

Risk Assessment, Uncertainty and Decision Making for the Application of Nanofiltration Membranes for Water Desalination

Application to the Red-Dead Project

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Introduction

Goal: To provide the population with pure water

Material:

Nanofiltration reverse osmosis membranes

Method:

Applying pressure to saltwater,
forcing fluids through very fine membranes.

Introduction

Technology use:

Removal of dissolved salts from salty water

Removal of micro-pollutants

Water softening

Wastewater treatment

Benefits:

Reduced energy use

Reduced cost of desalination by 25%+

Introduction

The Reverse Osmosis (RO) technology is considered one of the most environmentally friendly options for desalination plants.

But there is not enough information about the impact of replacing the existing membranes with nanofiltration membranes.

Planned Application

Several companies have introduced plans to use nanofiltration technology in the desalination plant of the Red-Dead Project.

The project is currently in the feasibility study stage.

If materialized, this will be the world's largest desalination plant.

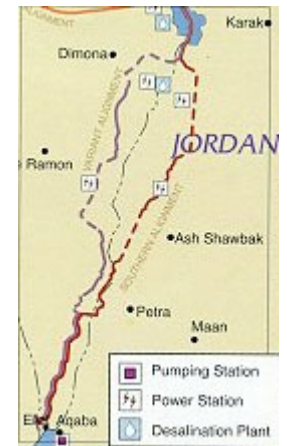
The Red-Dead Project

A Canal between the Red Sea to the Dead Sea

Transfer 1,900 mcm/year of water from the Gulf of Aqaba to the Dead Sea.

A joint Jordanian Israeli project.

Cost: \$4 billion;
time frame: 10 years.



Motivation for the Project

- The Jordan River is the main water source in that Jordan valley region
- Demand for water in the region is higher than renewable supply
- The water from the Jordan River is diverted for irrigation and drinking water
- Result: The Dead sea is drying up – has lost over 1/3 of its surface area over the past 20 years. Without action, will dry up completely in 50 years.

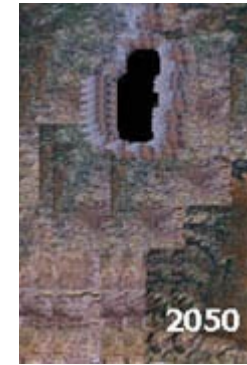
The Dead Sea



1960



2000
The southern
basin has
dried up



2050
Forecast
if nothing is done

Project Outputs

- Desalination plant (reverse osmosis)
- Water carrying capacity: 2 billion cm/year
- Increase in freshwater availability: 850 mcm/year
- Hydro-electric plant (400 meters differential in elevation) 550 megawatts of power

Benefits

- Stop the fall in water level
- Prevent future environmental damage
- Encourage economic growth in the region
- Encourage tourism in the region
- Help the potash works industry
- Increase freshwater supply
- Increase renewable energy supply
- Increase peaceful cooperation in the region!

Environmental Problems

- Pumping water out of the Red Sea could damage the coral reef and local ecosystem
- Mixing water from the Red Sea into the Dead Sea could cause algal growth and damage local species in the Dead Sea
- Environmental damages associated with desalination projects

Potential additional impacts of using nanofiltration membranes

A Multi-Disciplinary Model for Water Supply Planning

An integrated regional planning, economic, hydrological and technological decision-making model.

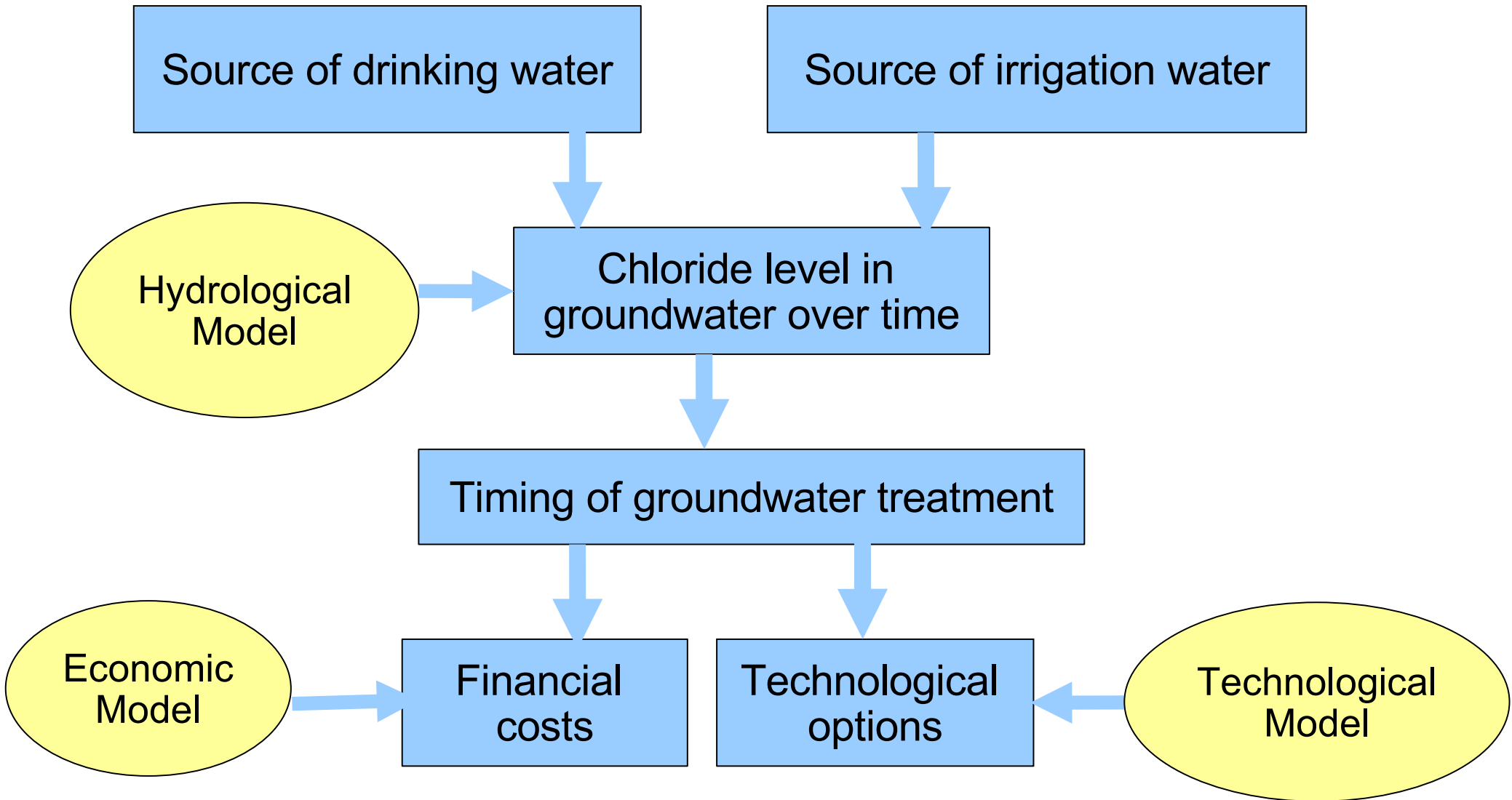
Assessment of the benefits, costs and impacts of different alternatives of water supply.

Goal: to plan the optimal combination and timing of water supply from different sources, including water supply through desalination and wastewater treatment.

The Model Inputs

- **Regional planning:** area allocations, demand for water, water sources
- **Hydrological information:** pumped water, chloride and water balances, forecasts of levels, groundwater salinity, maximum permitted salinity
- **Technological information:** desalination and other treatment processes
- **Economic model:** required quantity of water, total costs of water supply and treatment

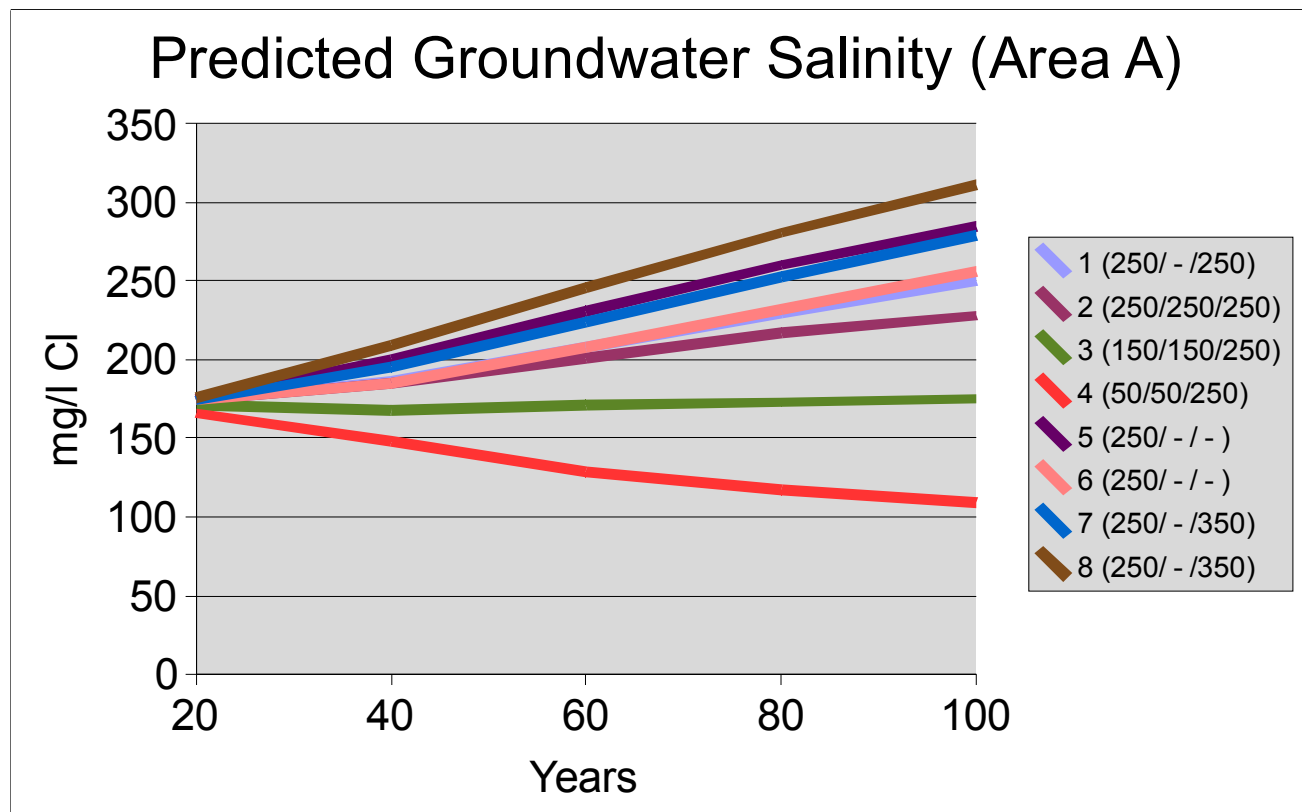
The Model



Results

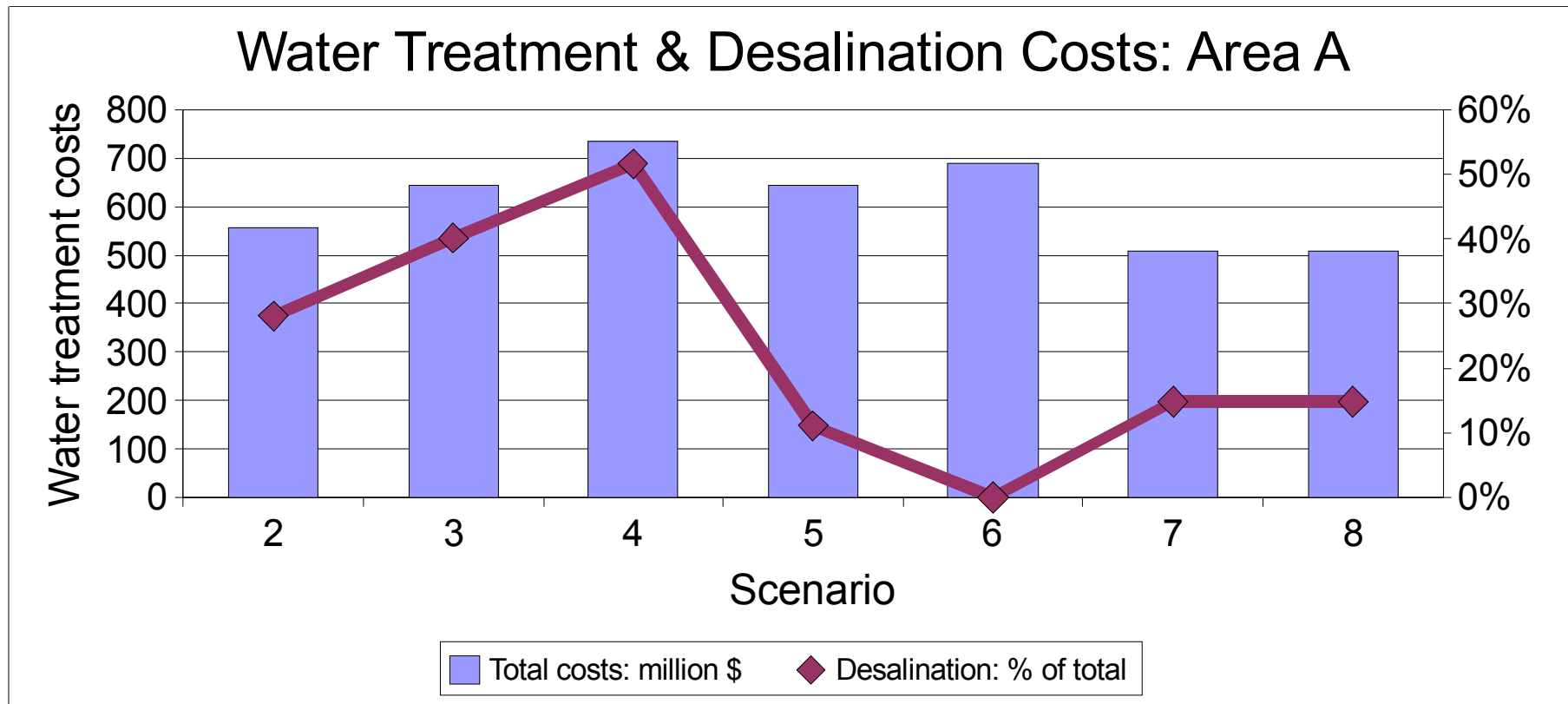
Application to Hydrological Cells in Israel

Eight scenarios of policy regulations and technology applications. The predicted increase in aquifer salinity by scenario: Salinity level lower in scenarios with greater restrictions



Economic Results

Irrigation with wastewater increases salinity -
increases desalination costs; decreases the total cost of water supply
Greater restrictions increase costs significantly



Application to the Red-Dead Project

Optimal decision making should incorporate the relevant regional planning, hydrological and technological aspects, and take into account the social, economic and environmental impacts of different alternatives under varying scenarios.

The **multi-disciplinary model of water planning** described here provides a skeleton for building a larger-scale model that will analyse the Red-Dead project.

Integration of nano-filtration technology – done at the technological model level, as part of the description of the desalination alternatives.

Because of the large scale of investment involved – important to carry out the assessment at the feasibility study stage.

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