Is Desalination the Solution? The Promise and Perils of a Technological Fix to the Water Crisis in BCS, Mexico

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Arizona-Baja California Sur Partnership for Water Sustainability

WSP Water Sustainability Program
Our Water Future
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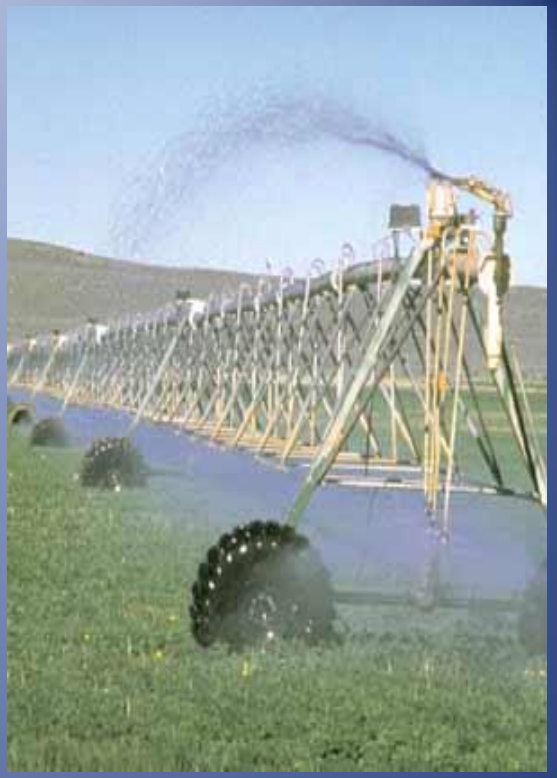
FULBRIGHT

Water Resources Research Center
April 26, 2013

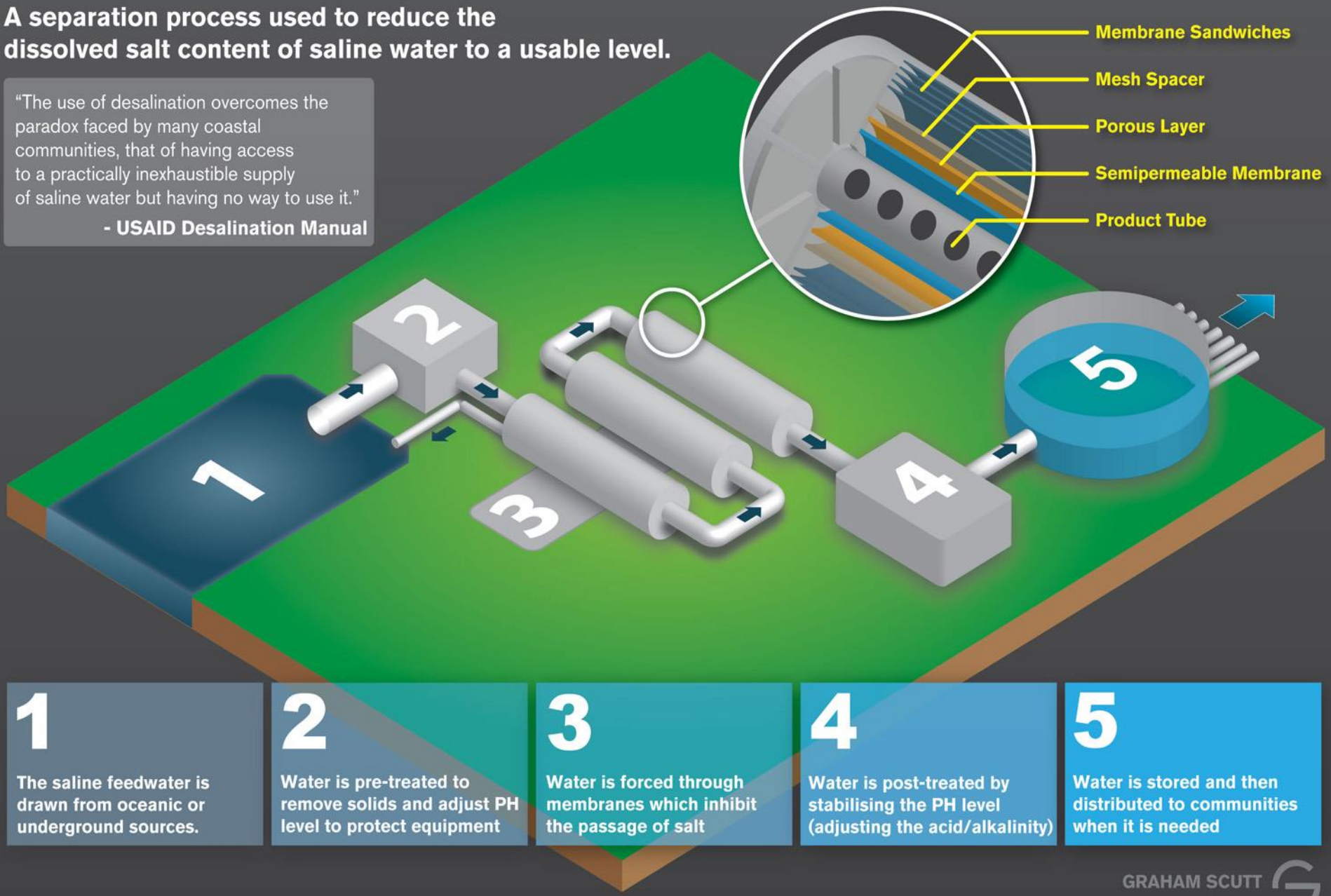


REVERSE OSMOSIS DESALINATION

A separation process used to reduce the dissolved salt content of saline water to a usable level.

"The use of desalination overcomes the paradox faced by many coastal communities, that of having access to a practically inexhaustible supply of saline water but having no way to use it."

- USAID Desalination Manual



1

The saline feedwater is drawn from oceanic or underground sources.

2

Water is pre-treated to remove solids and adjust PH level to protect equipment

3

Water is forced through membranes which inhibit the passage of salt

4

Water is post-treated by stabilising the PH level (adjusting the acid/alkalinity)

5

Water is stored and then distributed to communities when it is needed

2010 Border Governors' Binational Desalination Conference

2010 Border Governors Conference Water Work Table Binational Desalination Conference

The U.S.-Mexico border region needs upgraded and enhanced water infrastructure for projected population and economic growth as well as environmental protection. Expected climate change impacts will exacerbate competition for the region's finite water resources. Communities throughout the border region from California to Texas are increasingly examining desalination - of seawater or brackish groundwater - as a potential water supply option. Possible U.S. - Mexico desalination opportunities are under evaluation in the cooperative Colorado River binational process.

Conferences

2011 Santa Ana River Watershed Conference

2011 Integrated Regional Water Management Conference

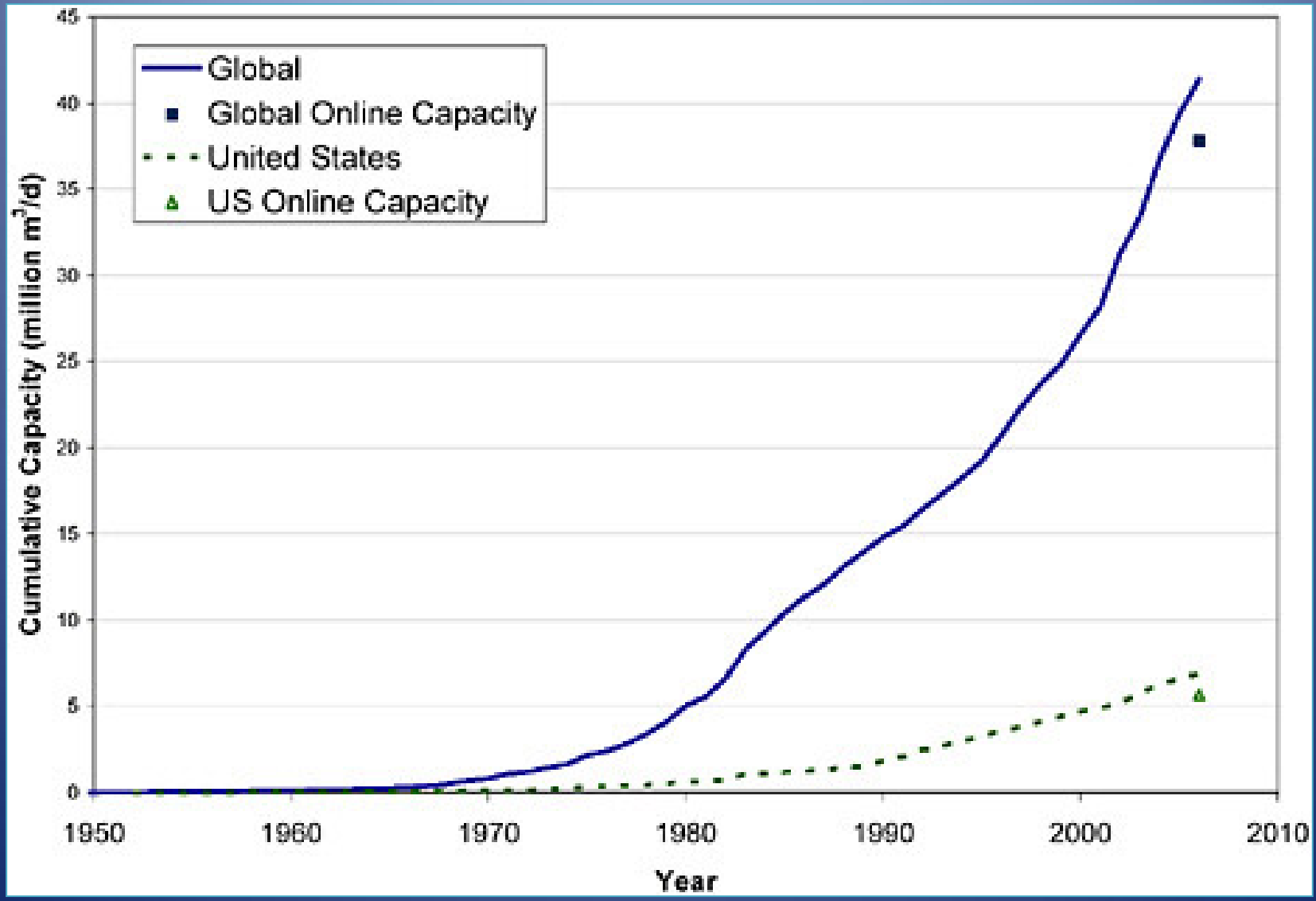
2011 Remote Sensing Applications for U.S. - Mexico Border Water Management

Mexico's 2007-2012
National Infrastructure Program

1. Tijuana, BC
2. Guaymas, SON
3. Ensenada, BC
4. Ensenada, BC (La Misión)
5. La Paz, BCS
6. Los Cabos, BCS (Expansion)
7. Puerto Peñasco, SON
8. Loreto, BCS

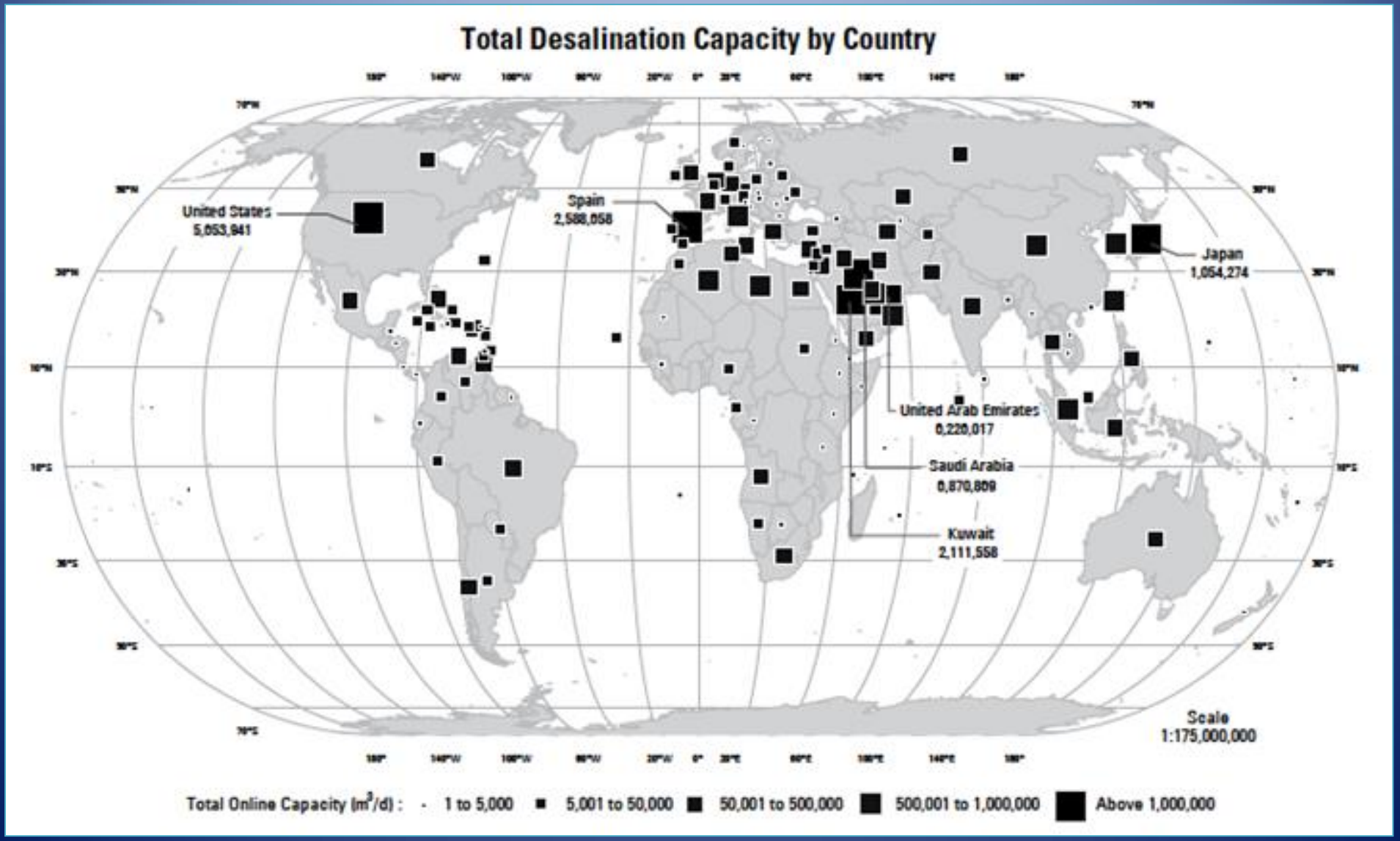
Conagua, 2012

Worldwide Desalination Capacity



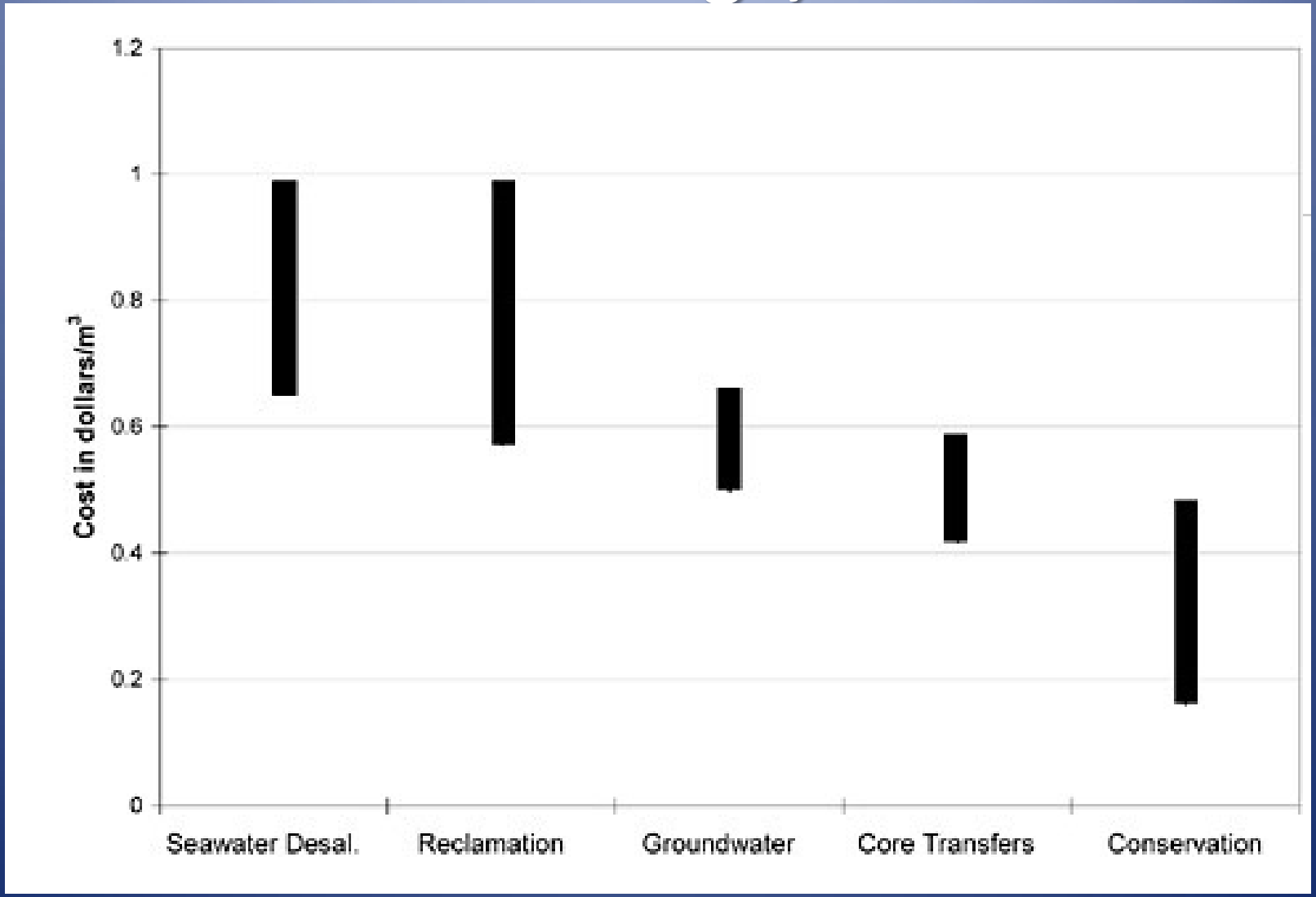
Source: Global Water Intelligence, in National Research Council 2008

Desalination around the Globe



Source: National Research Council 2008.

Relative Cost of Desalination in San Diego, CA

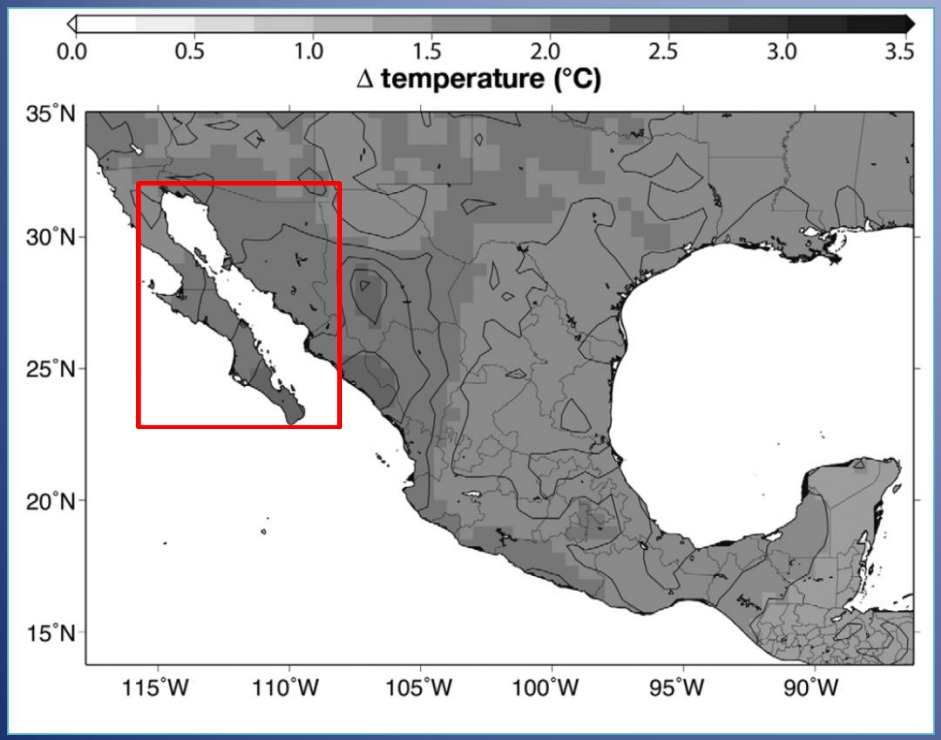


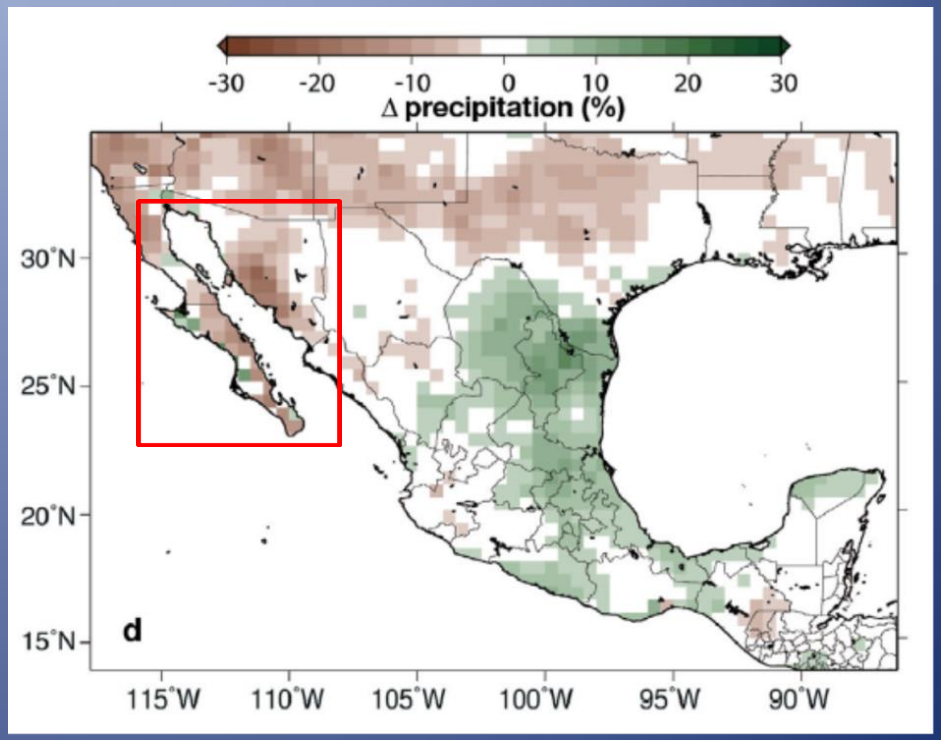
Source: National Research Council 2008.

Less Politically Divisive

Plataforma
en defensa
de l'Ebre - **PDE**

Projected Temperature and Precipitation Changes

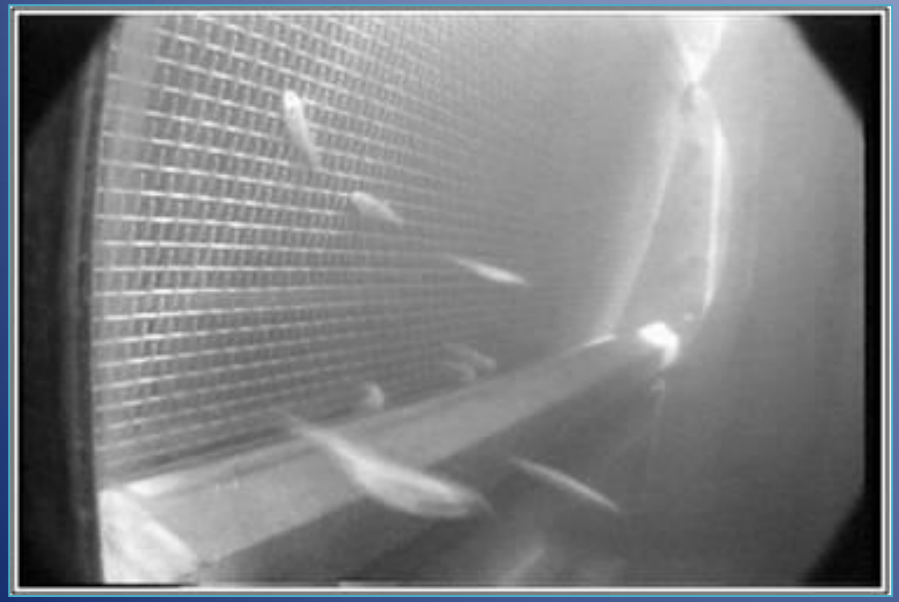




Source: Magaña et al. 2012.

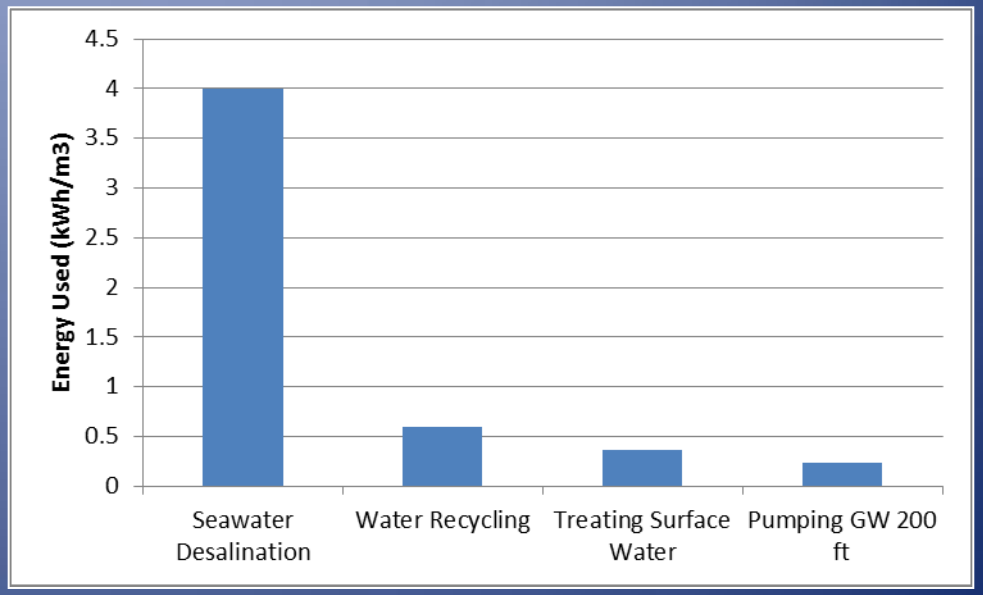
Concerns about Desalination

1. Environmental Impact



Source: www.aldenlab.com

2. Energy Intensity



Source: Adapted from Cohen et al. 2004

How does desalination technology affect water security?

Research Questions

- Is desalination an adaptive solution to a developing water crisis in arid Baja California Sur, Mexico?
- Does desalination reduce vulnerability to water scarcity and increase water security in the context of communities such as Los Cabos and La Paz?
- How does the implementation of new desalination systems at the municipal-scale affect alternative water management options?

“Water Security”

- “The availability of an acceptable **quantity** and **quality** of water for health, livelihoods, **ecosystems** and production, coupled with an acceptable level of water-related **risks** to people, environment and economies” (Grey and Sadoff, 2007)

- “The sustainable availability of adequate quantities and qualities of water for **resilient societies and ecosystems** in the face of **uncertain** global change” (Scott et al., 2013)

“Water Security”

Broad Framing

vs.

Narrow Framing

(see Cook and Bakker 2012)

“Water Security”

- The best path to water security is through balanced investments in water infrastructure and institutions (i.e., governance), while giving special attention to issues of equity in the distribution of the benefits of these investments. (Grey and Sadoff, 2007)

Factors that Affect Water Security

- Biophysical availability of water (i.e., natural hydrological regime)
- Social
- Political
- Economic
- Technological

(see Zeitoun, 2011)

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Water security: Debating an emerging paradigm

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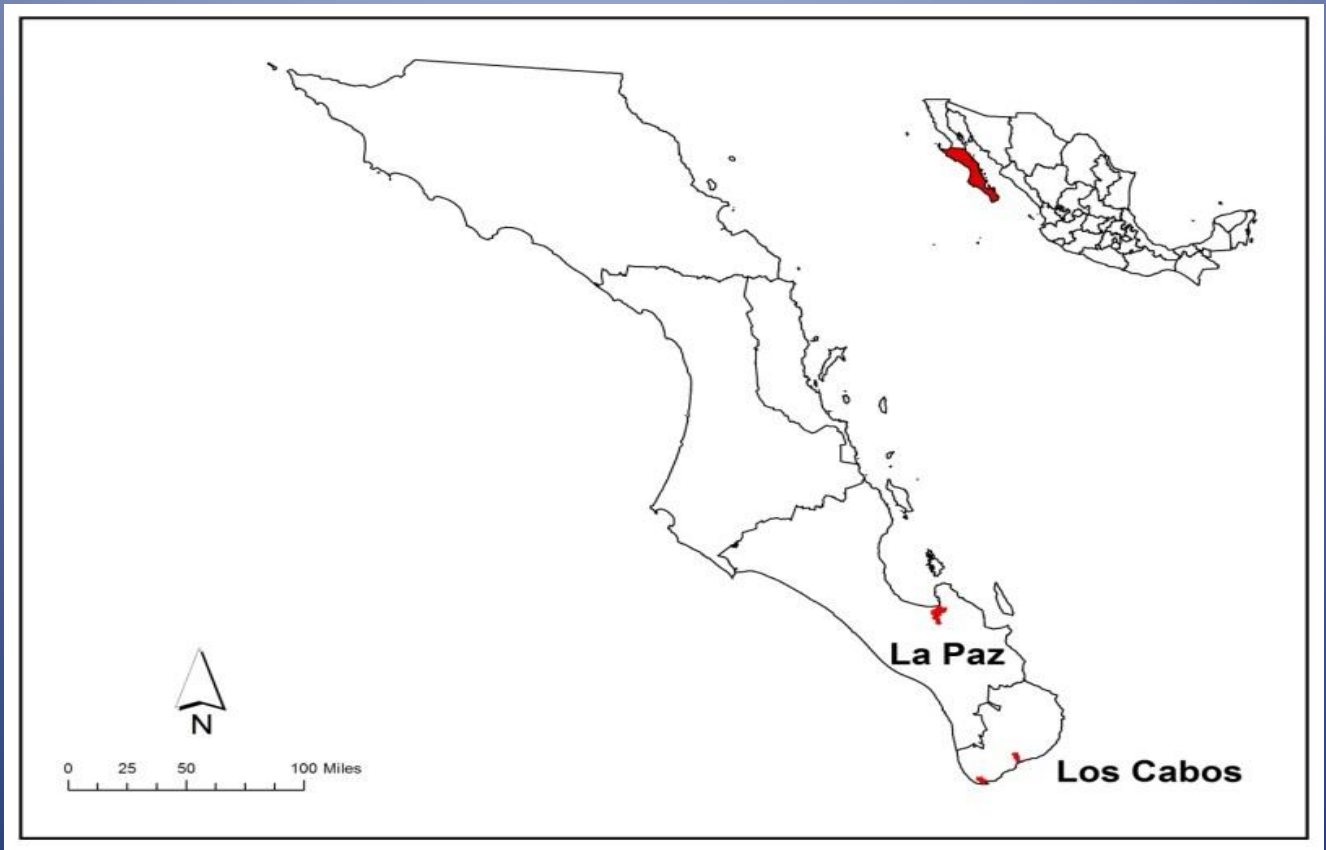
- Narrow framings of water security should be "usefully allied" with broader framings in order to account for the "multiple stressors that affect water security" (p. 99)

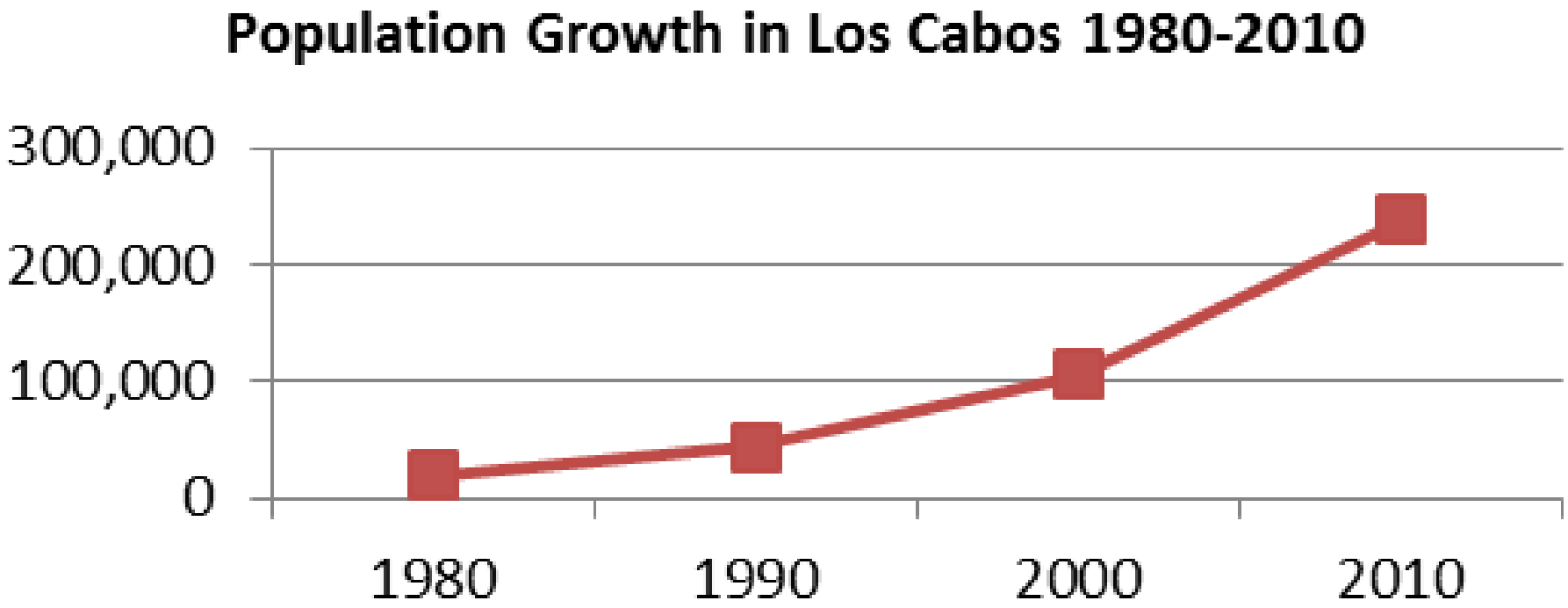
- Need "multi-scalar" analyses

Research Sites



Los Cabos

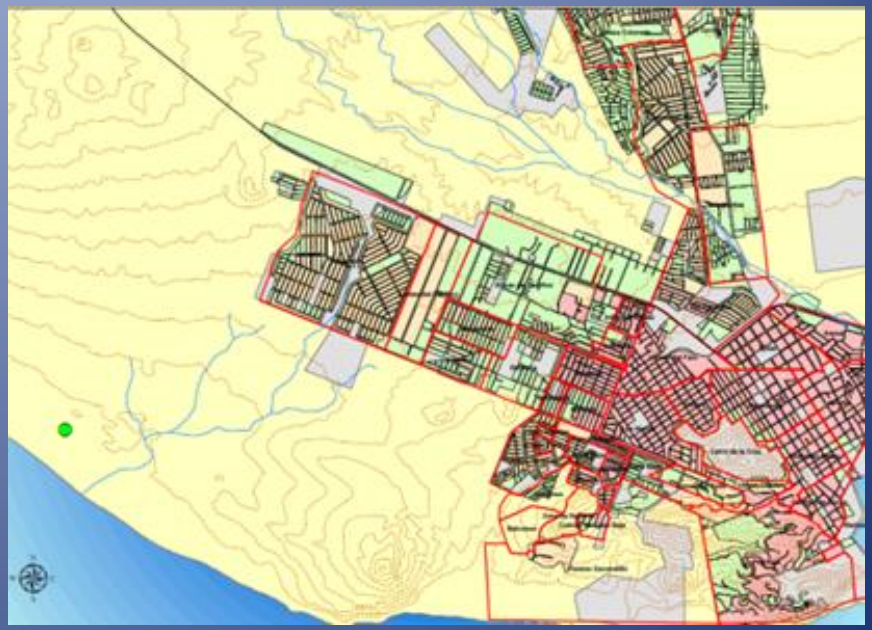

San Diego
Tijuana
Tucson
El Paso
TEXAS
Dallas
Austin
San Antonio
Hermosillo
Chihuahua
Gulf of California
Sierra Madre Occidental
Sierra Madre Oriental
Torreón
Monterrey
Brownsville
Culiacán
TROPIC OF CANCER
San Luis Potosí
MEXICO
Guadalajara
León
Querétaro
México City
Ecatepec
Toluca
Puebla
Bahía de la Paz
La Paz
Cerralvo Seamount
Soledad Canyon
Todos Santos
Los Cabos



Source: INEGI 2010

Growth of *Colonias* in Cabo San Lucas

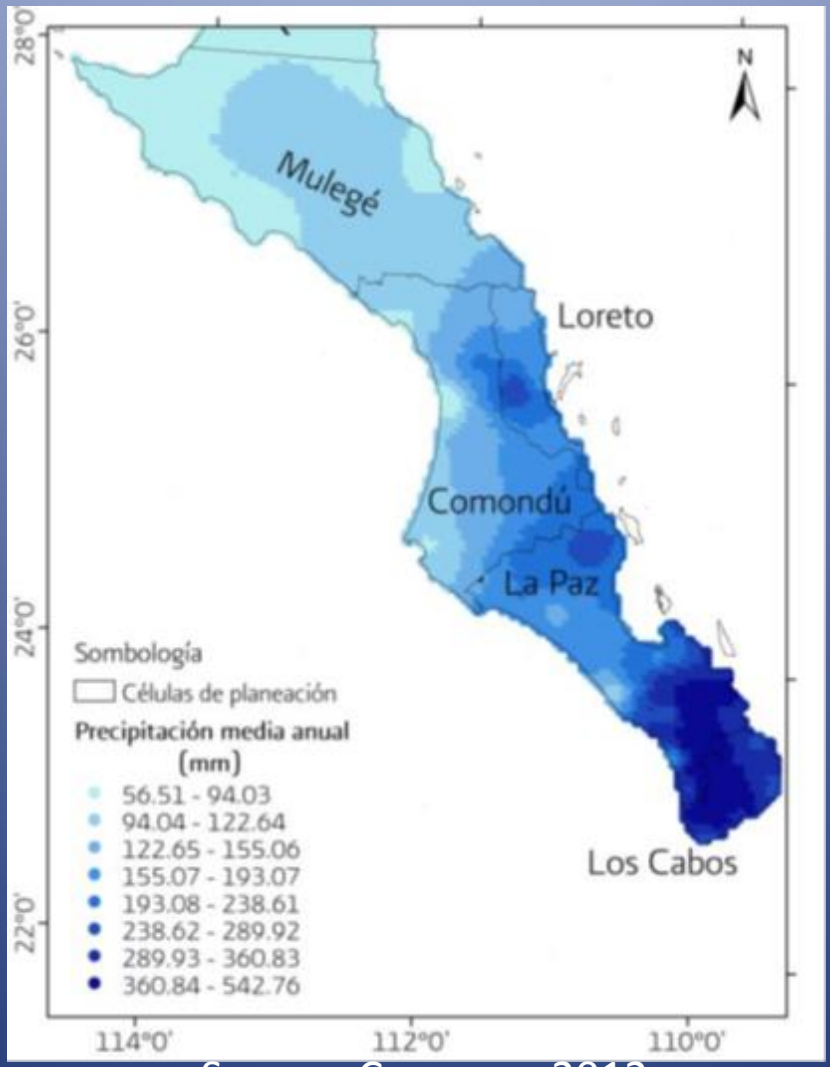
2000



2010

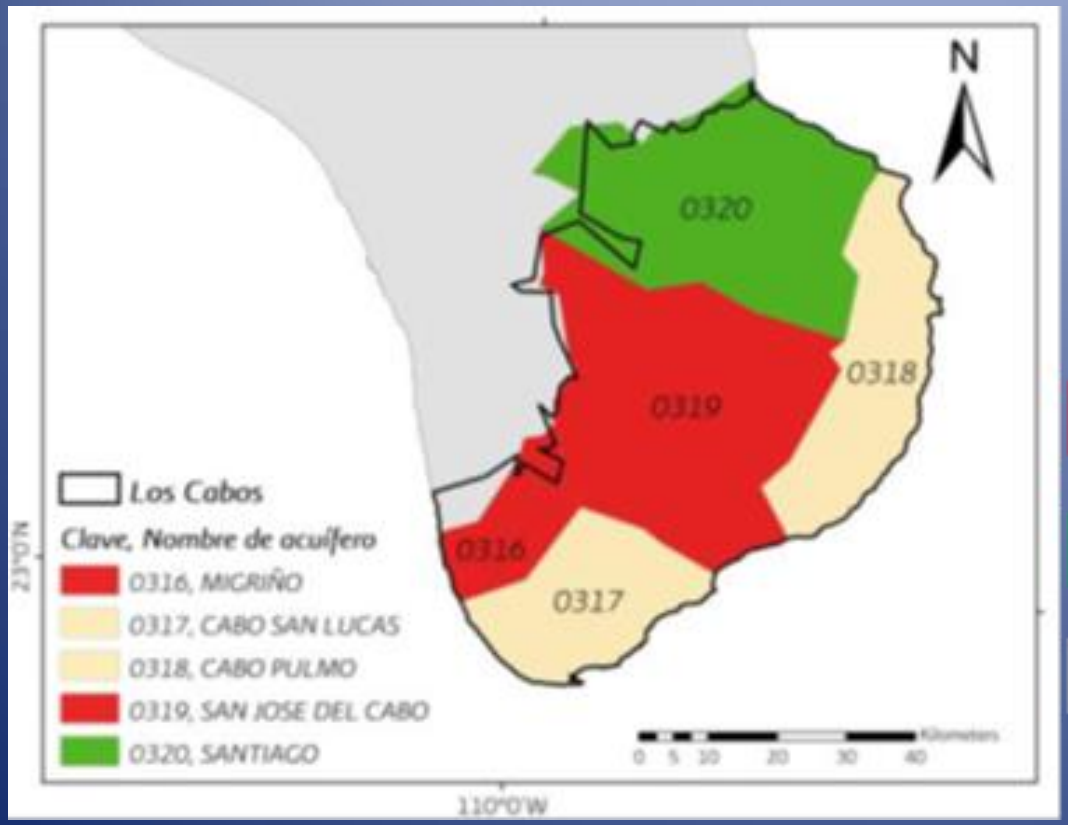
Source: IMPLAN, 2011

Water Supply Challenges in Los Cabos: Biophysical



Source: Conagua, 2012

Water Supply Challenges in Los Cabos: Biophysical



- Aquifer in overdraft
- Aquifer in balance
- Data unavailable

Source: Conagua, 2012

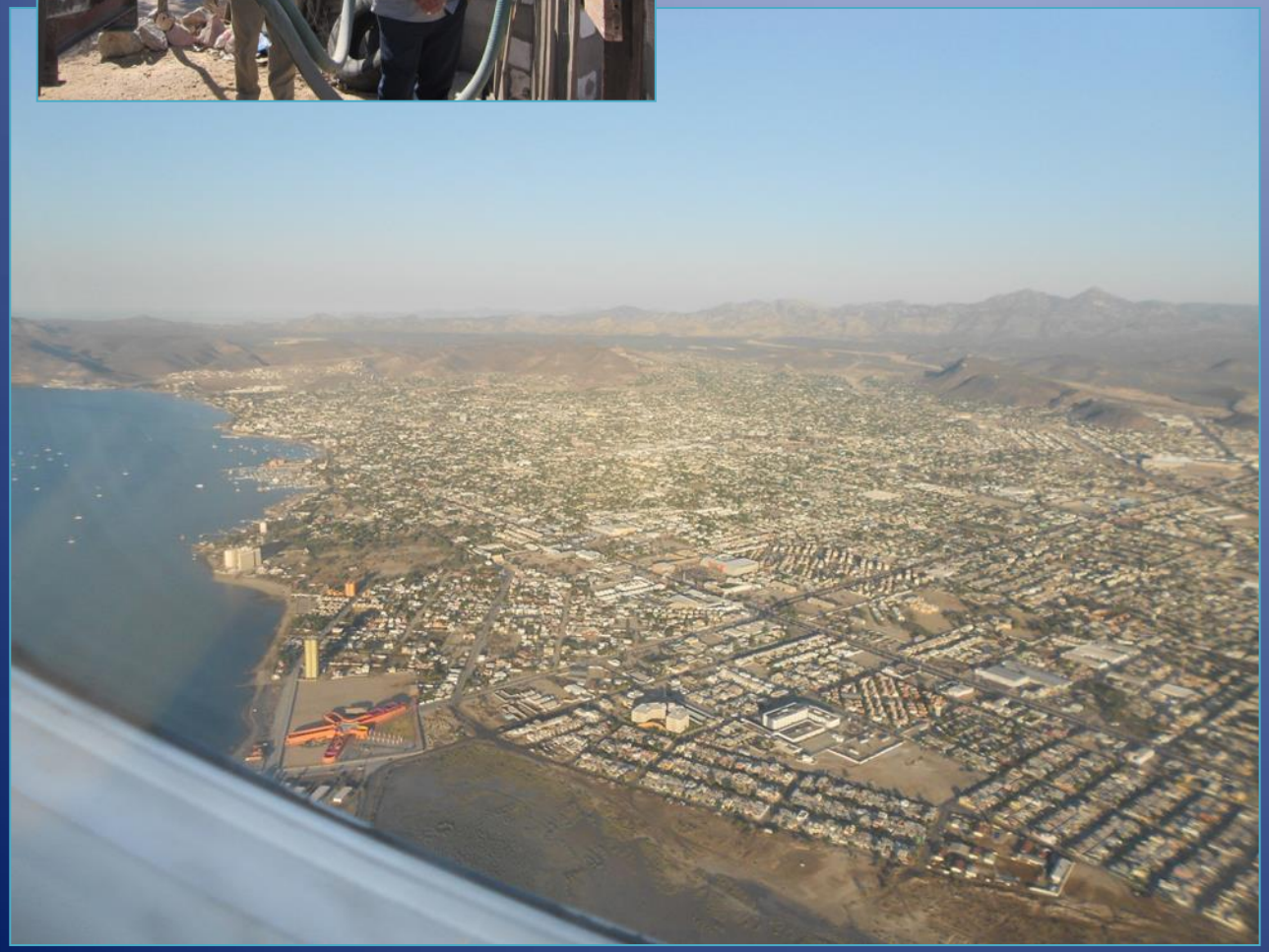
Water Supply Challenges in Los Cabos: Socio-Political/Technical

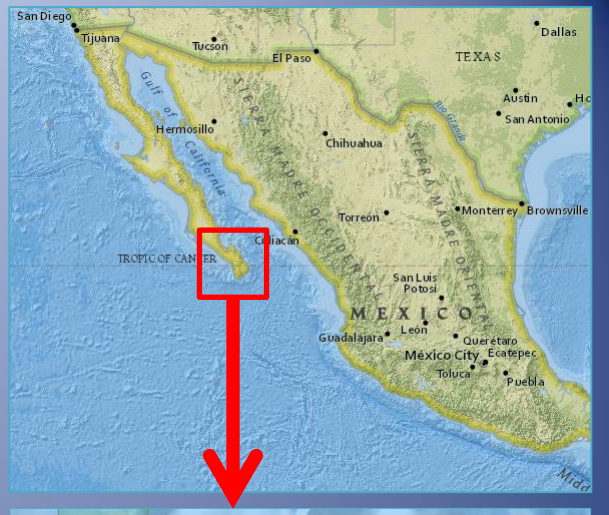
- Inefficient distribution system (Nationally, ~30-50% water loss due to leaks)
- Lack water meters

Source: Agundez, 2010

Source: Author, 2012

La Paz




San Diego
Tijuana
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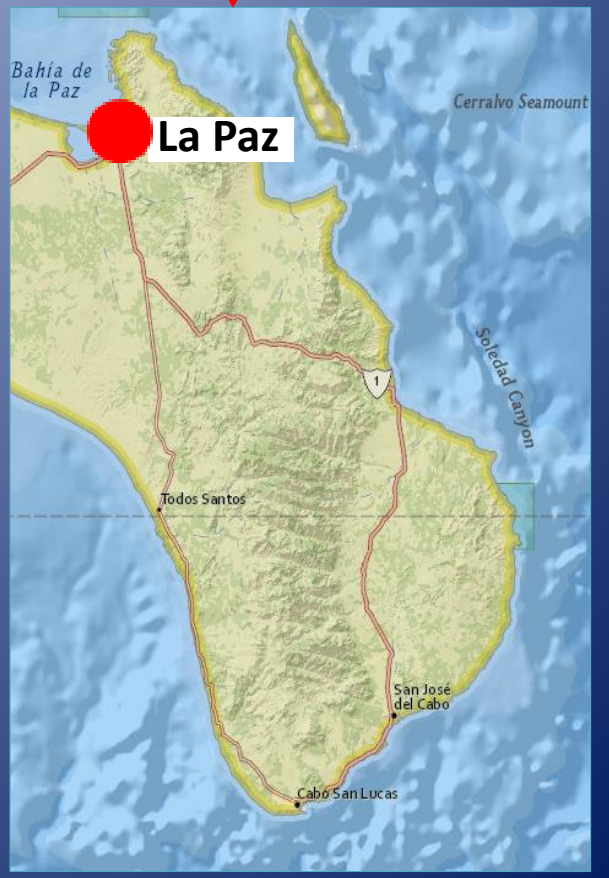
Austin
San Antonio
Hermosillo
Chihuahua
Gulf of California
Sierra Madre Occidental
Sierra Madre Oriental
Torreón
Monterrey
Brownsville
Culiacán
TROPIC OF CANCER
San Luis Potosí
MEXICO
Guadalajara
León
Querétaro
México City
Ecatepec
Toluca
Puebla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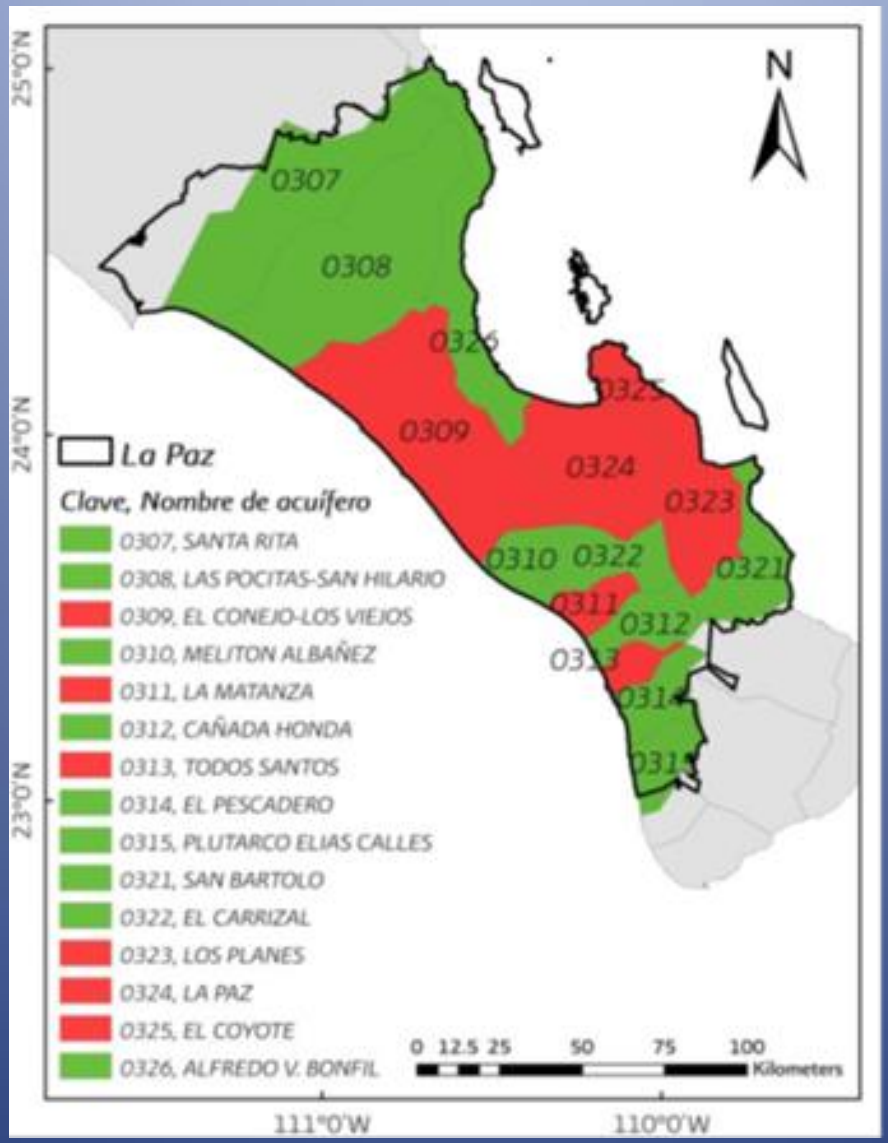
La Paz
Cerralvo Seamount
Soledad Canyon
1
Todos Santos
San José del Cabo
Cabo San Lucas



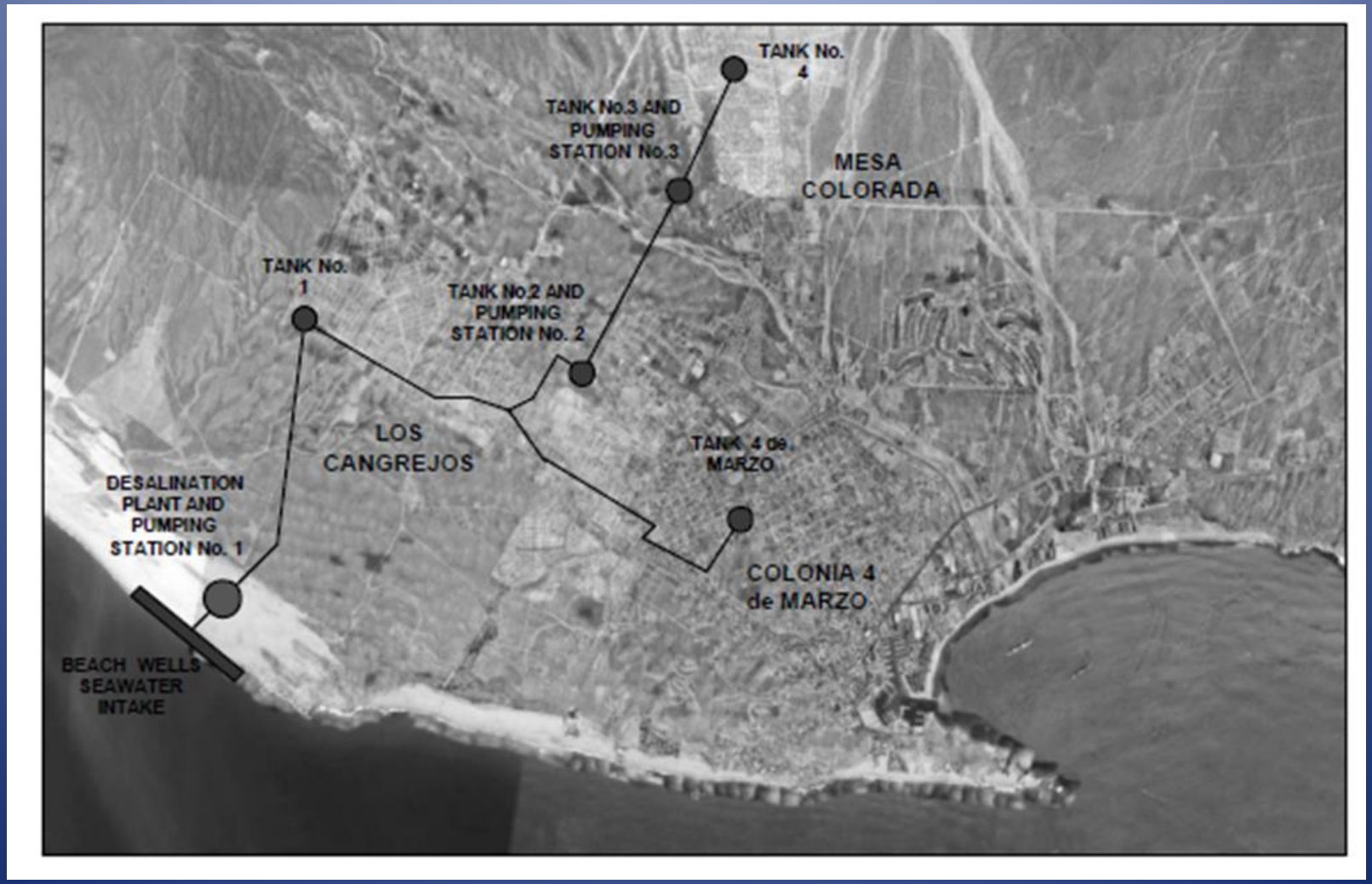
- Aquifer in overdraft
- Aquifer in balance

Source: Conagua, 2012

154 Household Surveys in Los Cangrejos

Designed to assess the impact of the desalination plant on water security at the household level

Distribution of Desalinated Water



Survey Questions

- Household characteristics
- Accessibility of public services
- Household water supply
- Household water use
- Perceptions of water issues
- Perceptions of desalination
- Socioeconomic status

Semi-Structured Interviews

Federal water commission (Conagua)	3
Federal government (other)	6
State water commission (CEA)	2
State government (other)	2
La Paz municipal water utility (OOMSAPA)	3
La Paz municipal government (other)	3
Los Cabos municipal water utility (OOMSAPASLC)	2
Los Cabos municipal government (other)	3
Environmental Non-Governmental Organizations (NGOs)	5
Academic/Researcher	6
Private development, architecture, or real estate firm	9
Private desalination operator	1
Colonia residents	16
Colonia leaders	4
Expat residents	3
Other	3
Total # of Interviewees	**71**

Conclusion #1

The degree to which desalination reduces water insecurity is extremely uneven

Private Water Truck Service – '*pipas*'

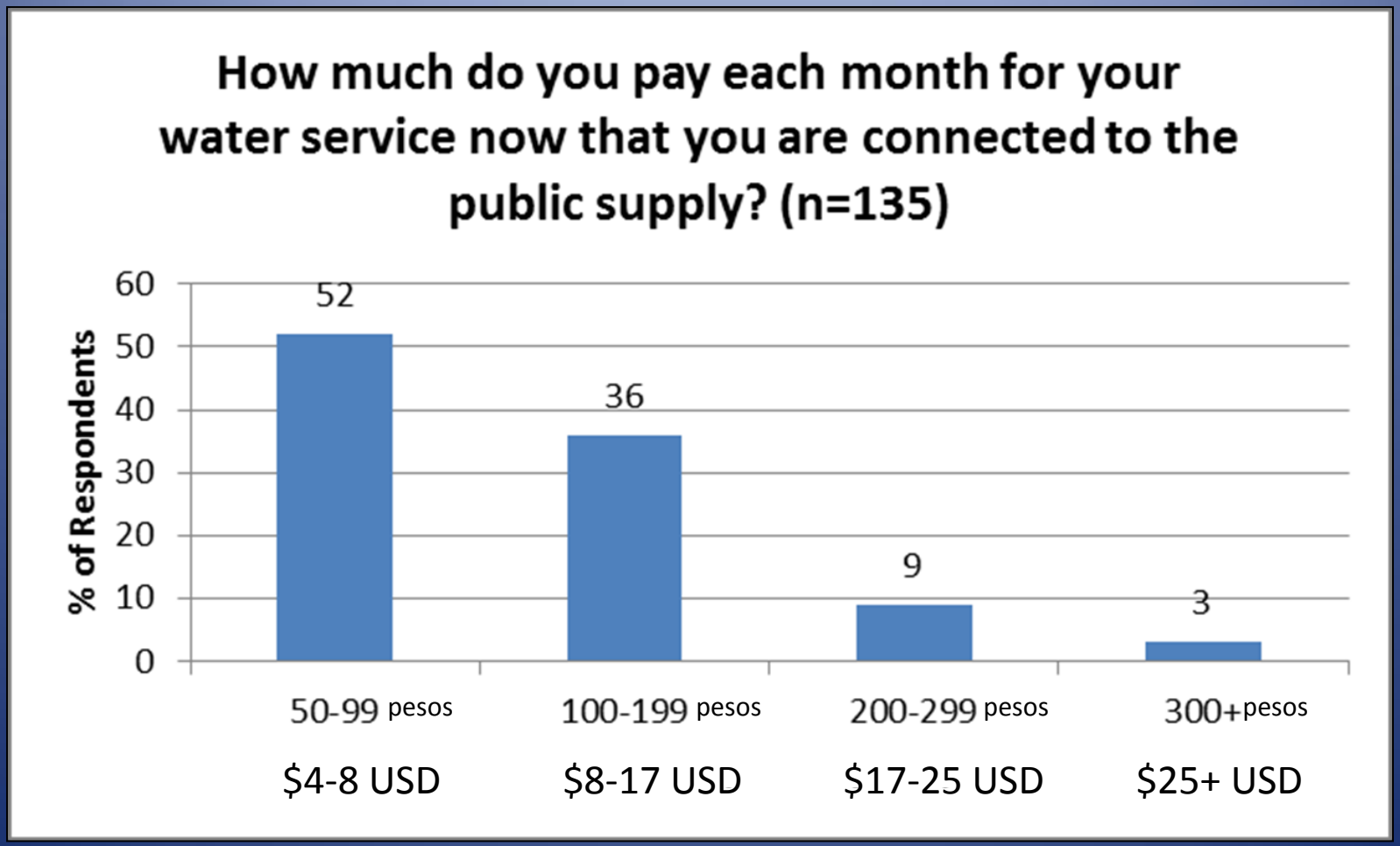
Survey respondents reported spending ~$400 pesos ($33USD) per month

"It was not fair, but that's all there was."

Large *cisterna*

Smaller *tambos*

Monthly Water Bill for Desalinated Water



User Satisfaction

- 76% of respondents were satisfied or very satisfied with their current water service
  - "Day and night we have water"
  - "Now we don't have to wait for the water trucks and buy from them."

Do you use tap water for the following? If no, why not?

Yes, bathing	100%
Yes, cleaning the house	100%
Yes, washing the dishes	100%
Yes, washing fruit and vegetables	89%
No, use purified water	11%

Do you drink the tap water?

Yes	13%
No	87%

If you don't drink the tap water, why not? (open ended)

Stated "it's not healthy" or "I get sick"	48%
Stated "too much chlorine," "smells bad" or "tastes bad"	39%
Stated "I'm used to drinking purified water"	14%
Stated, "I don't have confidence in/or am unsure about the desalination process"	5%

Other *Colonias*

Programa Hídrico Estatal de Baja California Sur

2012-2030

GOBIERNO FEDERAL

SEMARNAT

CONAGUA

Baja California Sur

Conclusion #2

Given limited resources, a priority focus on desalination is likely to forestall or foreclose alternative strategies.

Desalination should be considered as “la última opción”

Survey Results

Workshop with water managers in La Paz, n= 27

Top Priorities:

1) Program to control leaks
2) Water re-use projects
3) Long-term regional water plan
4) Greater capacity within local water agency

Lowest Priorities:

1) Desalination
2) Increase costs for connecting new users

Water Management Priorities (Niparaja and ProNatura)

- Water meters
- Leak detection
- Repairing & replacing infrastructure
- Incentivizing installation of water efficient appliances
- Promoting xeriscaping
- Promoting rainwater harvesting
- Expanding water reuse
- Increasing agricultural efficiency
- Provide all households with water storage containers

“Business as Usual” Water Culture

- Administrative directors are political appointees
- 3 year mayoral and administrative turnover hinders long-term planning

“Business as Usual” Water Culture

- Lack of coordination
- Limited integrated planning
- Narrow focus on resolving short-term problems

“Business as Usual” Water Culture

- Lack of transparency and financial mismanagement
  - “caja chica” – petty cash box for the city
  - $2 million USD debt to federal water authority
  - Ineligible to receive federal funding for infrastructure investments

Conclusion #3

Because a technological fix does not require institutional or behavioral changes, desalination leads to a "business as usual" water culture and forecloses other options

Thank you

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