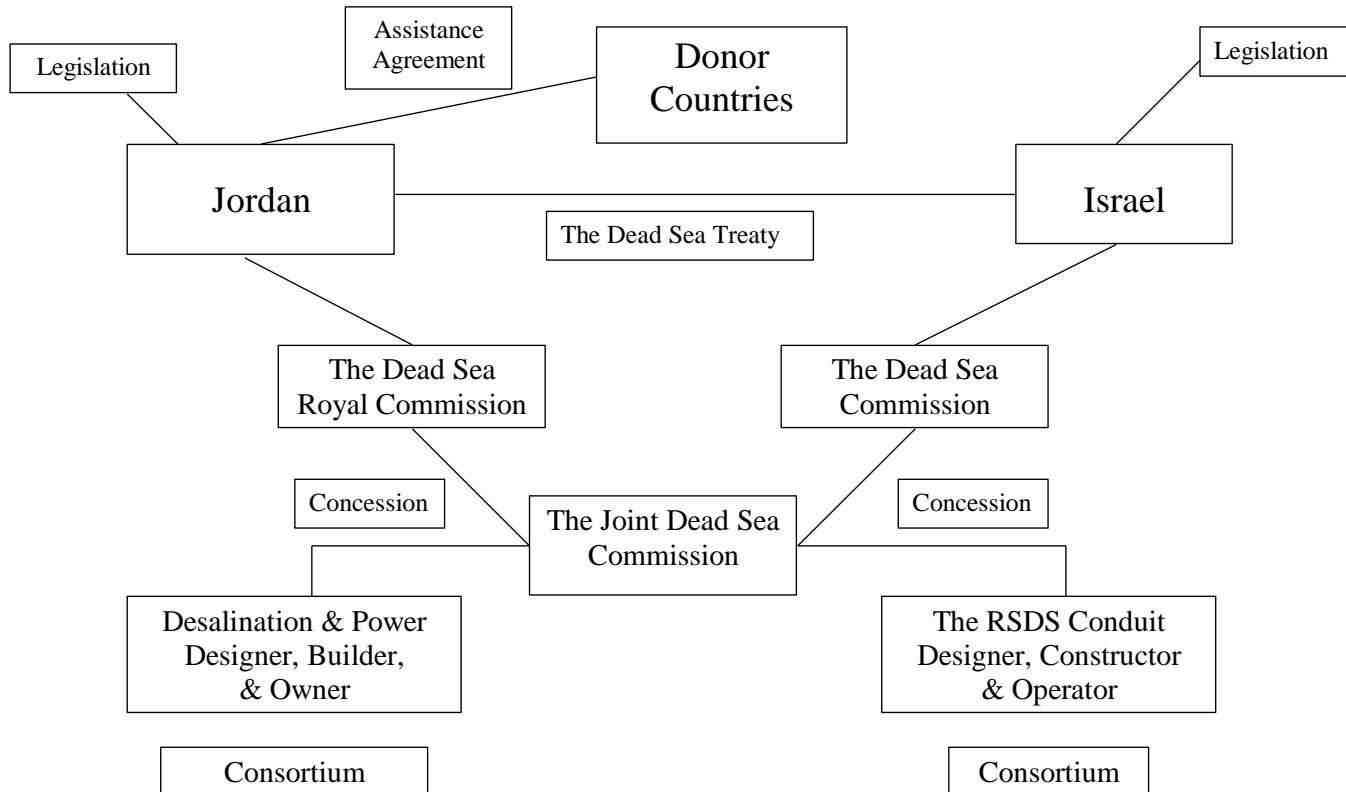
The Dead Sea Commission (DSC)



An Organizational Structure for the Implementation of the Red Sea Dead Sea Conduit Project (1)



An Organizational Structure for the Implementation of the Conduit Project (2) The Dead Sea Commissions



A List of Implementation Steps (1)

- *Establish a joint official working group to reach an agreement on the concept and how to implement it, including needed studies.*
- *Establish an international committee to support the efforts to save the Dead Sea.*
- *Convene an international donors' meeting on the financing of the "Red Sea Dead Sea Conduit"*
- *Initiate a formal invitation for potential promoters to submit plans on how to build and finance the project (RFI).*

A List of Implementation Steps (2)

- *Prepare a treaty between Jordan and Israel which will lay down the legal, financial and administrative bases on which the two countries will cooperate.*
- *Establish the two national Dead Sea Commissions and the Joint Commission.*
- *Prepare the legal underpinnings for the Joint Commission and the concessions.*
- *International tender for the project and/or its parts*

Environmental Issues (1)

Environmental Issues:

- **Changes in Dead Sea compositions:**
 - Gypsum Crystallization
 - Halite Precipitation
 - Hydrogen Sulfide Production
 - Brine Stratification
 - Weather Changes
 - Phosphate presence & Algal & Bacterial Bloom
 - Upper layer water dilution
 - Trace metals presence
- **“All changes have little practical significance for the environment” (Harza Report based on the Geological Survey of Israel Reports)**

► Environmental Issues (2)

- **Some of the issues may have practical significance on the Dead Sea chemical works. Mitigating steps can be designed.**
- **The issues need further study and the building of a dynamic limnological model is essential before detailed design of the project.**
- **The Red Sea Dead Sea Conduit can be damaged by seismic shocks with resulting possible contamination of the Arava aquifers. The damage can be minimized by adoption of seismic criteria for construction. (Harza Report & The Geological Survey of Israel)**

