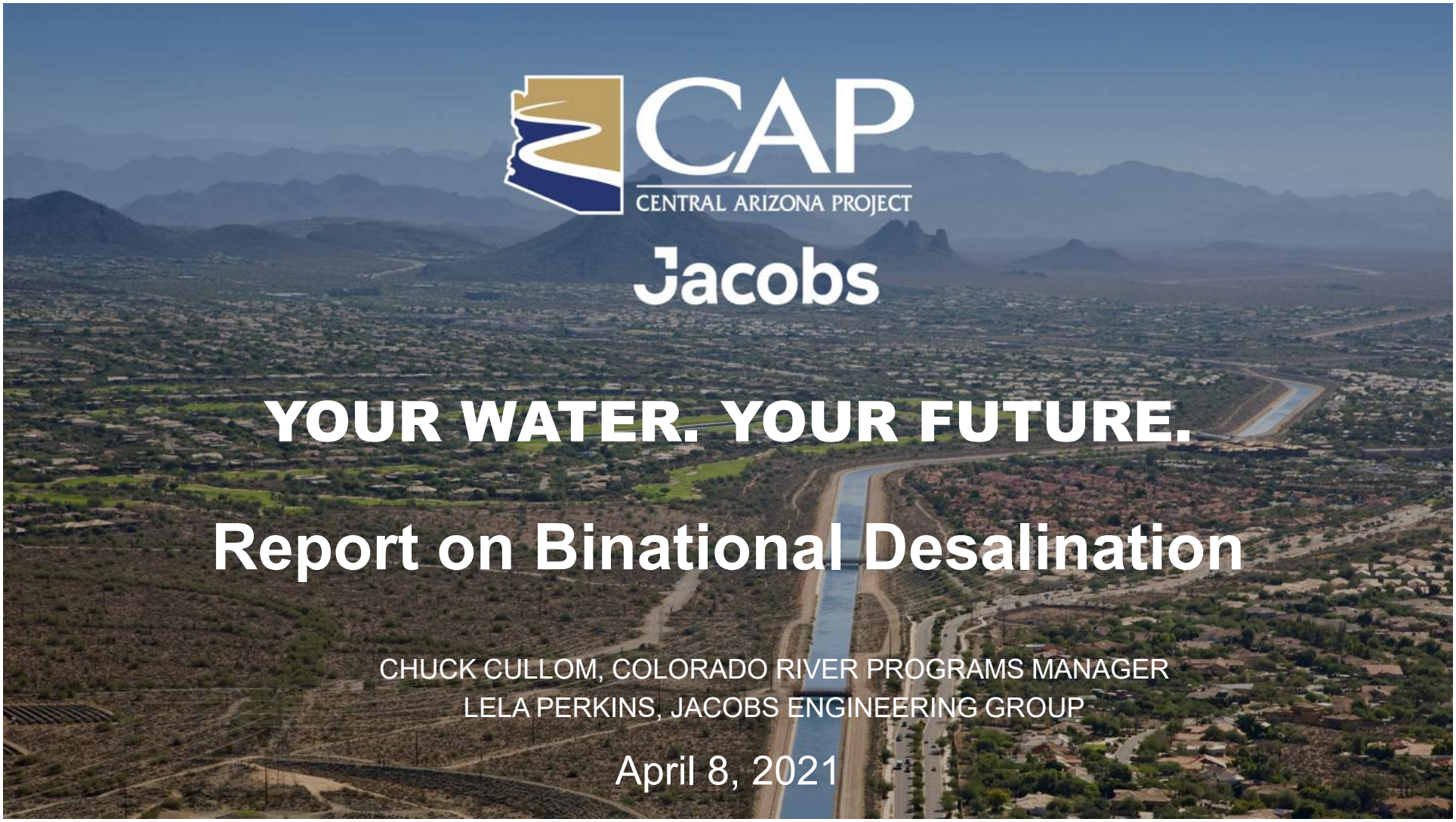


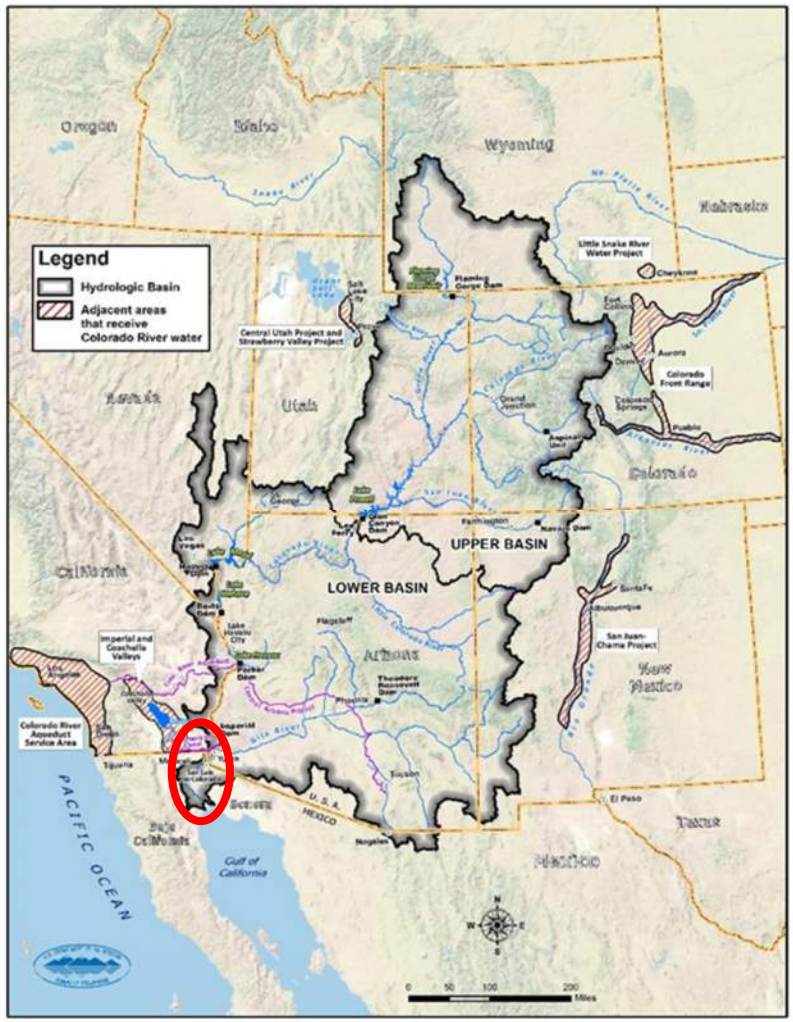
Report on Binational Desalination

CHUCK CULLOM, COLORADO RIVER PROGRAMS MANAGER
LELA PERKINS, JACOBS ENGINEERING GROUP

April 8, 2021

Colorado River System Overview

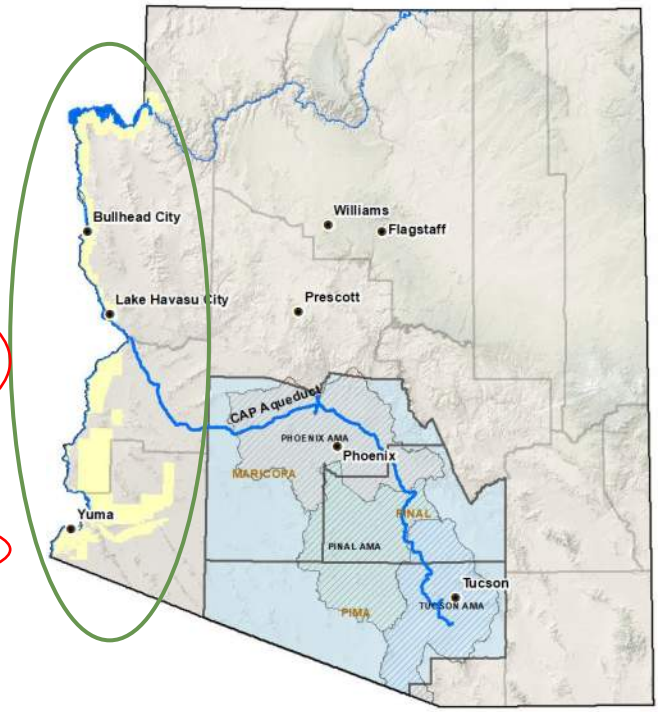
- 7 states in U.S. and 2 in Mexico
- Serves more than 40,000,000 people
- Reliability provided by storage in Lake Mead and Lake Powell
- Significant environmental resources in U.S. and Mexico
- More than 5,000,000 acres of irrigated agriculture



What are CAP's Interests in Binational Desalination?

- Arizona's Senior Colorado River users influence CAP's water supply annually
  - CAP's unquantified Sec. V Contract receives water from unused Arizona Colorado River supply
  - Consumptive use = Diversions – Return Flows
  - Water and salinity management in the Yuma Area directly impacts Arizona return flows
- Water and salinity management in the Yuma Area can increase or decrease releases from Lake Mead, influencing the risks of shortage in the Lower Basin
  - Long-term water and salinity management decisions in the Yuma Area can contribute to or decrease the Structural Deficit
- Binational Desalination represents a significant opportunity to jointly develop new supplies to augment the Colorado River (GWAICC)

Mainstem Contract Areas



Binational Desalination Study Background

- IBWC Commissioners signed Minute No. 323, “Extension of Cooperative Measures and Adoption of a Binational Water Scarcity Contingency Plan in the Colorado River Basin” on Sept 21, 2017
- Expressed a clear need for continued and additional actions due to the impacts on Colorado River storage
- **Noted the existence of opportunities for joint cooperative projects with the potential for direct delivery or exchange of Colorado River water benefitting both nations, including a binational desalination plant at the Sea of Cortez**
- Results will be compared to the investigations of other new water sources projects identified in Minute 323 once they are completed

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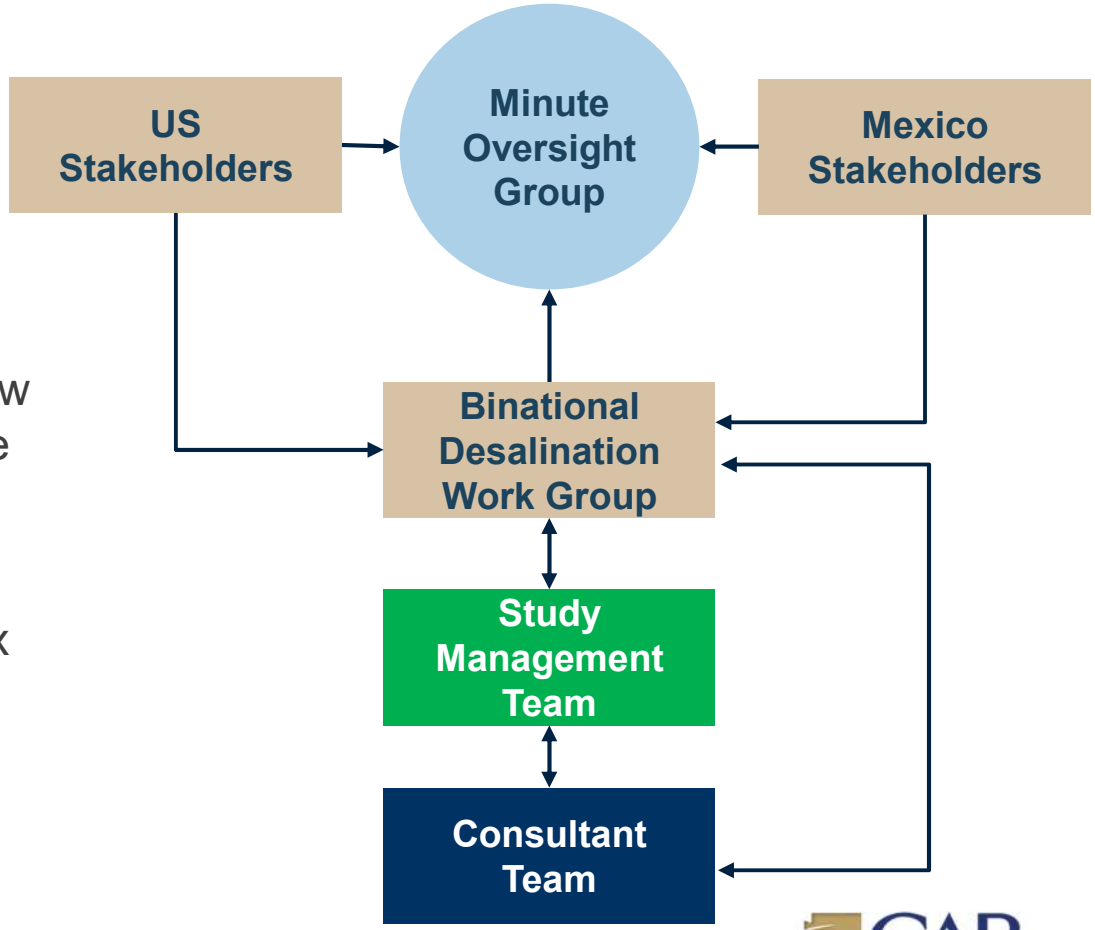
Background

- Study was prepared under the direction and guidance of the Minute No. 323 Binational Desalination Work Group in accordance with Section IX.B New Water Sources Projects of Minute No. 323 of the IBWC
- Funding provided by ADWR, CAWCD, Freeport McMoRan, Six Agency Committee, SNWA, SRP
- Completed by Black & Veatch, Libra Ingenieros Civiles, and Jacobs Engineering Group



Desalination Work Group Participating Agencies

- Arizona Department of Water Resources (ADWR)
- Central Arizona Water Conservation District (CAWCD)
- Colorado River Board of California (6 Agency)
- Comisión Estatal del Agua (CEA) Sonora
- Comisión Internacional de Límites y Aguas (CILA) Mexico Section
- Comisión Nacional del Agua (CONAGUA)
- Comisión Nacional de Áreas Naturales Protegidas (CONANP)
- Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT)
- CEA Baja California
- Pronatura Noroeste AC
- Colegio de la Frontera Norte
- Freeport McMoRan
- International Boundary and Water Commission (IBWC), U.S. Section
- Metropolitan Water District of Southern California (MWD)
- Salt River Project (SRP)
- San Diego County Water Authority (SDCWA)
- Southern Nevada Water Authority (SNWA)
- United States Department of the Interior, Bureau of Reclamation (USBR)

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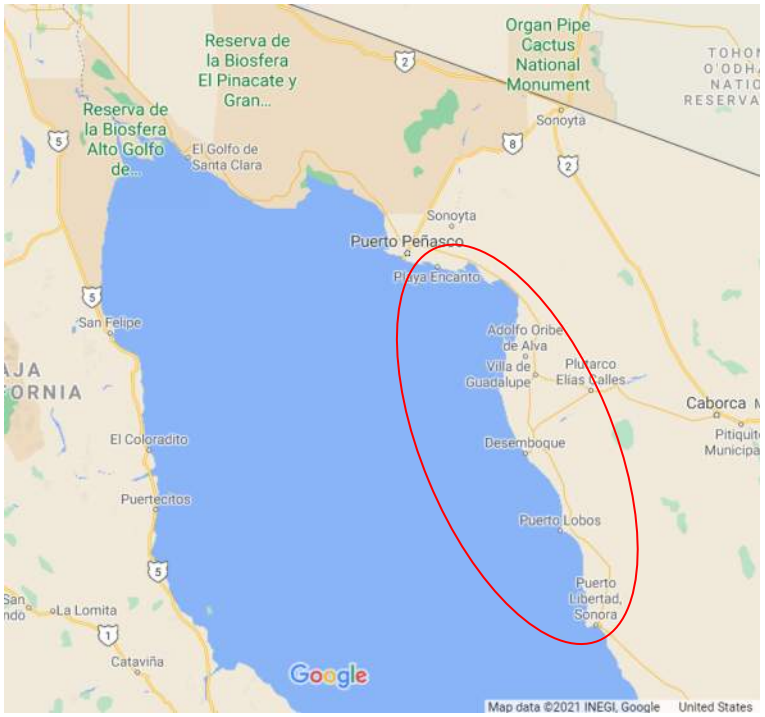
Study Parameters

- Identify potential desalination opportunities along the Sonoran coast of the Sea of Cortez, while recognizing the unique ecological nature of the area
- The study area is generally between Puerto Peñasco and Puerto Libertad
- Each opportunity has a minimum target yield of 50,000 AFY up to a total combined capacity of 200,000 AFY
- Direct delivery to Mexico at Morelos Dam, with delivery to US partners via Colorado River exchange



- Evaluate the identified potential opportunities and provide a recommendation of a preferred joint cooperative project concept(s) to carry forward for additional investigation, providing benefits for both countries
- All deliverables were produced in English and Spanish (side-by-side)

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Summary of Tasks

- Scope of work was developed by Work Group members
- 5 technical memoranda (TM) were produced
  - Water Supply Availability and Demand Analysis
  - Desalination Technologies and Brine Management Options
  - Identification of Potential Desalination Opportunities
  - Brine Dispersion Modeling
  - Evaluation of Potential Desalination Opportunities
- Production of each TM was managed by the Study Management Team and reviewed by the Work Group prior being compiled and presented to the Minute Oversight Group

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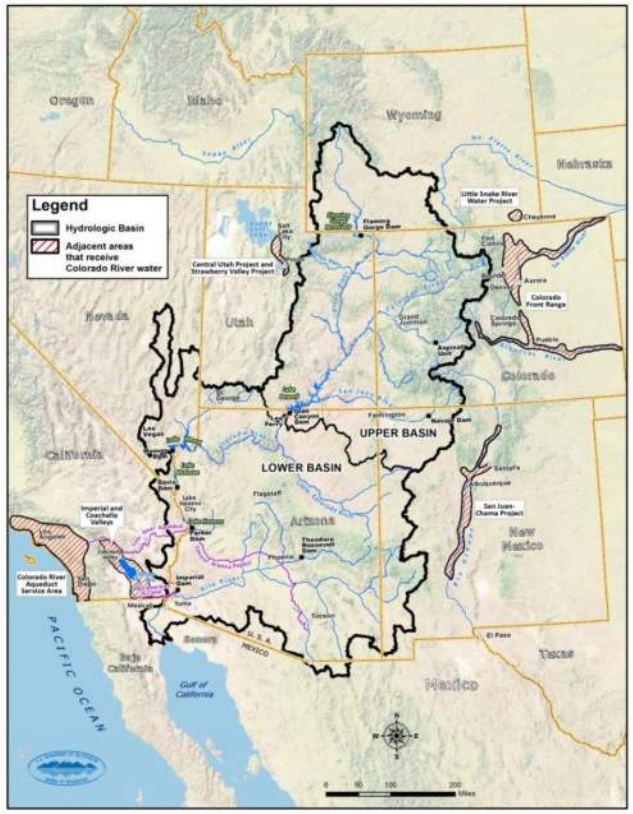
Water Supply Availability and Demand Analysis

- Analysis was focused on Lower Basin States and Baja California and Sonora
- Colorado River Basin (CRB) is subjected to frequent long-term drought conditions
- There is persistent risk to all water use sectors, which is exacerbated by uncertain future climate conditions
- CRB has experienced consistent population increases, which are projected to continue
- The Lower CRB is home to some of the most prolific agricultural areas in the world



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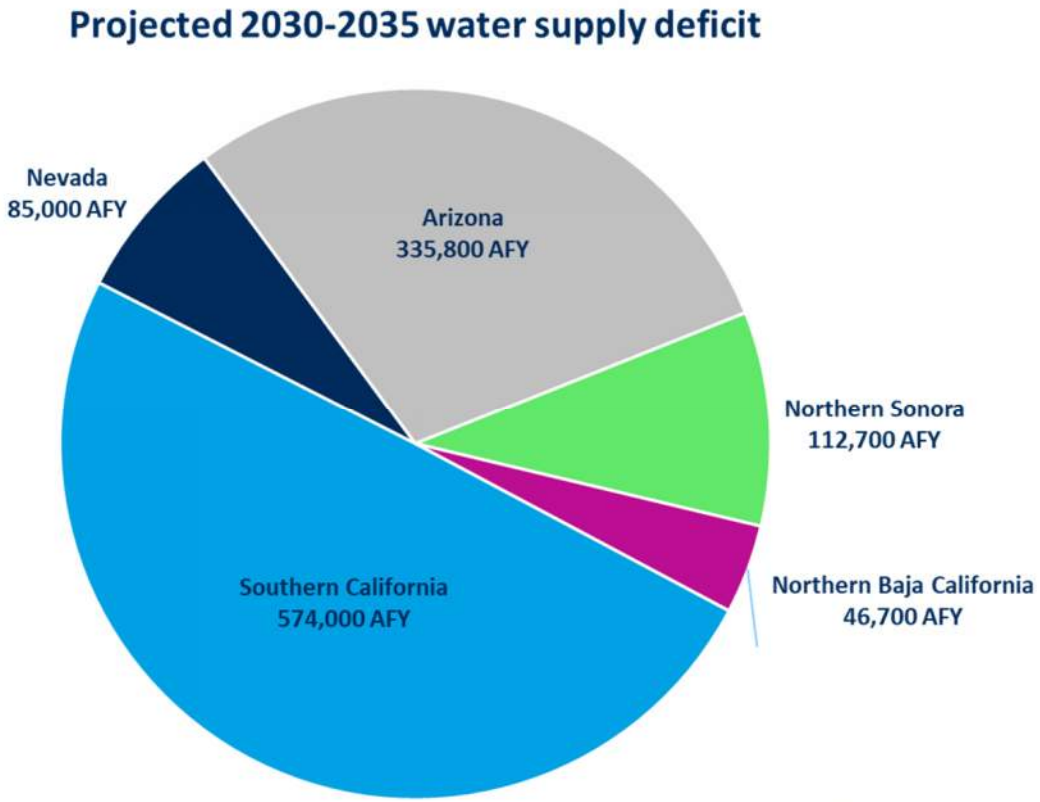
Water Supply Availability and Demand Analysis

- Identified current and projected water supply and demand imbalances in Sonora and Baja California, Mexico and the Lower Colorado River Basin of the United States
- Potential deficit for the total study area is conservatively estimated at 1.2 maf
- Projected imbalance warrants exploration of augmentation projects of this magnitude



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Desalination Technologies and Brine Management Options

- The appropriateness of current technologies was evaluated
- The following concepts were recommended to be carried forward:
  - Desalination technologies:
    - Seawater reverse osmosis
    - Thermal desalination for existing co-location sites
  - Brine management options:
    - Ocean discharge and dispersion for coastal desalination facilities
    - Deep well injection for inland desalination facilities
- Incorporation of seawater pumped-storage was considered when appropriate site conditions exist

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Potential Desalination Opportunities

- Work Group members identified 9 potential desalination concepts that were refined into 5 desalination opportunities for evaluation
- All opportunities:
  - Assumed delivery of treated water to the Northerly International Boundary (Morelos Dam) for exchange of Colorado River water
  - Utilized ocean discharge/dispersion for brine management
  - Were evaluated for a plant capacity size of 100,000 AFY to allow for a consistent comparison of the opportunities
  - Assumed a treated water TDS concentration of 500 mg/L (opportunity for improved water quality and salinity management)

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Potential Desalination Opportunities

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Potential Desalination Opportunities Considerations

- Land use mapping
- Marine works conceptual design
- Desalination facilities conceptual design
- Treated water conveyance conceptual design
- Power availability/power transmission facilities
- Federal, state, and municipal permitting/regulatory considerations
- Environmental and socio-economic considerations
- Constructability considerations
- Capital and operation and maintenance costs
- Near-field brine dispersion modeling

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Cost Estimate

COST COMPONENT	UNIT	OPPORTUNITIES 2 + 5 OPORTUNIDADES 2 + 5	OPPORTUNITIES 2 + 1 OPORTUNIDADES 2 + 1	OPPORTUNITIES 5 + 1 OPORTUNIDADES 5 + 1
Total capital cost Costo de capital total	USD MXN	$4,744,605,036 $91,172,330,371	$4,906,179,692 $94,277,148,961	$4,509,251,032 $86,649,767,830
Annual amortized capital cost Costo anual de capital amortizado	USD MXN	$308,643,366 $5,930,890,921	$319,154,030 $6,132,863,840	$293,333,251 $5,636,691,751
Annual operational cost (2019) Costo operativo anual (2019)	USD MXN	$155,369,000 $2,985,570,704	$148,391,000 $2,851,481,456	$196,558,000 $3,777,058,528
Net present value (2019) Valor presente neto (2019)	USD MXN	$12,300,351,749 $236,363,559,209	$12,297,126,544 $236,301,583,670	$13,368,271,764 $256,884,710,217
Net present value unit cost Costo unitario del valor presente neto	$USD/AF $MXN/m^3	$2,050 $31.94	$2,050 $31.94	$2,228 $34.71

Assumes a nominal interest rate of 5%, an inflation rate of 3%, a real interest rate of 1.9%, and 30 years for both the amortization and life cycle periods.

An exchange rate of 19.216 Mexican Pesos (MXN) to 1 US Dollar (USD) was used in the estimate.

Opportunities were combined in order to present life cycle unit costs based on an overall exchange opportunity of 200,000 AFY

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Study Conclusions

- 30-year net present value unit cost ranged from $2,000-$2,200/AF for an exchange opportunity of 200,000 AFY
- $2,000/AF is consistent with other existing/proposed projects to develop sources of new water
- This study demonstrates that a potential binational desalination project located along the Sea of Cortez is both technically and economically feasible
- The study did not and was not intended to recommend specific sites or projects for development or implementation
- Implementation of a project will require concurrence of both nations through a Minute

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Recommended Next Steps

- Tasks to further refine the potential opportunities
  - Additional analysis to determine the optimal capacity of each opportunity
  - Investigation to define the most appropriate approach through which this project could be successfully delivered
- Additional investigation of binational desalination in the Sea of Cortez (to be completed by Mexico)
  - The ability to obtain rights-of-way for treated water conveyance needs to be confirmed
  - The ability to obtain the necessary power from the Comisión Federal de Electricidad needs to be confirmed

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Recommended Next Steps

- Development of an exchange framework
  - Currently there is no framework through which binational exchanges of water can occur for New Water Sources Projects such as desalination
  - Minute Oversight Group should analyze and consider binational exchanges for New Water Sources Projects, specifically the use of seawater versus freshwater, and provide feedback to the Projects Work Group
- Comparison to other identified projects
  - Section IX.B of Minute 323, “New Water Sources Projects,” noted the existence of other opportunities for joint cooperative projects
  - Efforts will be undertaken by the Projects Work Group to gather and/or develop the information necessary to allow for a comparison of these potential new water source projects

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Report Links

- Executive Summary

  https://www.cap-az.com/documents/departments/planning/colorado-river-programs/Binational-Desal-Study-Executive-Summary.pdf

- Technical Memoranda

  https://www.ibwc.gov/Files/TMs_All_Portfolio.pdf

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