The Disi-Amman Water Conveyance Project

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&

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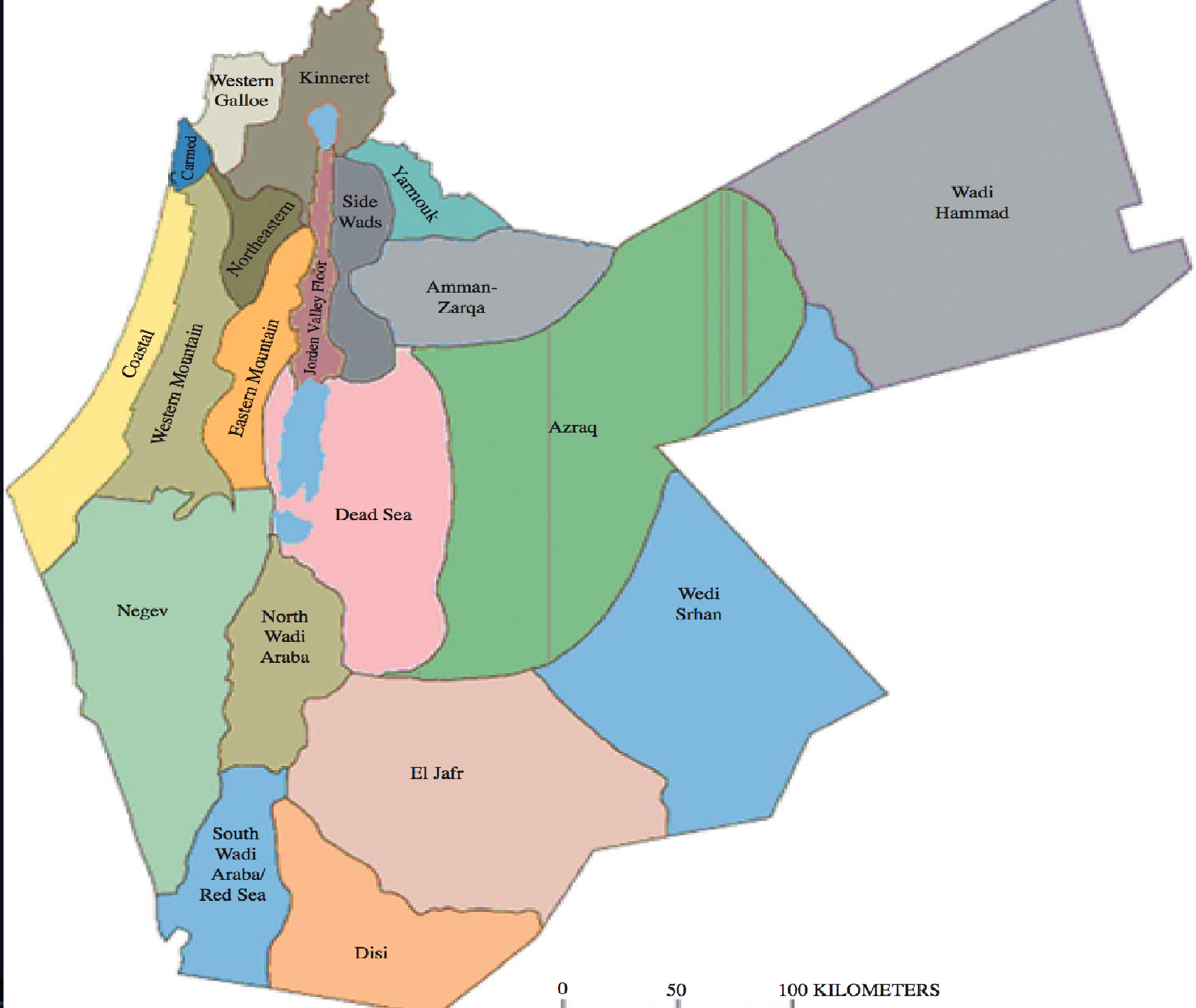
Jordan needs more water!

- Projected deficit of 1200 mcm/yr by 2015
- Utilization of unconventional resources such as the Disi Aquifer will be necessary to reduce this gap


al-Disi
Aquifer
TURKEY
Ankara
GREECE
Athens
ARMENIA
AZERBAIJAN
Yerevan
Baku
TURKMENISTAN
Ashgabat
CYPRUS
Nicosia
Mediterranean Sea
SYRIA
Aleppo
Beirut
LEBANON
Damascus
ISRAEL
Amman
Alexandria
Cairo
IRAQ
Baghdad
Mosul
Kirkuk
Arbil
An Nasiriyah
Al Basrah
IRAN
Tehran
Tabriz
Rasht
Qazvin
Qom
Esfahan
Kerman
Mashhad
Kermanshah
Ahvaz
Abadan
Zahedan
Bandar Abbas
Kuwait
EGYPT
Luxor
Aswan
Hafar al Batin
Al Jubayl
Ad Dammam
Dhahran
Manama
QATAR
Doha
Dubai
Abu Dhabi
Muscat
UNITED ARAB EMIRATES
SAUDI
ARABIA
Riyadh
Buraydah
Medina
Mecca
Yanbu al Bahr
Jiddah
OMAN
RUB AL KHALI
Port Sudan
Abha
SUDAN
Salalah


Western Galloe
Kinneret
Carmel
Side Wads
Yarmouk
Wadi Hammad
Northeastern
Amman-Zarqa
Coastal
Western Mountain
Eastern Mountain
Jorden Valley Floor
Azraq
Dead Sea
Negev
North Wadi Araba
Wedi Srhan
El Jafr
South Wadi Araba/ Red Sea
Disi
0
50
100 KILOMETERS

The Disi Aquifer:

- Is comprised of porous sandstone
- 250 km long, 50 km wide, ~1000m deep
- Only 10% is in Jordan
- Is a fossil water resource
- Jordan's portion contains an estimated 2.2 bcm of very clean water
  - TDS between 250 & 430 mg/L
  - some issues with radioactivity
    - Radium content

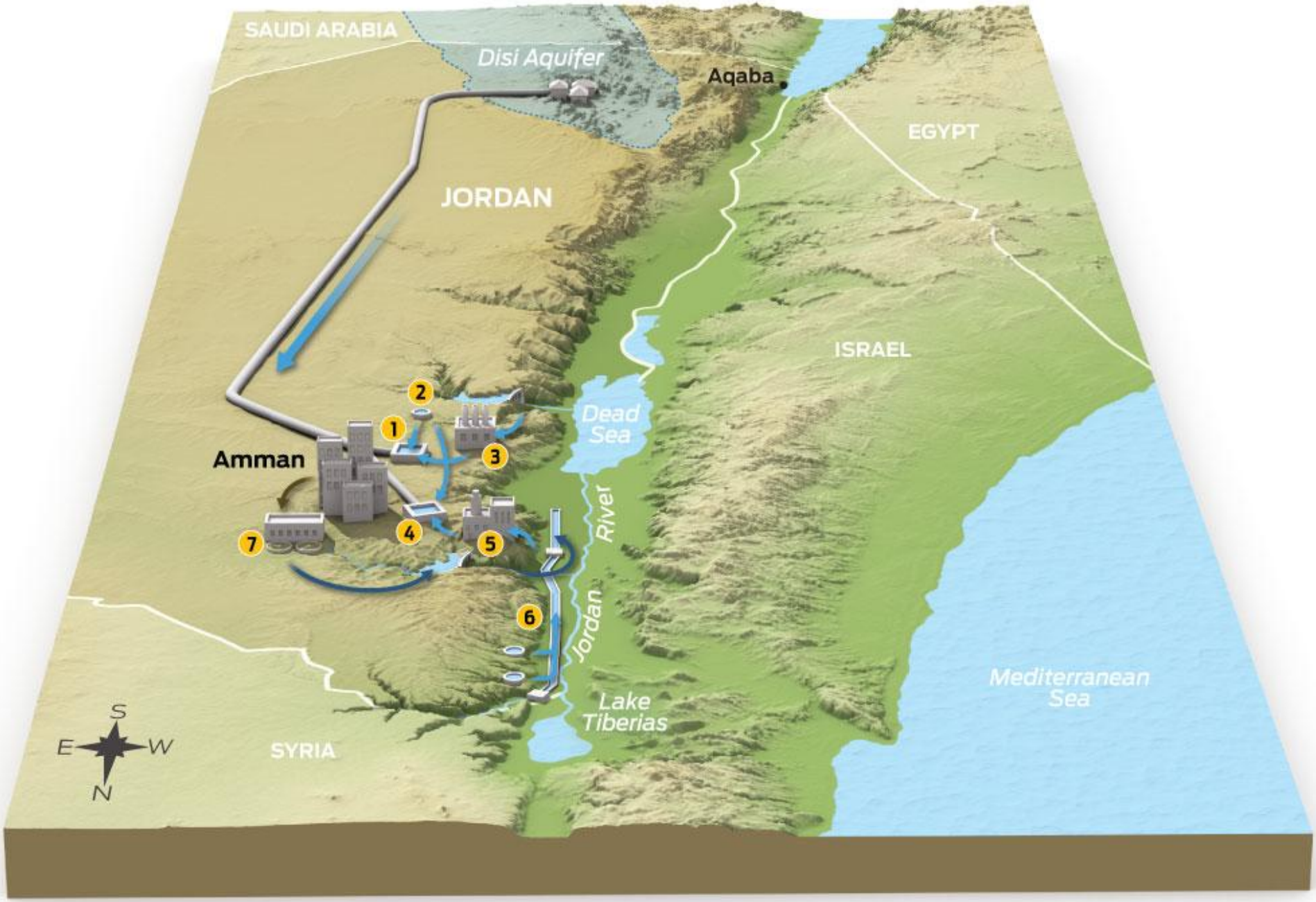
Current Exploitation

- In Jordan: Aqaba & surrounding areas currently abstract 75 mcm for agriculture and 16.5 mcm for domestic uses annually

- In Saudi Arabia: 1 bcm currently being abstracted annually for agriculture

Project to Increase Water Supply in Jordan

- A build, operate, transfer contract given to Turkish contracting co. Gama,
- To be operational in 2013
- Capacity to produce and distribute 100 mcm/yr, mostly to Amman
  - Dr. Munjed: actual amount may be as low as 55 mcm/yr
- Total Cost of 1.2 billion USD


SAUDI ARABIA
Disi Aquifer
Aqaba
EGYPT
JORDAN
ISRAEL
Amman
1
2
3
4
5
6
7
Dead Sea
River Jordan
Lake Tiberias
Mediterranean Sea
SYRIA
S
E
W
N

- **The project will include**:
  - 55 wells
  - 325 km of 2m diameter steel piping
    - 120km of ductile piping
  - 2 pumping stations to overcome 800m of dynamic head
  - Collection reservoir
  - Chlorination Generators
  - 85,000 m^3 regulating tank
  - 150,000 m^3 terminal reservoir

Current Progress

- 85% Complete
- Experimental pumping of 20-30 mcm to Amman should take place February, 2013

Positive Effects

- Provide 40% of Jordan's annual water demand; help close water demand gap: Priority
- Improve public health with increased supply of quality water
- Reduce ground water abstraction of other aquifers and allow for rehabilitation of renewable resources elsewhere
  - Azraq Oasis
  - Jordan River
- Improve effluent quality of wastewater
- Buy time for development of other resources
  - Red Dead Project
  - Larger share of Jordan River

Negative Effects

- Noisy, Dusty, Ugly
- Consumption of Fossil Water
- Energy Intensive
  - Use 4% Jordan's total electricity consumption
    - (Othman Kurdi, project manager)
  - Non-renewable energy sources: oil and gas
- Social and Economic Impact on people
- Interference with natural landscapes, drainage systems, ecosystems
  - Introduce invasive species
  - Interfere with migratory routes of birds

Socioeconomic Impacts

- Depending on energy consumption there will be steep increases in water prices
  - Total cost will exceed the affordable threshold ~ .94 - 1.4 USD/m^3
- Without continuation of proper awareness programs social unrest will arise
  - Further pressure on families if transparency with tariffs re not made in the future.

Relations with Saudi Arabia

- Saudi retains 90% of the aquifer
- A Memorandum of Agreement has been signed by both countries prohibiting any drilling of new wells within 10km of border upon completion of the Disi Project
  - Jordan's Ministry of Water and Irrigation
  - Saudi Arabia's Ministry of Electricity and Water
- This memorandum is non-binding; doesn't constitute a treaty under international law
- Relations regarding aquifer are complicated by donations (~1 billion USD/yr) given from Saudi Arabia to Jordan (Dr. Munjed)

Sustainability

- Short term solution for a long term problem
- Lifespan of aquifer available to Jordan:
  - Estimated at 20-30 years if abstraction rates are 100-120mcm/yr
  - Abstraction rates of the Saudi Arabian portion will effect lifespan
    - Could also increase radiation levels & salinity

Conclusions

- The Disi-Amman water conveyance project will be an expensive, but effective way to improve Jordan's current water situation. While the project is in effect, action must be taken to improve existing infrastructure and develop alternative sources to close the water demand gap before the Disi aquifer is depleted.

- These actions should include:
  - Red-Dead conveyance project
  - USAID funded project, Millenium Challenge Account-Jordan to reduce water losses in Amman
  - Increased Reclaimed water use, especially in agriculture
  - Public awareness and education campaigns
    - Tariff increase must be transparent and presented to affected communities
  - International transparency and increased cooperation
  - No more Tocgh-kha-Docgh!

Final Thoughts

- Engineering is the easy part.
- Thanks so much to Dr. Heidi, Dr. Muna, Jaffer, our fellow Jordanian students and our amazing guest speakers!

Works Cited

- The Fate of the Disi Aquifer as a Strategic Groundwater Reserve for Shared Countries, Journal of Water Resources and Protection, 2011, 3, 711-714

- The Rum-Saq Aquifer Resource- Risk Assesment for Long-Term Resource Reliability, National and Regional Policies Concerning the Sustainable use of Water, 1998

http://www.gama.com.tr/en/gama-energy/assets/in-construction-phase/disi/301

http://www.jordanecb.org/public/English.aspx?Lang=1&Page_Id=900&Menu_ID=33

http://jordantimes.com/overall-progress-in-disi-project-reaches-76-per-cent

http://www.hazenandsawyer.com/work/projects/upgrading-ammans-water-distribution-system/