Chapter 7

Increase Water Supply

Table of Contents

Table of Figures

Tables

Chapter 7. Increase Water Supply

Imperial Region resource management strategies to increase the water supply are discussed in this chapter, which is organized as follows:

- Groundwater Development, Storage, Banking and Conjunctive Management
- Recycled Municipal Water
- Desalination
- Source In-Lieu Use
- Matching Water Quality to Use
- Conveyance-Local
- Surface Storage-CALFED, Regional, and Local
- Precipitation Enhancement

This chapter and subsequent chapters present an introduction to the topic followed by:

- Findings and recommendations
- Historic conditions
- Opportunities
- Constraints
- Integration and relation to other resource management strategies
- Support for mitigating or adapting to climate change

7.1 Groundwater Development, Storage, and Conjunctive Management

Prior evaluation of groundwater development, storage, banking, and conjunctive use is reported in Appendices B and M. This information was available to the Water Forum during review of the groundwater strategies. The groundwater banking and storage project concepts on the East Mesa and in the Coachella Valley Water District were proposed for further development.

Groundwater development is the use of wells to economically extract water from a groundwater basin or aquifer system for beneficial use. Ideally, the total amount of groundwater extracted annually is balanced with the amount of water recharged naturally or through intentional groundwater recharge.

Groundwater storage and banking is the intentional recharge of surface water in the available and manageable groundwater basin storage space. Recharge can be through spreading ponds, injection wells, unlined canals, or through surface water substitution for groundwater pumping. Surface water substitution, also known as in-lieu recharge, leaves the groundwater that would have been pumped in the groundwater basin for future extraction and use. Groundwater storage and banking should include active monitoring and accounting for all recharge and extraction operations.

For groundwater storage operations, locally controlled groundwater basins and facilities are used to store and manage available surface water. On the other hand, groundwater banking involves providing or subscribing to services for use groundwater basins and facilities that are not directly under the control of the agency with available surface water.

For example, Imperial Region interests could build groundwater storage facilities in the Imperial Region to store the Region's Colorado River supplies (groundwater storage) and also to provide groundwater banking services to others, thus creating a revenue stream and sharing of costs.

Alternately, available Colorado River water could be banked in a groundwater basin through agreements to access groundwater storage space using facilities under the control of another agency.

Groundwater storage operations must not result in the degradation of any potable groundwater basin that has been designated by the USEPA as a Sole Source Aquifer for drinking water purposes where the vast majority of overlying domestic users take groundwater from individual domestic wells without any treatment.[1]

Conjunctive water management is the coordinated and combined use of surface water and groundwater to increase the overall water supply to a region and improve the reliability of that supply. Conjunctive use implies some safe or sustainable yield from the groundwater basin (USBR, 1992).

7.1.1 Findings and Recommendations

Draft Groundwater Development, Storage, and Conjunctive Use findings were prepared November 25, 2010; reviewed by the Projects Work Group on November 18, 2010; discussed at the Water Forum on November 19, 2010; and confirmed by the Projects Work Group on January 19, 2011. At the March 2011 Water Forum meeting, the Water Forum adopted the following priority for the Imperial IRWMP:

> *Groundwater storage and banking is the IRWMP number one priority to maximize Imperial Irrigation District's (IID) annual water supply entitlement and minimize underruns.*[2]

7.1.1.1 Findings

On April 14, 2011, the Water Forum adopted the following findings:

[1] For example, the Ocotillo-Coyote Wells groundwater basin in southwest Imperial County where USGS scientists believe there is no significant natural recharge. This Sole Source Aquifer is outside the IID Colorado River water service area.
[2] The IID system is said to have an 'underrun' when demand is less than the full entitlement available for diversion. During underrun years, other California interests with junior water right priorities can divert and beneficially use the water that IID is not able to use. IID is seeking to develop opportunities to divert and store this water to increase water supply reliability in the Imperial Region.

- ***Imperial IRWMP Goals and Objectives*** - development of groundwater storage and banking of Colorado River underruns would help to meet the goal to diversify the regional water supply portfolio and ensure a long-term, verifiable, reliable and sustainable supply to meet current and future agricultural, municipal, commercial, industrial, and environmental demands. Groundwater banking and storage would help meet objectives by:
    - Helping to avoid impacts to existing users
    - Providing a firm, verifiable, and sustainable supply
    - Supporting protection of surface water rights by putting the underrun water to beneficial use and by optimizing the Colorado River entitlements

- ***Complexity***
    - Groundwater storage and banking locally in the East Mesa would require integration with the desalination strategy. Legal, political, and technical issues need to be addressed, but no fatal flaws were identified. Facilities need to be consistent with U.S. Bureau of Land Management plans and policies if federal lands are used. This would necessitate compliance with National Environmental Policy Act (NEPA). Technical issues related to water quality, hydrogeology, and operations need to be further addressed.
    - Inter-regional groundwater storage and banking in the Coachella Valley, either through use of Coachella Valley Water District (CVWD) facilities or development of IID facilities within the Coachella Region consistent with the existing Quantification Settlement Agreement (QSA), are technically feasible, but require further study and analysis of specific site conditions. There are more political and legal complexities when compared to locally controlled facilities or groundwater storage areas.

- ***Resolve Conflicts, Colorado River*** - Groundwater banking and storage of underruns is consistent with existing agreements, though junior appropriators that use the underruns will likely resist development of projects to bank or store this water.
- ***Resolve Conflicts, Imperial Region*** - Groundwater banking and storage of underruns could provide a firm, verifiable, and sustainable supply for new users in-lieu of apportioning Colorado River supplies from current users to the new users. This would support land use agencies when making findings and determinations on available supplies and impacts to current users pursuant to state law. This will result in reducing the potential for local conflicts between the IID and the land use agencies, between current and future water users, and between the types of use.
- ***Regional Benefits*** - Groundwater storage and banking would provide benefits to all of the Region’s Colorado River water users by increasing the reliability of the supply, protecting the local water rights, and ensuring reasonable and beneficial use.
- ***Timeliness*** - Groundwater banking and storage projects need to be further defined through feasibility study and/or additional pilot and demonstration projects. Project alternatives are still being developed and compared, and a preferred alternative has not been selected. Further exploration, field work, and pilot or demonstration projects would fill data gaps, test and demonstrate the technologies and operational concepts, and support completion of alternatives evaluations and final design of full-scale projects.

- ***Political Acceptability, Local*** - With the exceptions of the West Mesa, there is support for groundwater storage and banking of underruns. Such support is expected to increase with greater understanding and awareness of the need to protect Colorado River water rights. Ability to pay and willingness to pay, cost-benefit analysis, cost distribution, and fiscal evaluation have not been fully determined and require additional economic evaluation to gage acceptability and to compare to other structural and non-structural alternatives.
- ***Political Acceptability, Inter-regional*** - Groundwater storage and banking in the Coachella Region could be favorably regarded by the interests in that region depending on the terms and conditions for use of the storage space in their basins.
- ***Adapting to Climate Change*** - Groundwater banking and storage would allow the Imperial Region to make maximum use of the IID water rights and improve the ability for the Imperial Region to respond to variable climate conditions. Regardless of the long-term effects of climate change to Colorado River Flows, whether increase or decrease to the flows, groundwater banking would help the Imperial Region respond to vulnerabilities, make maximum beneficial use of the current entitlements, and help meet Imperial IRWMP objectives.

Additional Specific Findings

- ***Groundwater Development*** - There are very limited opportunities for further groundwater development due to basins approaching or currently exceeding safe or sustainable yields (overdraft), low rates of natural recharge, and/or poor quality waters.

    - ***West Mesa***. The Ocotillo-Coyote Wells Groundwater Basin[3] area of the West Mesa is at or exceeding the sustainable yield and further development or use of these resources would need to be consistent with the Imperial County Groundwater Ordinance and existing policies to prevent additional local overdraft.
    - ***East Mesa.*** Groundwater development on a large scale (greater than 25,000 acre-feet per year) may not be sustainable over the long-term (50-year planning horizon) since there is limited natural recharge or sustainable yield; water quality is variable and in most areas brackish; and the potential for subsidence is unknown.
        - Large-scale development may have to be coupled with desalination and a recharge program to be viable.
        - Additional study is needed to determine the feasibility of additional groundwater development.
        - Groundwater in storage in the East Mesa is mostly the result of the leakage from the historical operations of the irrigation canals.
        - East Mesa groundwater development coupled with desalination of the brackish groundwater would take advantage of water in storage, but would still result in depletion of groundwater over time unless integrated with strategies to recharge and store Colorado River water.
    - ***Blending East Mesa Brackish Groundwater*** with Colorado River water to extend this supply would increase the salt content and impact agricultural uses, but such blended

[3] Ocotillo-Coyote Wells Groundwater Basin, as defined by US EPA Sole Source Aquifer Designation. CFR Vol 61, No. 176. September 10, 1996. Projects relying on and overlying the Ocotillo-Coyote Wells Groundwater Basin shall be based on safe yield considerations and resource constraints to protect correlative rights of overlying users.

water could be matched to beneficial uses where a lower water quality may be acceptable.
    - ***Central Imperial Valley*** development of brackish groundwater would require desalination.

- ***Groundwater Storage and Banking*** - Groundwater storage and banking of underruns should be the highest priority for the Water Forum and Imperial IRWMP.

    - Local areas for groundwater water management strategies that were carried forward and where reconnaissance-level projects have been configured for purposes of comparison and feasibility analysis include:
        - East Mesa groundwater development and desalination with recharge
        - East Mesa, Sand Hill, and Pilot Knob groundwater storage
        - IID groundwater bank development in the Coachella Valley
    - A potential timely, near-term solution would be to bank IID water through agreements with the CVWD and subscribe to the existing and/or expanded groundwater banks. The Coachella Region has an existing groundwater management plan.
    - Groundwater storage and banking projects are mid- to long-term opportunities. Specific groundwater storage and banking projects require further feasibility study and site investigations to better define water quality, hydrogeology, and design parameters; to optimize the recharge/extraction operations; and to compare local and inter-regional opportunities.
    - The following local and regional groundwater development and storage strategies have been eliminated from further consideration in the Imperial IRWMP based on technical feasibility or institutional constraints:
        - Central Imperial Valley Upper Aquifer
        - Central Imperial Valley Deep Aquifer
        - West Mesa groundwater development and large-scale banking
        - Arizona groundwater bank

- ***West Mes*****a -** The concept of in-lieu groundwater recharge should include providing Colorado River water to existing high volume industrial water users in-lieu of groundwater pumping to reduce the pressure on local groundwater supplies, and reduce or avoid overdraft.
- ***Groundwater Management Plan*** - The Imperial IRWMP will need to include groundwater management plan elements to meet requirements for state grant funding; support storage of Colorado River underruns in the Imperial Region; to make best use of the Imperial County and IID make best use of the Imperial County and IID authorities and responsibilities; and to protect current overly**ing users.**

7.1.1.2 Recommendations[4]

1. The number one priority for the Water Forum should be to develop groundwater storage and banking facilities, to capture Colorado River underruns, and protect local water rights.

[4] Recommendations were numbered for ease of reference.

2. Develop groundwater management plan elements in the Imperial IRWMP to support groundwater storage and banking projects and meet requirements for state grant funding.
3. Conduct needed feasibility studies and/or pilot and demonstration projects to obtain needed data, select a preferred groundwater banking alternative, and develop final project designs and funding requirements.
4. Seek state and federal grant funding to conduct the needed evaluations and pilot projects.

7.1.2 Imperial Region Groundwater Development and

7.1.2.1 Groundwater Development and Recharge

The groundwater basins within the Imperial Region are presented in Figure 7-1 and include portions of the Coyote Wells Valley Basin, Borrego Valley Basin, Ocotillo-Clark Valley Basin, West Salton Sea Basin, Ogilby Valley Basin, the Imperial Valley Basin, East Salton Sea Basin, and Amos Valley Basin, which in all total approximately 2,800 square miles (DWR, 1983). As described in Chapter 4, there has been very limited groundwater development in the Imperial Region. The limited development is the result of low natural recharge, limited yields and poor water quality found in many places. The availability of plentiful and inexpensive Colorado River supplies has also served to limit groundwater development. Historic groundwater conditions and the potential for groundwater development and recharge in the Imperial Region are discussed in greater detail in Appendix B.

The shallow aquifers beneath the Imperial Valley are affected by the inflow of Colorado River waters, the rate of evaporation, the depth of the agricultural tile drains beneath farm lands, and seepage from drains and rivers. Drainage from agricultural fields has resulted in local high salinity because of salt leaching, though there is good quality fresh water from irrigation canal seepage in other areas. Recharge by underflow from tributary areas is small compared to recharge that came from imported Colorado River water, which is the largest source of recharge into shallow groundwater aquifers. Historically, the All-American, Coachella, and the East Highline canals contributed to recharge because they were unlined. Canal lining and well recovery systems have been developed over the past 20 years to conserve water and reduce delivery losses.

Figure 7-1 presents a map of areas where recharge is occurring, or may occur through development of recharge facilities. Recharge conditions in the region are dictated by the permeability of the topsoil and the underlying sediments. Figure 7-1 shows ancient Lake Cahuilla, which deposited an extensive clay layer that underlies the central Imperial Valley and reduces or precludes water from recharging the lower sediments.

Outside of the area where the clay layer is present, there are highly permeable soils overlying the East and West mesas.[5] The best available soil data was used to map permeable areas; however, soil data was not available for the entire East Mesa, which results in an abrupt eastern boundary of the permeable soils layer on Figure 7-1.

[5] Hydrologic soils group A in the USDA Soil Conservation Service Maps was used to indicate areas with high permeability.

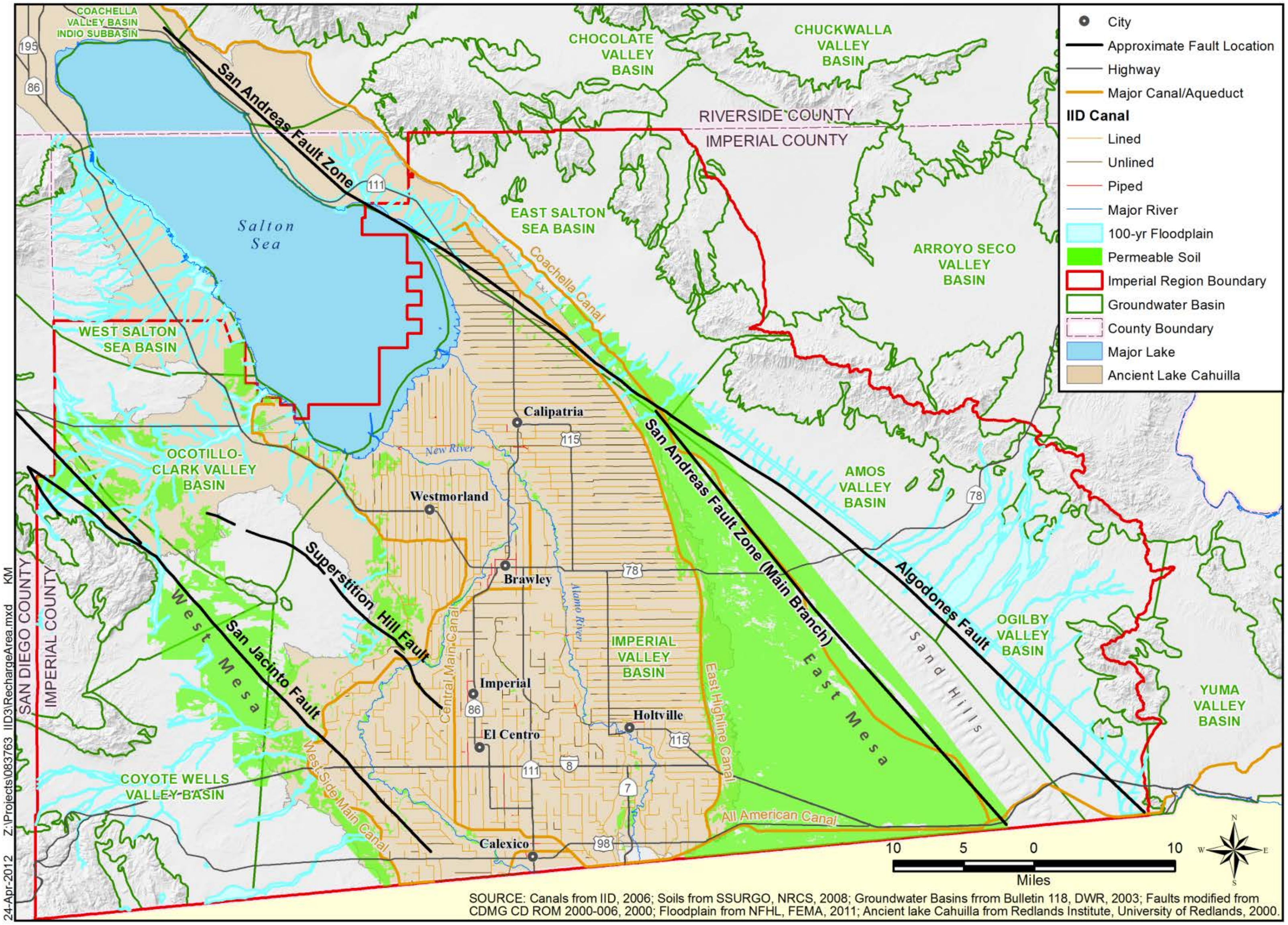

Figure 7-1. Imperial Region Recharge Areas

Direct recharge from rainfall is a minor part of the groundwater budget. However, on higher alluvial slopes and in the washes and drainages that discharge to the central part of the valley and the Salton Sea, precipitation can be sufficient for runoff to concentrate and infiltrate to groundwater. The location of 100-year floodplain was used to indicate areas where natural runoff could percolate and recharge the groundwater basins in the East and West Mesa. The Federal Emergency Management Agency (FEMA) has not mapped the 100-year flood plain in the East Mesa west of the Sand Hills area.

Figure 7-2 shows the proposed East Mesa Groundwater Management Area (East Mesa GMA). It includes the area east of the East Highline Canal out to the Algodones Fault, which defines the groundwater basin boundary. If recharge projects are to be developed in the East Mesa GMA, monitoring programs will be designed consistent with the County Groundwater Ordinance and project specific environmental documentation. The monitoring program would be developed to track project performance, and to ensure that any potential impacts or third party effects are monitored.

The West Mesa has not been designated a groundwater management area since the Water Forum and stakeholders eliminated the area based on technical feasibility and institutional constraints.[6]

[6] See Findings, Section 7.1.1.1

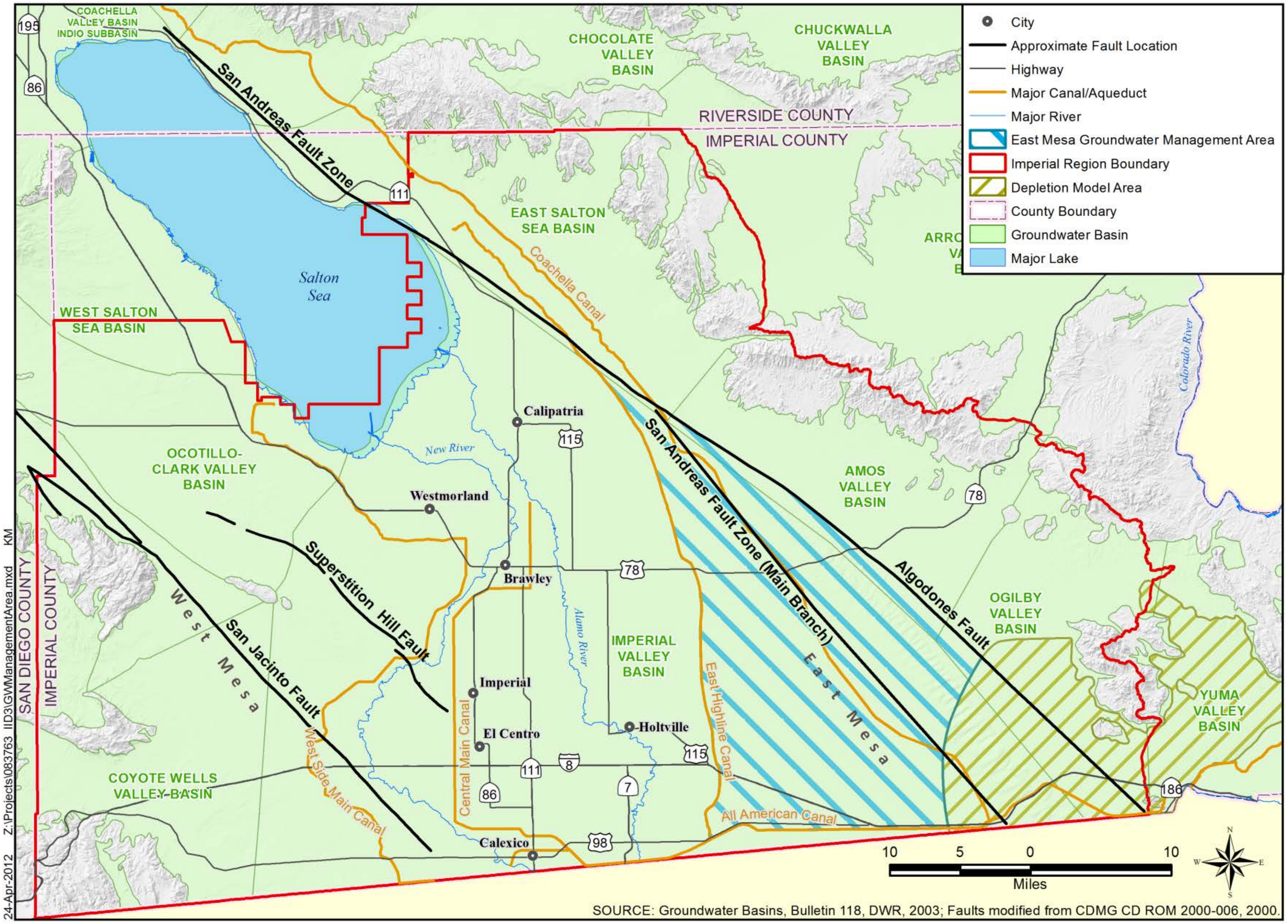

Figure 7-2. Proposed East Mesa Groundwater Management Area

7.1.2.2 Groundwater Management

There are three basic methods available for managing groundwater resources in California: (1) local government groundwater ordinances or joint powers agreements, (2) management by local agencies under authority granted in the California Water Code or other applicable State statutes, (3) court adjudications, and (4) through appropriation.

7.1.2.2.1 Local Ordinance and General Plan

Imperial County is responsible for groundwater management in the Imperial Region under the land use planning and police powers of the Board of Supervisors. Imperial County provides local groundwater management through the County Groundwater Ordinance and under the Water Element of the Imperial County General Plan (Imperial County 2003c).

Two Imperial County ordinances provide the foundation for managing and protecting groundwater within the County, including regulating groundwater storage and banking, requiring monitoring, and defining the well and project permit process and opportunities for public involvement. County requirements for managing groundwater are defined in Title 9, the County Land Use Ordinance, which provides comprehensive land use regulations for all unincorporated areas.[7] Title 9 includes Division 21 – Water Well Regulations, and Division 22 – the County Groundwater Management Ordinance.

The General Plan Water Element identifies and analyzes the sources and availability of water within the County and establishes policies and programs to maintain, conserve, and preserve the supply quality; and to provide for the management and wise use of water resources for groundwater recharge.[8] The Water Element states that the County of Imperial shall:

- Make every reasonable effort to limit or preclude the contamination or degradation of all groundwater and surface water resources in the County.
- Direct the departments to review existing ordinances, policies, and guidelines and determine their adequacy in protecting groundwater from contamination.
- Coordinate with the state and federal agencies to ensure that these agencies are taking active steps to protect and reclaim groundwater from contamination.
- Encourage inter-agency and inter-jurisdictional coordination and cooperation for management of groundwater recharge.
- Require active consultation with other agencies regarding the limitation or elimination of impacts to surface and groundwater resources due to agricultural and urban development.
- Regulate land development to protect the limited, but important areas that contribute to groundwater recharge.

[7] <http://www.icpds.com/?pid=573>
[8] Water Element Objective 5.1

7.1.2.2.2 County Management through IRWMP and GMP

The California Water Code[9] defines the requirements for a Groundwater Management Plan (GMP).[10] The groundwater basins have not been adjudicated by the courts. None of the urban water suppliers are currently reliant on groundwater, but could be participants in future plans to fund, build, and operate groundwater recharge, banking, and conjunctive management projects to meet Imperial IRWMP goals to store Colorado River water and protect the Imperial Region's rights and entitlements. None of the 2010 UWMPs projected a need for groundwater to be pumped by any of the urban water suppliers.

Both Imperial County and Imperial Irrigation District have the authority to manage the groundwater resources within the County through California Water Code, Division 6, Part 2.75 (Sections 10750 et seq.).

Legislative Requirements. Groundwater management in California is planned and coordinated locally to ensure a sustainable groundwater basin to meet future water supply needs. With the passage of AB 3030 in 1992, local water agencies were provided a systematic way of formulating Groundwater Management Plans (GMPs).9 AB 3030 also encourages coordination between local entities through joint power authorities or Memorandums of Understanding (MOU).

AB 3030 was amended in 2002 with the passage of the Groundwater Management and Planning Act of 2002 (SB 1938). The act amends existing law related to groundwater management by local agencies. The law requires any public agency seeking State funds administered through the California Department of Water Resources (CDWR) for the construction of any groundwater projects or groundwater quality projects to prepare and implement a GMP with certain specified components. Prior to this legislation, there were no required plan components. New requirements include establishing Basin Management Objectives, preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management.

New Requirements Since 2002. AB 359[11] expanded the existing law to require local agencies to include public participation when preparing the GMP, provide specific public notification, and include a recharge area map in the GMP.

SB x7-6 was approved by the Governor of California in November 2009. The bill directed CDWR to establish a statewide groundwater monitoring program. The purpose was to establish groundwater elevation monitoring programs by local entities in each groundwater basin or subbasin in California, and make the collected data available for planning. The local entities would work with CDWR to develop appropriate groundwater elevation monitoring plans. CDWR has established the California Statewide

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[9] CWC Division 6, Part 2.7, § 10750-10795
[10] An adopted GMP is required to pursue State grant funding for groundwater project from California Department of Water Resources (CDWR) Proposition 84 IRWMP grant program <http://www.water.ca.gov/irwm/index.cfm>; and for the Local Groundwater Assistance grant program <http://www.water.ca.gov/lgagrant/>
[11] Chaptered by Secretary of State - Chapter 572, Statutes of 2011

Groundwater Elevation Monitoring (CASGEM) program to manage, track, and evaluate groundwater data and monitoring results.

The development of a CASGEM monitoring plan is important for Imperial County to maintain local program control and qualify for grant funding. If the County or some other local entity does not have a groundwater monitoring program, then the state is required to perform monitoring functions and the County would not be eligible for grants or loans administered by the state.[12]

7.1.2.2.3 Groundwater Monitoring

One significant gap identified to meet the State GMP requirements is related to groundwater monitoring. Groundwater monitoring programs by the County have not been active due to the limited use of groundwater. The County does not have groundwater monitoring records.[13]

Nearby water levels are currently monitored by USGS in the Sand Hills area.[14] USGS conducted a well canvas to find wells suitable for monitoring, and was able to outfit 12 wells with data loggers. Some of the wells placed in the monitoring program are also sampled for water quality. The majority of the wells are located east of the Coachella Canal. USGS is also collecting microgravity data at each well location once a year. These data can be used to monitor change in storage. In the future, the USGS plans to use the data from these wells to create a groundwater model of the Sand Hills area. Much of the USGS monitoring data for wells in Imperial County is available at the USGS websites.

In the West Mesa, the USGS monitors 20 wells in the Ocotillo/Coyote Wells Groundwater Basin (Todd Engineers, 2007).

7.1.2.2.4 Groundwater Models

Groundwater models can be used to evaluate the water budget and support the evaluation of projects and management alternatives. There have been several numerical groundwater models completed within the Imperial Region. The models could be further developed to evaluate alternatives, and to support project development, designs, and environmental review. These models include:

- The Coachella Canal Seepage model was developed by Lawrence Berkeley Laboratory in 1977.[15]
- USGS developed a 1977 computer model simulating the steady-state transport of fluid mass and heat in a shallow confined aquifer within the East Mesa area. The data for the model consisted

[12] CWC §10933.7(a). "If the department is required to perform groundwater monitoring functions pursuant to §10933.5, the county and the entities described in subdivisions (a) to (d), inclusive, of Section 10927 shall not be eligible for a water grant or loan awarded or administered by the state." "If the department is required to perform groundwater monitoring functions pursuant to §10933.5, the county and the entities described in subdivisions (a) to (d), inclusive, of Section 10927 shall not be eligible for a water grant or loan awarded or administered by the state."
[13] Personal communication, Jim Minnick, Imperial County Assistant Planning & Development Services Director, February 14, 2012
[14] Personal communication, Michael Land, USGS, February 23, 2012
[15] Narasimhan et al., 1977, 1978

of information from water wells, geothermal wells, oil test wells, and included water quality data.

- USGS developed a groundwater model for the Borrego area (USGS, 1988).
- Imperial County Groundwater Model referenced in the County Groundwater Ordinance (MWH, 1996).
- Ocotillo/Coyote Wells Basin Hydrology and Groundwater Modeling Study (Bookman-Edmonston Engineering, 1996).
- Ocotillo/Coyote Wells Basin Hydrology and Groundwater Modeling Study (Bookman-Edmonston Engineering, 2004). This was an update of the model developed in 1996 and was used for environmental analysis of the U.S. Gypsum Project.
- Lawrence Livermore National Laboratory developed a MODFLOW groundwater model (LLNL, 2008).

7.1.3 Opportunities

7.1.3.1 Groundwater Development

Groundwater development opportunities that were reviewed include:

- West Mesa
- Deep aquifer in central Imperial Valley
- East Mesa
- East Mesa blending in IID conveyance canals
- East Mesa in central Imperial Valley with blending on-site
- East Mesa with blending and conveyance in IID drains

The purpose for evaluating groundwater development potential was to:

- document if there was available natural yield to help meet forecasted future demand
- evaluate the potential to develop wellfields to either recover recharged Colorado River water or to provide brackish groundwater for desalination
- provide reconnaissance-level wellfield designs and costs

The reconnaissance-level wellfield designs and costs were prepared to configure an array of recharge projects concepts both with and without desalination and are reported in Appendix B.

7.1.3.1.1 West Mesa Groundwater Development

The safe or sustained yield of this area is limited and current levels of development are probably at, or exceeding, the natural recharge rates, but there is uncertainty and varying interpretations of the available data. Groundwater of good quality can be found in the Ocotillo-Coyote Wells Groundwater Basin in the West Mesa. In the western section of the valley, water quality varies widely. Almost all of the wells in Coyote Valley had total dissolved solids concentrations below 500 mg/L; however, West

Mesa wells had levels between 1,800 and 5,200 mg/L (Imperial County, 2003). The area has been designated a sole source aquifer[16] by the U.S. Environmental Protection Agency (USEPA). Furthermore, local development for specific projects would be reviewed under requirements of the County General Plan, Groundwater Ordinance, and pursuant to California Environmental Quality Act (CEQA). Additional groundwater development in the West Mesa is not considered viable as a regional strategy for the Imperial IRWMP.

7.1.3.1.2 Deep Aquifer in Central Imperial Valley

The central portions of the Imperial Valley are underlain by at least two regional aquifers. The upper aquifer is about 200 feet thick and may contain 0.8 million acre-feet of water. The aquifers are for the most part relatively thin sand beds. Recovery of water could be by wells or drains, but they are hampered by low aquifer permeability, poor and highly variable water quality, and other impacts such as land subsidence. The deep aquifer beneath the central irrigated area is about 600 feet thick and may contain 24 million acre-feet of water. The aquifers are relatively thick sand beds that could be more favorable for developing higher capacity wells. The salinity of the groundwater ranges from a relatively low 700 to 3,330 mg/L, which makes treatment of the water more feasible. The full extent of the aquifer is unknown and its hydraulic interconnection to the upper aquifer is poorly understood. There is insufficient geologic information to ascertain the source area for recharge to the deeper aquifer. There is limited development potential for direct use without treatment to improve water quality, but this water could provide brackish water for desalination, or could be blended with Colorado River water to reduce the salinity of the groundwater and the blended supply provided for uses consistent with water of the resultant quality. This water could be integrated with a desalination strategy.

Development of the Imperial Valley groundwater as a stand-alone strategy was eliminated from further consideration for the Imperial IRWMP because it would not provide a sustainable, long-term supply.

7.1.3.1.3 East Mesa Groundwater Development

The East Mesa may have water of adequate quality to sustain limited overlying uses. There is limited natural recharge to the area and yield is minimal. For purposes of the Imperial IRWMP, groundwater development in the East Mesa would imply extraction of water that was lost from seepage from the historical operation of the East Highline, All-American, and Coachella canals. The volume of groundwater associated with canal seepage underlying these areas was estimated to be between 700,000 and 1,500,000 acre feet. The aquifer is favorable for development of high capacity wells, and water is generally of relatively good quality, with total dissolved solids (TDS) ranging from 500 to 1,000 mg/L. There is water in storage that could be economically recovered to provide an interim supply over a number of years, but development without additional groundwater recharge would deplete the water

[16] Groundwater storage operations must not result in the degradation of any potable groundwater basin that has been designated by the USEPA as a Sole Source Aquifer for drinking water purposes where the vast majority of overlying domestic users take groundwater from individual domestic wells without any treatment; see footnote 1.

in storage over time, and the resultant overdraft would be contrary to the County Groundwater Ordinance.

Development of East Mesa groundwater as a stand-alone strategy was eliminated from further consideration in the Imperial IRWMP because it would not provide a sustainable long-term supply.

Development of brackish groundwater in the East Mesa could be a sustainable practice as part of an integrated strategy for groundwater development, recharge and storage of Colorado River water to prevent overdraft, desalination or matching water quality to an appropriate beneficial use. East Mesa groundwater development would help to evacuate storage for subsequent groundwater recharge and storage operations.

7.1.3.1.4 East Mesa Groundwater Development with Blending in IID Conveyance

This strategy would include pumping of East Mesa brackish groundwater and blending the water with Colorado River water in either the All-American Canal or East Highline Canal for delivery to agricultural users. The increase in groundwater pumping could then be accounted for as the supply to meet new MCI demands. Blending groundwater would increase the salinity of the delivered water. The increase in salinity results in increased irrigation water demand to satisfy salt leaching requirements. Preliminary reconnaissance-level evaluations were conducted. Different pumping amounts were calculated based on varying the groundwater quality and the allowable increase in salt concentrations of the blended Colorado River supply (GEI, 2009c), and of the potential effects of increasing water salinity on crop water needs (Davids Engineering, 2009). The additional groundwater pumping to satisfy increased on-farm demands, with varying total pumping and groundwater salinity, are shown in **Error! Reference source not found.**.

The net increase in supply is less than the total water pumped due to the increased application rates required to leach salts and maintain crop productivity. For example, total groundwater pumping of 50,000 acre-feet per year would result in a net increase in supply of 46,648 acre-feet per year if groundwater started at 1,000 ppm of total dissolved salt. This was factored into the sizing of wellfields. In general, the increase in total water requirements for a given groundwater salinity, blending ratio, and crop are small. It is likely that adjustments to irrigation and other management practices in response to small increases in water salinity will be small; however, over time and in aggregate it is anticipated that growers will respond by applying additional irrigation water to maintain salt balance in the root zone in order to maintain crop production.

Table 7-1. Pumping Needed to Satisfy On-Farm Demands with Varying Groundwater Salinity, Acre-Feet

Total Groundwater Pumping Volume	Net Supply		
	Groundwater Salinity		
	1000 ppm	2000 ppm	3000 ppm
1,000	932	656	380
5,000	4,660	3,283	1,904
10,000	9,321	6,569	3,810
15,000	13,983	9,858	5,720
20,000	18,646	13,152	7,634
25,000	23,311	16,449	9,550
30,000	27,976	19,750	11,470
40,000	37,310	26,362	15,319
50,000	46,648	32,988	19,180
60,000	55,991	39,628	23,055
70,000	65,337	46,283	26,942
80,000	74,687	52,951	30,842
90,000	84,042	59,634	34,755
100,000	93,401	66,330	38,680
110,000	102,763	73,040	42,617
120,000	112,130	79,763	46,568
130,000	121,500	86,500	50,530
140,000	130,874	93,251	54,505
150,000	140,252	100,015	58,493

Development of brackish groundwater in the East Mesa and blending in IID Conveyance Canals for agricultural use was eliminated from further consideration due to concerns expressed by growers related to the increase in salinity and potential impacts on production.

7.1.3.1.5 East Mesa Groundwater Development with Blending On-Site

This element would include pumping East Mesa brackish groundwater, blending with Colorado River supplies at a project site and matching the resultant water quality to potential economic uses. For example, using brackish water to grow algae and produce high value co-products. Where existing IID turnouts are available, new conveyances would not need to deliver Colorado River water for blending with groundwater. This strategy could extend the Colorado River supply and be integrated with desalination. Saline water from agricultural and municipal wastewater can be blended to grow algae, as part of an integrated regional strategy to manage and control dust on the playas along the Salton Sea, to support Salton Sea enhancement, or provide feed water for desalination.

7.1.3.1.6 East Mesa Groundwater Development with Blending and Conveyance in IID Drains

This element would include pumping East Mesa brackish groundwater, blending with Colorado River supplies and conveyance using IID drains, new canals or pipelines, to deliver water to locations that can use the resultant water quality for an economically viable beneficial use such as algae production. This strategy could extend the Colorado River supply and be integrated with desalination. In addition, saline water from agricultural and municipal wastewater can be blended to grow algae, as part of an integrated regional strategy to manage and control dust on the playas along the Salton Sea, and to support Salton Sea enhancement or provide feed water for desalination.

7.1.3.1.7 Wellfield and Conveyance Conceptual Designs

Wellfields and pipelines were configured to extract and deliver brackish water to desalination facilities; extract and deliver clean recharged Colorado River water to existing canals for direct delivery, and/or to evacuate groundwater storage so Colorado River can be recharged (Appendix B). Aquifer characteristics from available data were used to determine the potential well pumping rate over the 30-year life of the concept projects, and analysis was conducted to space wells to limit interference. The work provided reconnaissance-level costs to compare a range of integrated alternatives. Since the largest forecasted future water demand is planned for geothermal energy projects, wellfields were configured to serve the East Brawley, East Mesa, Heber, and Salton Sea known geothermal resource areas (KGRAs). Preliminary designs and costs for wellfields were developed to supply 5,000 acre-feet per year (acre-feet per year), 25,000 acre-feet per year, and 50,000 acre-feet per year of brackish groundwater to the KGRA desalination plants. Costs also included pipelines to municipal systems when integrated with desalination strategies. Appendix B contains conceptual sketches of the wellfields, recharge sites, and pumped and finished water distribution systems for the desalination program.

7.1.3.2 Groundwater Storage, Banking and Conjunctive Management

Development of groundwater storage and banking facilities requires a source of good quality water; conveyance facilities to put water into groundwater storage (canals, pipelines, recharge ponds); facilities to extract water from storage and deliver the water to the point of use (wells, canals, or pipelines); and recharge areas with appropriate groundwater conditions. The type of groundwater storage and banking being considered is sometimes referred to as a "put and take" operation. Operational scenarios and facility designs are based on the timing and amount of the available supply and user demand. Conveyance includes using the existing regional Colorado River delivery canals when there is available capacity and developing smaller conveyances to move water into and out of the recharge area or wellfields used to recover recharged water. Developing recharge ponds requires access to relatively large tracts of land. In areas like East Mesa where the groundwater levels are relatively high, groundwater can be pumped to make storage space available. The groundwater conditions that influence site selection and design of recharge ponds and wells include permeability of the surface soils and underlying aquifers, the extent of clay layers, location of faults, groundwater quality, and current levels of groundwater use.

7.1.3.2.1 Sources of Water for Groundwater Storage

Alternative supplies available for groundwater storage or banking in the Imperial Region are limited. The potential elements and sources of water for storage or banking include:

- Colorado River water
- Local runoff and floodwaters
- Imported water acquired from other regions

Colorado River Water. Colorado River entitlements were determined to be the best and most feasible source for groundwater storage (Appendix B). Groundwater storage is a beneficial use consistent with IID Colorado River water rights and California state law. The IID entitlement is fixed, but the agricultural demands vary year to year, resulting on underruns and overruns.[17] IID could divert water in underrun years to store in a groundwater basin for future use. Figure 7-3 shows the last eight years of Colorado River overruns and underruns under the QSA/Transfer Agreements. The U.S. Bureau of Reclamations (USBR) has developed the Inadvertent Overrun and Payback Policy (IOPP) that provides accounting for overruns and manner of payback (USBR , 2003).

[17] An underrun occurs when all of the Colorado River water available is not diverted or delivered. An overrun occurs when IID has taken more water than is available under the cap to the Colorado River supply.

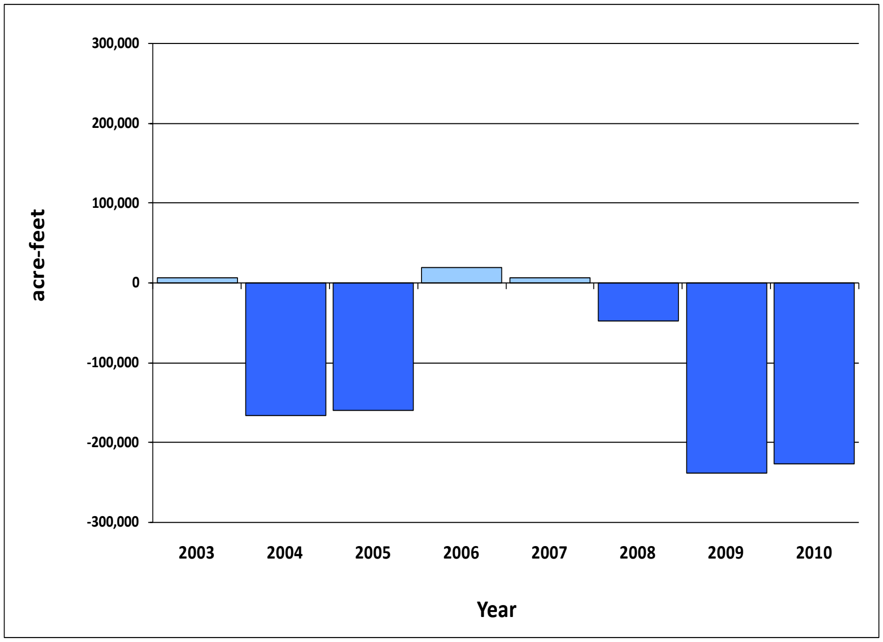

Figure 7-3. Colorado River Overruns and Underruns (2000-2010)

Not all of the underruns could be recharged for groundwater storage. It has been conservatively estimated that the annual yield could be between 19,000 and 55,000 acre-feet per year depending on the assumptions related to capping overruns, depleting groundwater storage, and how the water would be distributed (NRCE, 2009).[18] The higher yields are related to managing overruns through demand management and the IID Equitable Distribution Plan. Limiting overruns decreases the payback requirement, thus increasing the amount of water available for use or retained in storage in future years. The stored water could be pumped and used by agricultural and other current users, and/or be provided to meet future water demands to avoid potential impacts to current water users. When IID is not able to divert underrun water in any given year to store the water in the groundwater basin, those with junior rights to the Colorado River are able to divert the water.

Colorado River water averages approximately 760 mg/l total dissolved solids (Figure 7-4); however, this is a relatively high quality in comparison to existing groundwater quality in some of the areas considered for recharge and is likely better than ambient water quality in the East Mesa. This level of salinity is higher than ambient groundwater quality in the West Mesa; which is a sole source aquifer not available for development.

[18] See Appendix F

Local Runoff and Floodwaters. While local runoff and floodwaters could be used for recharge, such waters are episodic, come at a high rate and volume when available, carry large sediment loads, and face other constraints related to environmental effects and the Salton Sea.[19] Local runoff and floodwaters were removed from further review as a source of supply for recharge.

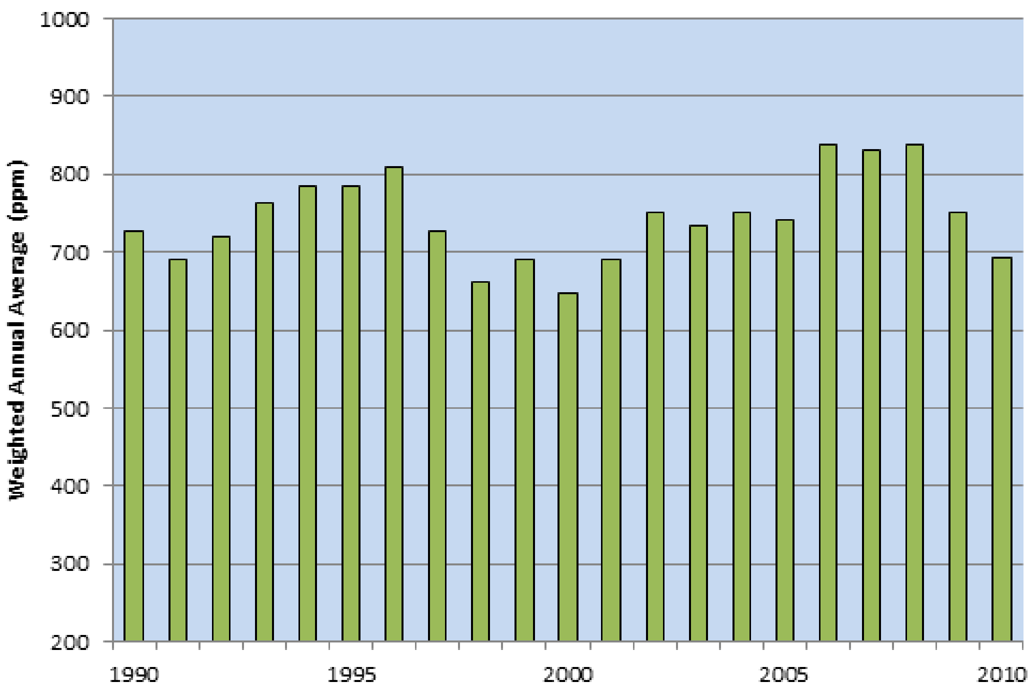

Figure 7-4. Colorado River Salinity at All-American Canal below Drop 1
Source: IID 2010 Annual Water Report

Imported Water Acquired from Other Regions. A potential source of water for groundwater storage could be water transfers into the Imperial Region from sources outside the Region. Water Forum members or other private development interests could procure water through transfer, convey (wheel) the water through existing IID canals, and store the water in regional groundwater bank. IID has adopted a wheeling policy that would allow others to convey water in its canals when capacity is available.[20] This source of water for banking was removed from further review for purposes of the Imperial IRWMP.

[19] While not relied upon for supply, local runoff and floodwaters will recharge the aquifers to some degree and should be monitored as part of a groundwater management program
[20] IID Water Wheeling Policy Adopted February 8, 2011.

7.1.3.2.2 Conveyance Facilities for Recharge Operations

The Imperial Region is fortunate to have facilities to convey Colorado River water to candidate groundwater recharge locations. For the purpose of the reconnaissance study, smaller conveyance canals were configured to move water from the main canals to proposed recharge areas and from wellfields to the point of delivery (GEI, Inc., 2009b). Colorado River water is conveyed through the 80-mile-long All-American Canal and diverted to CVWD's Coachella Canal and to IID's East Highline, Central Main, and Westside canals. There must be operational capacity in the existing conveyance at times when there is Colorado River water available for delivery to recharge sites. No capacity limitations were identified in existing conveyance facilities based on the water availability and operational scenarios that were considered. A more detailed capacity analysis should be conducted during feasibility and pre-design to refine the operation scenarios.

7.1.3.2.3 Imperial Region Recharge Areas

Recharge areas were generally described in Section 7.1.2.1. This section reviews the potential for development of specific recharge projects. It is recommended that additional feasibility study and/or pilot projects be conducted to fill data gaps, and address uncertainties to select a final preferred area and location. In October 2011, IID initiated an independent review of the prior work to determine which area in the eastern part of the Imperial Region was most appropriate, to define specific sites within the area, and to identify next steps. The next steps are included in the Imperial IRWMP implementation plan (Chapter 13).

For the Imperial IRWMP, the feasibility of wellfields and recharge facilities in East Mesa, Sand Hills, and the Pilot Knob Mesa areas were reviewed using existing data and reports. The general concept of a groundwater recharge program in the East Mesa was investigated by the Colorado River Board of California and the USBR (USBR, 1992; USBR, 1979). West Mesa groundwater storage and in-lieu storage were also explored.

The East Mesa provides the best opportunity for development of recharge and storage projects. IID entitlements to Colorado River water would be conveyed through the All-American and Coachella canals, and smaller project-specific conveyance developed to move water to proposed recharge ponds or the unlined portions of the old and unused Coachella Canal.

A 15-mile section of the unlined Coachella Canal west of the San Andreas Fault was abandoned when the lined canal was constructed. The unlined Coachella Canal has the ability to recharge about 10,000 acre-feet per year per mile (USBR, 1992). If all of the unlined section were used, up to 150,000 acre-feet per year could be recharged. Clay was used to reduce seepage from the unlined canal and removal of the clay layer might increase the percolation rate. To keep the recharge near the wellfields, modifying a two-mile long section of the unlined Coachella Canal could provide capacity to percolate 20,000 to 40,000 acre-feet per year. Wellfields would be located to remove water from storage and to recapture the recharged water.

Groundwater levels are relatively shallow in this area. This means available groundwater storage space is relatively full and would be pumped to create storage for Colorado River water. Pumped water quality may be ready for direct delivery or for blending (see Section 7.4).

In areas of saline water, water pumped to evacuate groundwater storage for recharging Colorado River waters would either need to be treated (desalination) before use or be used to match this brackish groundwater to an appropriate beneficial use. Put and take operations could be configured and tested to time recharge and pumping cycles to create and maintain a pocket of Colorado River water in the East Mesa.

Project feasibility study and field investigations should include shallow and deeper drilling in the East Mesa and evaluation of groundwater and aquifer conditions, water quality, and structural geology. This includes identifying whether the East Mesa recharge water would reach the deeper aquifer in the Imperial Valley. Should hydraulic communication exist between the East Mesa recharge area and the deeper aquifer, this could expand the recharge and storage opportunity and allow the aquifers to convey the water to a larger area within the Imperial Region. This information would also help with design of the recharge ponds and wellfield.

Possible constraints to East Mesa groundwater storage include the presence of listed species, critical habitats and/or cultural resources; and potential land use conflicts with U.S. Bureau of Land Management (USBLM), special management areas, and U.S. Navy target areas; presence of clay layers or faults; water quality; legal or political issues; ownership or entitlement to surface water seeped to the groundwater basin over the historic operation of the regional canals; projects costs; and distribution of costs and benefits. Species and habitat constraints are shown in Figure 7-5. The endangered species habitats were not considered for recharge or wellfields in the Imperial IRWMP analysis.

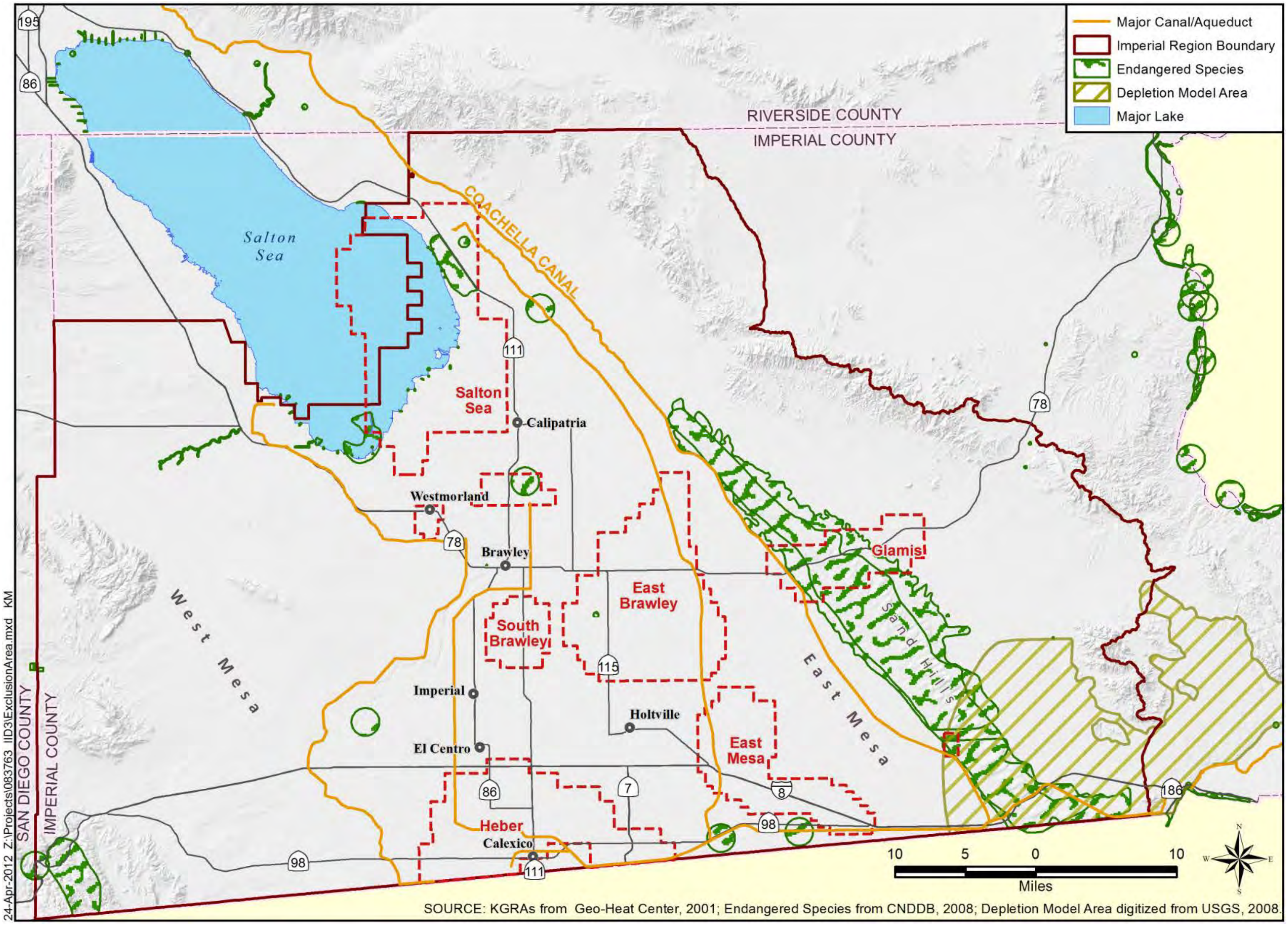

Figure 7-5. Imperial Region Endangered Species and Habitat Constraints

Approval from USBR and USBLM to use the unlined Coachella Canal for recharge would be necessary. Other concerns are related to raising the groundwater table around the existing canals and structures and the potential for flotation of the Coachella Canal lining, and the potential for liquefaction associated with seismic activity resulting in structural damage to existing facilities. Pumping groundwater to create storage would lower groundwater levels and could create a potential for subsidence if depressed below historical low levels.

Critical unknowns to be addressed pertain to the underlying geological and aquifer conditions and existing groundwater quality. The underlying geological and aquifer conditions control the recharge rate, volume and direction of flow for the recharged water, well design, and ability to recover the water. Groundwater pumping in the East Mesa, depending on the rate and depth, could induce the eastward inflow of poor quality groundwater from the central Imperial Valley aquifers, could reduce the groundwater discharge to the Alamo River, or could increase infiltration from the East Highline Canal. Additional site-specific studies and analysis of proposed put and take scenarios are needed to locate and design recharge facilities and wellfields. Further definition of groundwater quality would be required for an accurate assessment using exploratory observation wells and further sampling.

Sand Hills. Between the San Andreas main branch and Algodones faults, the Sand Hills has storage space available and recharge would be limited only by available Coachella Canal capacity. Recharged Colorado River water in this area would likely remain contained between the faults, making it more manageable. Depending on location, groundwater storage in the shallow, unsaturated zone could be limited by the relatively shallow depth to groundwater. Storage could be increased by pumping to lower the water table then refilling the storage when water becomes available. The aquifer is favorable for development of high capacity wells and water is generally of relatively good quality, with TDS ranging from 500 to 1,000 mg/L. Other constraints would be similar to the East Mesa area. This area is a viable recharge location and should be further reviewed.

Pilot Knob. The Pilot Knob area is likely to have appropriate hydrogeologic conditions and may have higher water quality than other areas. An important consideration for the Pilot Knob area is whether the groundwater is classified as part of the Colorado River Aquifer (River Aquifer) and subject to restriction of groundwater pumping. Groundwater in the River Aquifer is considered to be Colorado River water, and therefore any water pumped from the River Aquifer would be considered river water. Under California law, water recharged into an aquifer is recoverable by the party that conducted the recharge operation and put the water into storage, so any water intentionally recharged should be recoverable. According to the U.S. Geological Survey, the Colorado River accounting surface[21] did not appear to extend to areas in the East Mesa, Sand Hills, or Pilot Knob Mesa areas. The U.S. Geological Survey (USGS) subsequently published a model to define where Colorado River water was being depleted (USGS, 2008). Figure 7-5 shows the approximate extent of the Colorado River depletion model areas. The current depletion model area (see Figure 7-5) would overlap into the Pilot Knob area. It is

[21] The accounting surface was proposed in the July 16, 2008 Federal Register but was subsequently withdrawn.

unknown how this current USGS report would affect potential water banking projects in the East Mesa, and a new federal rule may emerge that uses the accounting surface or the depletion zones. Given the uncertainty, the depletion model area was not considered for recharge or wellfields in the Imperial IRWMP analysis.

West Mesa Groundwater Storage. In general, areas could be considered viable for groundwater banking if are outside (i.e., west of) the shoreline of ancient Lake Cahuilla, and up-gradient of the San Jacinto Fault (see Figure 7-1). Areas that could be technically viable are near the Carrizo Wash or Palm Canyon. The largest constraint to groundwater banking in the West Mesa is that the area is outside of the place of use for IID's existing water rights, and this would likely imply changes to the water rights permit and IID regulation. The ability to recover the water is also uncertain and the water could migrate over a large area. The area is at, or approaching, overdraft conditions. Stakeholder interests in the West Mesa area are not supportive of groundwater storage of Colorado River water due to the potential for water quality degradation of local groundwater since the groundwater is typically lower in total dissolved solids than the Colorado River water, and due to the perception that groundwater storage could increase development. The West Mesa could be a viable area from a technical standpoint, but has institutional issues and constraints that make this area a low priority when compared to other opportunities. West Mesa groundwater storage was not supported by local interests and is not recommended for inclusion in the Imperial IRWMP.

West Mesa In-lieu Storage. The concept of surface water substitution and in-lieu storage has application in the West Mesa. Colorado River water, desalinated water, or recycled water could be provided to existing groundwater users as a substitute supply (in-lieu use) of current groundwater pumping. The water left in groundwater storage (in-lieu recharge) would reduce the pressure on local groundwater supplies and reduce or avoid overdraft conditions. A project to deliver Colorado River water as a substitute supply to groundwater for industrial use at U.S. Gypsum has been proposed. No other large users were identified and further development of this concept was not included in the Imperial IRWMP.

Inter-Regional Opportunities - Coachella Valley. The California Department of Water Resources (CDWR) is encouraging IRWM planning regions to work together to develop inter-regional facilities that provide multiple benefits and support management of imported water supplies. The QSA/Transfer Agreements provide for inter-regional coordination between IID and the Coachella Valley Water District (CVWD) to store Colorado River water in the Coachella Valley groundwater basin.[22] Two groundwater storage facility concepts have been proposed and both are potential options for further development in the mid- to long-term. Both types of projects would use the same basic operating concepts: IID Colorado River water would be diverted up the Coachella Canal to be stored in the Coachella Valley groundwater basin. Extraction would be through existing groundwater wells or additional new wells.[23] The amount of the water exchanged would be subject to negotiation between CVWD and IID. For example, IID may only be able to exchange some percentage of the water placed in groundwater storage.

[22] Agreement for Storage of Groundwater by and between the Coachella Valley Water District and Imperial Irrigation District. October 2003.
[23] CVWD would trade Colorado River entitlement water for IID's stored groundwater.

Participation in Coachella Valley Groundwater Storage and Banking.

There are four recharge areas in the Coachella Valley IRWM region:

- Whitewater Spreading Area artificially recharges stormwater and State Water Project (SWP) water, with a historical peak recharge of 288,000 acre-feet in 1986.
- Mission Creek Spreading Facility recharges Colorado River water from the Colorado River Aqueductt and has a recharge capacity of 30,000 to 40,000 acre-feet per year.
- Thomas E. Levy (Dike No. 4) Recharge Facility recharges Colorado River water obtained from the Coachella Canal and has a recharge capacity of about 40,000 acre-feet per year.
- Martinez Canyon Pilot Recharge Project (Avenue 72) stores Colorado River water and currently has capacity of about 2,000 acre-feet per year. It includes 8 recharge basins on 20 acres as part of a pilot project that began operating in 2005. Long-term plans call for it to be expanded into a full-scale facility by 2014 and eventually provide up to 40,000 acre-feet per year.

In 2010, IID delivered 526 acre-feet to the Coachella Canal for groundwater storage through use of the existing CVWD recharge facilities demonstrating the opportunities available through inter-regional coordination. Use of the CVWD facilities under the groundwater storage QSA/Transfer agreement provides the best near-term opportunity for groundwater storage of Colorado River water. Specific agreements with CVWD would be needed to define conditions and costs for this alternative. This alternative is included in the Imperial IRWMP.

IID-Developed Groundwater Storage and Banking Facility in the Coachella Region. Under the groundwater storage QSA/Transfer Agreement with CVWD, IID can develop groundwater storage facilities in the Coachella Region. IID conducted reconnaissance-level evaluations for groundwater storage projects in the eastern part of the Coachella Valley that are still under review and could be further developed. Additional feasibility studies, including site-specific investigations, agreements with CVWD, acquisition of land or easements, environmental review and permitting, and design work are needed. This concept is a potential opportunity for the mid- to long-term and is an alternative included in the Imperial IRWMP.

Interstate Groundwater Storage and Banking – Lower Colorado Basin Groundwater Storage and Banking. Groundwater storage and banking in the Lower Colorado River Basin would involve diverting unused allocations to depleted groundwater basins using existing or new conveyance or recharge facilities. Groundwater storage has been pursued because limited banking is allowed in the two major Colorado River storage reservoirs at Lake Mead and Lake Powell. Water banking would require agreement between participating parties, usually requiring some form of incentive for the banking entity. An example of water banking in the Lower Basin is the Arizona Water Bank that has been diverting unused Colorado River allocations from Nevada and Arizona into a large depleted groundwater aquifer in Arizona. Nevada pays Arizona to bank its unused water. In the future, Nevada can use direct diversions from the Colorado River beyond its annual allocation and Arizona will decrease its diversions from the Colorado River by an equal amount, instead withdrawing from the banked water. The Arizona

Water Banking Authority oversees the Arizona Water Bank established in 1996.[24] An evaluation of water banking as a water supply augmentation option was completed in 2008 by the Colorado River Water Consultants for the Seven Basin States. The evaluation was focused on the Arizona Water Bank and several water banks in California. The study estimated the cost of water banking at $400 to $700 per acre-feet.

The potential for banking groundwater in Arizona or areas along the Colorado River would face a range of institutional constraints. This alternative is not considered timely, and is not recommended for further consideration in the Imperial IRWMP at this time. This concept could be part of a subsequent update and included as part of the Imperial Region's adaptive management strategy.

7.1.4 Constraints

Many of the constraints to develop specific groundwater storage and banking opportunities were discussed above. These constraints are summarized here:

- **Lack of Data and Uncertainty of Groundwater and Aquifer Conditions** - Technical constraints for further development of groundwater storage and banking projects are related to lack of historical data and information on the areas proposed in the East Mesa and Coachella Region.
- **Access to Federal Lands and Procurement of Easements and Rights of Way** - Much of the land being considered for recharge sites is in federal ownership. Easements and rights of way are needed. Some private lands may be available in areas with good recharge and groundwater conditions and these would need to be acquired. Some sections of land that are privately owned are located within the areas that are primarily under federal ownership. It could be possible to acquire these lands for development of recharge facilities and/or exchange these lands for other federal land to meet the objectives of both the Imperial IRWMP and the USBLM, acting as the federal land management agency. Use of federal lands, funding or permits requires compliance with NEPA.
- **Listed Species and Protected Habitats** - Much of the viable recharge areas are in native habitats and may be constrained by the presence of listed species and federal land and species management plans.
- **Origin and Legal Status of Groundwater** - There are policy questions related to management and access to groundwater and groundwater storage in the East Mesa. The issues are related to the origin of the water, legal status of the water, and who can recover and use the water for what purpose.
- **Need for Agreements** - Detailed agreements with the Coachella Valley interests, and development of final terms and conditions are needed for Coachella Valley storage.
- **Funding and Finance** - The costs to conduct exploration, characterize basin conditions, develop pilot and demonstration projects, and obtain information to prepare final designs may be substantial. Additional economic and fiscal analyses are needed to quantify who benefits and

[24] Proposed legislation authorizing the Arizona Water Banking Authority to obtain excess central Arizona Project Water for certain purposes be it enacted by the Arizona Legislature: Section 1. Section 45-2402, Arizona Revised Statutes, <http://www.azwaterbank.gov/awba/default.shtml>

who pays. A Proposition 218 initiative would be needed prior to changing assessments or rates for a large regional project.

7.1.5 Integration and Relation to Other Strategies

- **Desalination** - East Mesa groundwater development can be integrated with desalination strategies to meet water quality requirements for agriculture, municipal, commercial cooling water, and other industrial uses.
- **Ecosystem Restoration, Matching Quality to Use** - East Mesa brackish groundwater water could be pumped and/or blended with Colorado River water and matched to the needs of ecosystem restoration projects, algae production, or playa dust control. The use of the old Coachella Canal could include development of oasis habitats for desert species to provide multiple benefits from recharge operations.
- **Import, Transfer** - Water transferred and imported to the Imperial Region could be used in groundwater storage and banking facilities.
- **Water Quality Protection** - Increased recharge into aquifers with impaired water quality would improve groundwater quality, but could likely degrade the quality of the recharge water.
- **Land Use Planning and Management -** Groundwater banking elements could provide a new source of supply to support future water needs and provide mitigation for potential impacts to existing supplies and users.

7.1.6 Support for Mitigating or Adapting to Climate Change

Groundwater banking and storage would allow the Imperial Region to make maximum use of the available Colorado River supply and improve the ability for the Imperial Region to respond to variable climate conditions. Regardless of the long-term effects of climate change to Colorado River flows, whether it increases or decreases flows, groundwater banking would help the Imperial Region respond to supply vulnerabilities, make maximum beneficial use of the current entitlements, and help meet Imperial IRWMP objectives.

7.2 RECYCLED MUNICIPAL WATER

Recycled municipal water is water that, as a result of wastewater treatment, is suitable for a direct beneficial use, or other intentional use under a controlled environment, that would not otherwise occur[25] and is therefore considered a valuable resource. Recycled water and reclaimed water have the same meaning.[26]

The applications of recycled wastewater at the various treatment levels are defined by state and regional regulations. Table 7-2 lists minimum treatment levels for specific water uses. The permitted uses of recycled water increase with advanced levels of treatment.[27] To protect water quality and public health, state regulations mandate that producers and users of recycled water meet waste discharge and

[25] California Water Code §13050
[26] California Water Code §26
[27] California Water Plan Update 2009: Volume 2 Resource Management Strategies – Ch 11 Recycled Municipal Water

water reclamation requirements from the Regional Water Quality Control Boards (RWQCBs), including the water recycling criteria adopted by the California Department of Public Health (CDPH). These criteria specify approved uses of recycled water, numerical limitations and requirements, treatment methods, and performance standards. Regulations and policies are continuing to be developed, refined, and updated. In January 2009, the CDPH released updates to recycled water statues and regulations.

Table 7-2. Demand Sectors and Minimum Treatment Levels for Specific Uses to Protect Public Health

Type of Use	Treatment Level		
	Disinfected Tertiary	Disinfected Secondary	Un-disinfected Secondary
Urban Uses and Landscape Irrigation*	✓		
Fire protection	✓		
Toilet and urinal flushing	✓		
Irrigation of parks, schoolyards, residential landscaping	✓		
Irrigation of cemeteries, highway landscaping		✓	
Irrigation of nurseries		✓	
Landscape impoundment	✓	✓*	
Agricultural Irrigation			
Pasture for milk animals		✓	
Fodder and fiber crops			✓
Orchards (no contact between fruit and recycled water)			✓
Vineyards (no contact between fruit and recycled water)			✓
Non-food bearing trees			✓
Food crops eaten after processing		✓	
Food crops eaten raw	✓		
Commercial/Industrial			
Cooling and air condition –with cooling towers	✓	✓*	
Structural fire fighting	✓		
Commercial car washes	✓		
Commercial laundries	✓		
Artificial snow making	✓		
Soil compaction, concrete mixing		✓	
Environmental and Other Uses			
Recreational ponds with body contact	✓		
Wildlife habitat/wetland		✓	
Aquaculture	✓	✓*	
Groundwater Recharge			
Seawater intrusion barrier	✓*		
Replenishment of potable aquifers	✓*		

* Restrictions may apply

In 2009, SWRCB adopted the Recycled Water Policy whose purpose is to increase the use of recycled water from municipal wastewater sources in a manner that implements state and federal water quality laws, and streamlines permitting of projects. [28]

7.2.1 Findings and Recommendations

The Imperial IRWMP Projects Work Group reviewed the recycled municipal wastewater strategy in December 2010 and January 2011. The Water Forum reviewed and discussed the recycled municipal wastewater strategy in January 2011 and February 2011 and adopted the recycled water findings and recommendations over the course of two meetings, on March 24, 2011 and April 20, 2011.

7.2.1.1 Findings

Recycling municipal wastewater could produce "new water"; can be integrated with a disadvantaged community support strategy; help meet a state goal of 20 percent conservation by the year 2020; and could support development of a water exchange strategy.[29]

Reclaiming all forecasted future municipal wastewater flows would provide an estimated 36,000 acre-feet per year, approximately 25 percent of the forecasted future MCI demand.[30]

Findings related to the criteria used to screen the CDWR Resource Management Strategies include:

- **Meeting Imperial IRWMP Goals and Objectives** – Reclaimed municipal wastewater would help to meet the goal to diversify the regional water supply portfolio and ensure a long-term, verifiable, reliable, and sustainable supply to meet current and future agricultural, municipal, commercial, industrial, and environmental demands. Reclaimed wastewater would help meet objectives by:
    - Helping to avoid impacts to existing users by providing a new supply.
    - Supporting disadvantaged and other communities in meeting wastewater discharge and permit requirements when coupled as a regional strategy for use of water and funding facilities.
    - Matching water quality to appropriate uses and supply treated wastewater to extend use of Colorado River supplies.
    - Supporting the 20 percent conservation goals in the region.

- **Complexity** – Treatment technologies to reclaim municipal wastewater are well established. Complexity would be related to integrating funding strategies for upgrading existing plants or developing regional wastewater facilities to reclaim wastewater. There are some permitting

[28] State Water Resources Control Board Resolution No. 2009-0011; Adoption of a Policy for Water Quality Control for Recycled Water. <http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf>
[29] DPH requirement that no recycled water to be discharged to IID canals used for MCI supplies.
[30] Original Water Forum finding edited to be consistent with the updated demand forecast.

issues that would need to be resolved and potential impacts to IID drains and the Salton Sea present challenges.

- **Resolve Conflicts, Colorado River** – Reclaiming municipal wastewater would neutrally affect in resolving Colorado River conflicts, but this practice would demonstrate the regional commitment to making use of this resource.
- **Resolve Conflicts, Imperial Region** – Reclaiming municipal wastewater could provide a firm, verifiable, and sustainable supply for new users in-lieu of apportioning Colorado River supplies from current users to the new users. This would support land use agencies when making findings and determinations on available supplies and impacts to current users pursuant to state law. This would result in reducing the potential for local conflicts between the IID and the land use agencies; between current and future water users; and between types of use.
- **Regional Benefits** – A regional strategy for reclaiming municipal wastewater could provide regional benefits by helping to meet the requirements to conserve 20 percent by 2020; increasing the reliability of the supply, and supporting economic development.
- **Timeliness** – A number of potential reclaimed municipal wastewater facilities are currently in the planning and design stages, and a number of projects are near or ready to proceed. Regional strategies and policies to account for the conserved water and use of this source in-lieu of Colorado River water, and a regional approach to mitigating impacts are needed. Development of regional plants to realize economies of scale and increase cost-effectiveness will take more time.
- **Political Acceptability, Local** – Upgrading individual plants without subsidy by new water users would encounter political opposition due to the increase in rates required to fund upgrades to existing plants. Regional plants could be resisted due to loss of control of individual facilities. Regional strategies for accounting for the conserved water could also face opposition. Marketability of crops irrigated with reclaimed water can be problematic for growers. During periods of high agricultural demand the ability to use the IID distribution system is limited or nonexistent. Stranded investments are a concern as are the initial capital and operations and maintenance costs.
- **Political Acceptability, Inter-regional** – Reclaiming municipal wastewater is not expected to encounter resistance by other lower Colorado River users or regions, and would likely be supported as a means of reducing Colorado River demands.
- **Adaptability to Climate Change** – Reclaiming municipal wastewater would help to adapt to climate change by secondary uses of available supplies, by providing flexibility in operations, and increasing ability to respond to changing conditions.

7.2.1.2 Recommendations

1. A number of projects could be ready to proceed in the near-term. Recycling municipal wastewater should be integrated with a regional mitigation banking strategy.

2. Support wastewater facility plant upgrades that propose reclaiming municipal water for use in renewable energy projects that are planned for Seeley, Brawley, and Imperial and include as part of the near-term strategy.

3. Require mitigation to meet state and federal environmental requirements related to reduction in flows to IID drains and to the New and Alamo rivers and other waterways through development of a regional mitigation bank; seek to provide regional benefits, create partnerships, and meet multiple Imperial IRWMP goals by using reclaimed wastewater for this purpose where cost-effective and timely.

4. Consider regional municipal water reclamation projects to increase cost-effectiveness of project development and operation, provide benefits to multiple parties, and improve opportunities to reuse the water.

5. Provide policy and financial incentives for public/private partnerships to construct municipal recycling facilities and for crediting the produced water to sponsoring entities to allow for exchange of produced water for delivery of Colorado River water.

6. Continue to evaluate the cost-effectiveness and political viability of regional municipal wastewater treatment facilities that include reclaiming wastewater as part of the mid- and long-term water management strategy.

7. Imperial County and IID should coordinate and adopt appropriate policies to encourage use of recycled municipal water in-lieu of Colorado River water to mirror California Energy Commission (CEC) and SWRCB policy.

7.2.2 Imperial Region Recycling

Existing facilities were described in Chapter 4. No communities in the Imperial Region are currently recycling municipal water, but there are a number of potential projects being considered. The communities' 2010 Urban Water Management Plan (UWMP) updates reviewed recycled water to varying degrees and noted cost, limited funding, ratepayer support for rate increases, and potential impacts to environmental resources.[31]

Wastewater facilities within the Imperial Region ultimately discharge to the Salton Sea (via drains and/or the Alamo or New River). The flows help support habitat along the IID drains, New River, and Alamo River. The Salton Sea depends on such inflows to reduce the effect of evaporation on salinity levels. Even with the mitigation measures undertaken, the Salton Sea has continued to decline, with its water levels lower as a result of (1) lowered water use within the Region over the past 10 years, (2) reduced inflows from the New and Alamo rivers, and (3) low precipitation.[32] Further reduction could occur because the flows from Mexico may be diminished as Mexicali implements their own reclaimed water program.[33]

[31] The UWMP Act requires cities and urban water suppliers to evaluate recycled water opportunities. UWMP Guidebook, Checklist #44–#51 (CDWR 2010).
[32] Joint Petition by the Imperial Irrigation District and the San Diego County Water Authority ("Petitioners") requesting changes to the State Water Resources Control Board Revised Order WRO 2002-0013.
[33] Salton Sea Authority Plan for Multi-Purpose Project July 2006 Draft for Board Review.

The owner of a wastewater treatment plant, for the purpose of treating wastes from a sanitary sewer system, holds the exclusive right to the treated wastewater against anyone who has supplied the water discharged into the wastewater collection and treatment system, including a person using water under a water service contract, unless otherwise provided by agreement. This implies that any of the entities treating and disposing of wastewater have the exclusive right to treat, sell, and convey the water. The wastewater treatment entity needs approval from the RWQCB to ensure consistency with the Water Quality Control Plan and that the new uses of water have appropriate permits or waste discharge requirements.

7.2.3 Opportunities for Recycled Water

The review of regional recycled water opportunities was coordinated through the Water Forum. The Imperial IRWMP provides reconnaissance-level costs for a number of recycled water projects and evaluated the feasibility of recycling wastewater in the Region. Recycling treated wastewater offers potential benefits to the Region and could supplement supply by giving Colorado River water a second life. Recycled water could be matched to new or current uses suitable to the level of treatment and quality of the recycled water. Recycled water could be used to help supplement or replace Colorado River water used to irrigate local golf courses, recreational areas, green spaces, or nearby agricultural land. Reclaimed water could be used to create or maintain habit features or for algae production. This would help to free Colorado River water for future industrial growth or other beneficial uses.

7.2.3.1 Upgrade Wastewater Treatment Plants

There are 14 wastewater treatment plants and discharge sources within the Imperial Region (Chapter 4). Annual wastewater effluent volume is approximately 16,000 acre-feet per year and future volume is projected to exceed 36,000 acre-feet per year. The future forecasted water demand in the Region for renewable energy is between 146,000 and 180,000 acre-feet per year, with and without conservation, respectively. If all the wastewater available were reclaimed, it would only provide a fraction of the forecasted future demand.

A number of plants are under review for upgrading to provide tertiary treatment wastewater treatment for a renewable energy facility cooling water, including those of:

- City of Imperial
- City of Brawley
- Seeley

While recycled water may not be cost-effective for an individual community since they can obtain less expensive water from IID, it may be a viable method to increase regional water supplies or may become more cost-effective as the true cost of water for new users is factored into the planning process.

Many cities in the Region are not in compliance with waste discharge permit conditions and are having trouble finding funding to improve existing plants. Working with renewable energy facilities to fund upgrades to wastewater treatment plants would allow communities to comply with permit requirements. State and federal grants that support recycling can help overcome fiscal constraints.

7.2.3.2 Regional Recycling

For cities in relative proximity to one another, economies of scale might be achieved through consolidation and aggregation of wastewater treatment plants. The 1992 IID Regional Water and Wastewater Utilities Feasibility Study considered five alternatives to develop recycled water facilities, from no change to full regionalization, and concluded that regional facilities were in the best interest of the Imperial Region, citing economies of scale among the reasons (Black and Veatch, 1992). An additional feasibility study completed in 1994 evaluated four treated water alternatives weighing more than 13 criteria and found that a centralized or regional treatment and distribution would be best for the area (Black and Veatch, 1994). The proximity to agricultural areas reduces piped distribution costs from the regional treatment facilities to potential customers.

7.2.3.3 Support to Achieve Regional Conservation Goal

In November 2009, the Water Conservation Act of 2009 was signed into law as part of a comprehensive water legislation package. The act addresses both urban and agricultural water conservation. The legislation sets a goal of achieving a 20 percent statewide reduction in urban per capita water use and directs urban retail water suppliers to set 2020 urban water use targets. Use of recycled water can be counted as part of the conservation goal.

7.2.4 Constraints

7.2.4.1 User Acceptance

Successful water recycling projects require water user acceptance and commitment, public support and acceptance, evaluation of environmental impacts and benefits, and analysis of economic feasibility. Growers have expressed concern with proposals to blend tertiary treated Title 22 compliant water in IID irrigation canals. Public acceptance of recycled water remains a major obstacle to implementation of water recycling projects. The following four water quality characteristics have been identified as being of particular concern regarding confidence in the safety of the water: (1) microbiological quality, (2) salinity, (3) heavy metals, and (4) organic and inorganic substances such as pharmaceuticals and personal care products, household chemicals and detergents, fertilizers, pesticides, fungicides, and animal growth hormones.

7.2.4.2 Salinity

Salinity is a particular concern in the Imperial Region. Municipal water supplies typically have salinity levels over 600 ppm, and municipal use typically adds 300 ppm. TDS levels of 1,000 ppm adversely affect most crops or require changes in irrigation practices (e.g., increased leaching). Thus, recycling for irrigation may require desalting, blending with other supplies, or changes in agricultural practices.

7.2.4.3 Cost

DAC and SDACs have limited ability and willingness to pay for increased treatment. Given the variability of local conditions and their effect on treatment and distribution costs, the estimated capital and operational costs of water recycling ranges from $300 to $1,300 per acre-foot. The cost to install a new distribution system is a major obstacle to the expansion of water recycling. Because recycled water is not classified as potable, regulatory constraints prohibit conveying recycled water and potable water in the same pipelines. Recycled water must be conveyed in a separate (purple pipe) distribution system that is readily distinguished from traditional water lines.

Regionalization constraints include gaining individual communities' support and the status of community investment in local facilities and facility upgrades planned or underway (i.e., sunk costs).

7.2.4.4 Environmental Concerns

The County General Plan Water Element identifies the major environmental issues expected to be of concern with local tertiary treatment systems:

- Reduction of flows in IID drains
- Reduction of flows to Salton Sea
- Increase in drain water salinity
- Impact on fish and wildlife, recreation, and aesthetic values

Any diversion of flows may have environmental impacts on the drains, rivers and/or the Salton Sea, and related mitigation costs must be factored into reuse strategies. Directing treated discharges away from the Salton Sea may not be feasible until the Salton Sea salinity level impedes fish production or has been restored and is not dependent on the inflows (Salton Sea Authority, 2006). Also, additional treatment to facilitate recycling could result in the concentration of contaminants in the remaining flows discharged to the drains or rivers.

7.2.5 Relation to Other Strategies

Implementation of water recycling can affect other water management strategies:

- **Water Use Efficiency, and Matching Water Quality to Use –** Recycled water can be used to reduce reliance on the Colorado River supply. State policies supporting use of recycled water.
- **Economic Incentives –** State bond monies are available for recycling. Historic industrial users seeking alternatives to Colorado River water could support DACs and SDACs in upgrading wastewater treatment plants.

- **Salt and Salinity Management –** Reduced wastewater influent volume could increase TDS levels on drains and rivers.
- **Local Land Use Planning and Management –** Recycled water could provide a long-term, verifiable, and sustainable source of supply and support land use agencies when making defensible findings during project environmental review and permitting.
- **Ecosystem Restoration –** Reduced flows to drains could impact drain flows and related habitat and require mitigation. Some recycled wastewater could be used to support creation or maintenance of habitat utilizing a regional mitigation bank. A regional mitigation bank could provide mitigation for loss of drain or river flow, or any identified impacts to the Salton Sea.

7.2.6 Support for Mitigating or Adapting to Climate Change

Recycling of municipal wastewater sources could allow the Imperial Region to provide secondary use of Colorado River water, support development of untapped resources, and improve the ability for the Imperial Region to respond to variable climate conditions. Regardless of the long-term effects of climate change to Colorado River flows, whether it increases or decreases flows, recycling would help the Region respond to vulnerabilities and make maximum beneficial use of the current entitlements by reducing reliance on Colorado River supplies when meeting the demands for cooling water or other uses.

7.3 DESALINATION

Prior project concepts for desalination of brackish groundwater and drain water were evaluated (see Appendices B and G) and the information was made available to the Water Forum during review of desalination strategies.

Two principal methods for large-scale production of desalted water are available; distillation and reverse osmosis. Distillation uses heat to evaporate water that is then captured and condensed as fresh water leaving the dissolved solids in the waste stream. This is a reliable, but energy-intensive process and is primarily used in fuel-rich areas of the world. Heat energy can be far less costly than electrical energy. Distillation in the Imperial Region would require a low cost heat source to be competitive. Low cost heat may be available in the Region from geothermal, solar thermal, industrial waste heat, cogeneration with power plants, or other sources.

Distillation of geothermal brine is an integral part of the flash geothermal distillation process extensively used in the Imperial Region. It economically supplies the majority of the cooling water needed by local geothermal power plants that employ a flash distillation process, reducing demand on the Colorado River supply. Low grade heat from a geothermal process can also be applied to desalinate other water resources.

Reverse osmosis is a more energy-efficient process that uses semi-permeable membranes to separate fresh water from salt water. Water is forced at very high pressures through tightly wrapped membranes, which facilitate the passing of water molecules that are smaller than almost all impurities through the membranes. Improvements in reverse osmosis technologies have reduced the amount of energy required to produce fresh water, making desalination a viable alternative. As a result, desalination of brackish water is becoming cost-competitive with other water supply options available in water-stressed regions.

The Water Forum adopted the following desalination findings and recommendations on March 24, 2011.

7.3.1 Findings and Recommendations

7.3.1.1 Findings[34]

- Desalination of brackish groundwater could be a near- or mid-term project opportunity and could provide a new source of water to be used in place of imported Colorado River water.
- Desalination of brackish drain water has more constraints, but could be an opportunity for long-term development, but this is likely to require higher mitigation costs and environmental compliance requirements.
- Large-scale desalination, coupled with inter-regional conveyance could be a long-term opportunity, but is considered costly when compared to other water supply strategies, and is not considered a near- or mid-term opportunity for purposes of the Imperial IRWMP.

Findings related to the criteria used to screen the desalination resource management strategy include:

- ***Imperial IRWMP Goals and Objectives*** – Desalination of brackish groundwater, drain water, the New or Alamo rivers, and other local saline water sources could help to meet the goals toward diversifying the regional water supply portfolio and could help to ensure a long-term, verifiable, reliable, and sustainable supply to meet current and future agricultural, municipal, commercial, industrial, and environmental demands. Desalination would help meet objectives by providing a new water source to avoid impacts to existing users.
- ***Complexity***
  - Desalination technologies for brackish water are relatively well defined, and relatively cost-effective as compared to other opportunities to develop new water supplies.
  - Constraints to be overcome include:
    - Access to sites in the East Mesa
    - Mitigation requirements for potential impacts to drain habitat, riparian resources, and the Salton Sea
- ***Resolve Conflicts, Colorado River*** – Desalination of the source water proposed would not be expected to increase conflicts with the Colorado River users.

[34] The desalination materials and briefings were reviewed by the Projects Work Group 11/18/10 and 12/08/10, introduced and discussed at Water Forum 12/08/10, further reviewed by the Projects Work Group 1/19/11, and further reviewed and discussed by the Water Forum 1/20/11 and 2/24/11.

- ***Resolve Conflicts, Imperial Region***
    - Desalination could reduce conflicts over existing Colorado River water supplies by providing a firm supply for new users and projects in lieu of Colorado River supplies.
    - Reduced flow from drains or river water could have impacts to the Salton Sea and increase conflicts related to responsibility for and costs of mitigation.
- ***Regional Benefits*** – Desalination would provide regional benefits by increasing the supply and by providing water for economic development while protecting current agricultural uses.
- ***Timeliness***
    - Projects to desalinate brackish groundwater could be developed in the near- to mid-term if IID and the County work cooperatively with industry to develop and permit such projects.
    - Adding a groundwater recharge component could slow project development and implementation, but an integrated project could be developed in phases over the mid- to long-term.
    - Desalination projects to use drain or river water would likely require greater environmental review and a longer time period to design, permit, and implement and could encounter significant regulatory compliance requirements.
- Political Acceptability, Local
    - The method of financing and distribution of cost needs to be determined. Ability to pay and willingness to pay for desalination has not been fully determined and requires additional economic evaluation.
    - Desalination of drain and river water will likely have higher mitigation costs, greater potential impacts, and potentially higher political resistance as compared to groundwater desalination.
- Political Acceptability, Inter-regional
    - Drain and river water projects would face a higher degree of scrutiny due to potential effects on the Salton Sea as compared to brackish groundwater and could create political controversy.
- Adaptability to Climate Change
    - Desalination of brackish water sources would develop an untapped resource and improve the ability for the Imperial Region to respond to variable climate conditions.

7.3.1.2 Recommendations

1. Desalination of brackish groundwater in the East Mesa is a near- to mid-term proposition and could be sustainable when integrated with recharge project elements

   a.) Pilot and demonstration projects should be undertaken to provide a basis for design and to determine the feasibility of large-scale projects.
   b.) Federal or state funding opportunities for development of pilot projects should be pursued if a local funding match can be developed.

2. Imperial County and IID should coordinate and adopt appropriate policies to allow for and promote development and desalination of East Mesa groundwater resources. Such policies could be targeted to requiring use of desalination or recycled water in-lieu of Colorado River water to mirror CEC and SWRCB policy.

3. Operational concept—Consider and further evaluate economic and political feasibility for including desalinated water in a regional water exchange whereby those that fund development of desalination facilities would receive credit for the produced water and receive Colorado River water in exchange.

   a.) Cooperative public/private partnerships should be investigated for creating a new water supply for non-agricultural water users using desalination technologies.
   b.) Economic incentives and pricing would need to be worked out to finalize a business model, and additional economic evaluations are recommended.

7.3.2 Imperial Region – Desalination

There are limited desalination facilities in the Imperial Region. Some of the geothermal plants are using very high temperature fluids that flash to steam under the reduced pressures at the land surface. The resultant steam, once condensed, results in fresh water. The highly concentrated fluids and solids that remain are then re-injected into the underground formations. One of the possibilities is to desalinate IID drain water to create additional fresh water supplies and support transfer of water via exchange.

Using federal grant funding, CVWD completed a pilot project to demonstrate desalination of brackish groundwater and agricultural drainage water to produce potable water (Malcom-Pirnie, 2008). This study concluded that brackish groundwater and agricultural drainage water can be effectively treated for reuse as non-potable water and potentially as new potable water. The estimated cost of drain water desalination, including brine disposal to managed wetlands, ranges from $480 to $740 per acre-foot depending on the facility capacity and source configuration. Brine disposal using zero liquid discharge approaches could increase the cost of drain water desalination to as much as $1,200 per acre-foot.

Additionally, Metropolitan Water District of Southern California initiated a study (Whitewater Demonstration Project) with CVWD to examine the feasibility of desalting agricultural return flows within the Coachella Valley (MWD/CVWD, 1999).

7.3.3 Opportunities

7.3.3.1 Imperial Region Desalination Plant Projects

To configure desalination alternatives and develop projects at a reconnaissance-level of detail and cost, the desalination plants were configured assuming use of reverse osmosis (RO) as the treatment process. Cost estimates were based on the U.S. Bureau of Reclamation Desalting Handbook for Planners (USBR, 2003). Based on this handbook, the most cost-effective technology for desalting brackish water is RO. The Cities and urban water suppliers are required to evaluate desalinated water opportunities in their UWMPs,[35] including brackish water and groundwater as a long-term supply.

The factors considered to locate and develop reconnaissance-level project concepts included:

- Types of use and proximity to the potential demands for the water produced
- Types of available source water supply
- Access to power
- Avoidance of environmental constraints
- Land ownership
- Brine disposal
- Locations with easy access to major highways

7.3.3.1.1 Produced Water Use

Alternative uses of the desalinated water have been considered including geothermal, agricultural, and municipal uses. Consideration was given to delivering the desalted project water to geothermal power plants, municipalities, industrial users, or to the IID distribution system. For the reconnaissance evaluation and for purposes of comparison, desalination plant facilities were located near the known geothermal resources areas (KGRAs) since geothermal demands are anticipated to be the largest increase in water use over the planning period. If wellfields were located adjacent to canals or drains that extend to the desalination plants, the drains could be used to convey source water to the plant instead of more costly piping. Capital project alternatives have been created that outline the use of this approach.

There are two concepts for the use of desalinated water; 1) Desalinated water could be delivered directly to meet the water demands of proposed projects, and 2) Desalinated water could also be put into the IID canals, accounted for as new water in the Imperial Region water supply portfolio, and then apportioned to proposed new demands for use even if desalinated water was not directly delivered to the point of demand. Reconnaissance-level facilities designs were based on an assumed 650 mg/L TDS for the delivered water.

[35] The UWMP Act (CWC 10631(i)). Adoption of the IRWMP by the Cities that are urban water suppliers will support the city in meeting the requirement.

7.3.3.1.2 Desalination Source Water

Local desalination strategies were developed for several sources of water, including:

- Brackish groundwater
- Drain water[36]
- New and Alamo rivers
- Salton Sea
- Imported seawater

Brackish Groundwater. Desalination of brackish groundwater would remove water that is in storage in the groundwater basin (Section 7.1.3). Environmentally, brackish groundwater is the least constrained. In certain locations within the Imperial Region the groundwater temperatures range from 180 to 300 degrees Fahrenheit. In order for the water to undergo RO, it will need to be cooled to approximately 100 degrees Fahrenheit. Without cooling, the water would damage the desalination membranes.

Drain Water and Salinity. Salinity levels of the drain flows affect desalination costs. The QSA/Transfer Agreements will reduce the drain and river flows, but opportunities to capture drain water before it reaches the New or Alamo rivers will remain. IID drain data were used to estimate future drain inflow and salinity along the New and Alamo rivers. These estimates are used to project the amount of drain water that may be available for industrial uses. Spatial and temporal distribution of drain flow into the New and Alamo rivers was used to estimate future flows under the QSA/Transfer Agreements by distributing flows along the rivers based on estimated and metered drain contribution. Unmetered drain flows were based on length of drains. The results provide estimated monthly average and annual average future flows. USGS water quality data for the Alamo and New rivers were used to estimate salt loading at each drain discharge point according to the flow contributions. Salt loading in the New River from Mexico was accounted for based on USGS measured salinity.

Post-QSA drain flow and salinity from three large drains, the Holtville Main, Central, and Rose drains were analyzed as a case study for siting desalination facilities, and the results are summarized in Table 7-3. The three-drain system could reasonably provide about 90,000 acre-feet per year of water (70 percent of the low flow monthly average); with any two drains providing about 60,000 acre-feet per year.

Table 7-3. Estimated Post-QSA Drain Flows and Salinity for Holtville Main, Rose, and Central Drains — Desalination RMS

Drain	Average Annual (ac-ft)	Maximum Month (ac-ft)	Minimum Month (ac-ft)	Maximum TDS (mg/L)	Average TDS (mg/L)
Holtville Main Drain	55,600	5,800	3,300	3,670	3,190
Rose Drain	55,000	5,300	3,900	3,670	3,190

[36] See Appendix G -- Water quality and flows from IID drains and the New and Alamo rivers were evaluated as sources for feed water for desalination (NRCE 2009).

Central Drain upstream of Mesquite Drain Cut Off	59,900	6,300	3,600	3,670	3,190
TOTAL	**170,500**		**10,800**		

The existing drain system could be modified by cross-connections to link and expand the usable and recoverable portion of drain water. In so doing, it would be necessary to re-grade the channels to improve capacity. Linkage of the Central, Mesquite, Holtville Main, and Rose drain systems were studied to combine drain systems and supply drain water for Keystone Development-area desalination plant concepts.

Reclamation of the Region's drainage water represents a significant and potentially useful source of water for uses within IID's service area. The flow of recoverable drain water exceeds the raw water feed requirements for a 50,000 acre-feet per year (product water) desalination plant. The salinity within the drain system varies between 2,702 and 3,680 (mg/L) under estimated post-QSA/Transfer Agreements conditions. Reducing drain water volume may affect riparian habitats and inflow to the Salton Sea and could require mitigation. Mitigation costs could add to the overall project cost.

River Water and Salinity. New and Alamo river flows are potentially viable sources for a desalination plant, but river diversions would be complicated to permit, and facilities could be subject to flooding. Both drain water and river water support habitat, could have potential environmental effects, and would face greater permitting challenges as compared to brackish groundwater.

Consideration of river flow variability is important when studying the quantity of water that can be reclaimed. Variability in salinity is important when considering costs of treatment and of suitability of the water supply. It is noted that New River flows from Mexico across the U.S./Mexico border to the Salton Sea will likely decrease with time. Generally, a decrease in return/drain flow will result in an increase in salinity.

Salton Sea. The Salton Sea as a source of water is not reasonably feasible due to the high salt content and related increase in treatment cost when using RO technology. Distillation using a brine concentrator type configuration can be feasible if a low cost thermal energy source is available, but the associated costs are not yet fully defined. The Salton Sea was eliminated from further consideration for purposes of the Imperial IRWMP.

Imported Seawater. Imported seawater would involve construction of a large-scale conveyance. Concepts have been proposed for further development by a number of private interests, and there are public/private partnership opportunities that have been actively promoted. For this round of the Imperial IRWMP, and since there are no public agency sponsors, these are not recommended for further consideration, though it is noted that they could be long-term opportunities.

7.3.3.1.3 Brine Disposal

For purposes of brine management resulting from inland facilities located within the Imperial Region's, major strategies for brine disposal were limited to four general categories: 1) deep well injection with new wells, 2) deep well injection co-located at existing or proposed geothermal power plants, 3) evaporation ponds, and 4) salt disposal ponds at the Salton Sea.

Deep Well Injection with New or Existing Wells. Typically with the deep well injection method, desalting concentrate is injected into unusable groundwater aquifers through new wells or utilizing existing geothermal wells. Both alternatives can only occur in areas where large volumes of concentrate can be accepted by the aquifers. Therefore, additional study of the site-specific geological and hydrological conditions is needed to determine the suitability of aquifers. Also, the constituent makeup of the brine concentrate must be compatible with the aquifers and the injection wells. To determine the proper location to site an injection well, the depth to the saline aquifer must be known. If a desalination plant is proposed to serve a small number of geothermal plants, there may be opportunities for collaboration between the desalination plant and the geothermal plant. Such opportunities may include joint use of facilities such as cooling towers and injection wells, optimization of water quality for the intended use, or more efficient use of thermal or electric power generated by the geothermal plant.

Evaporation Ponds. Evaporation ponds dispose of brine from inland desalination plants by discharging the concentrate to ponds, where it is evaporated for final disposal in an appropriately designated landfill for non-hazardous waste. Evaporation ponds are generally suitable for small inland desalination plants located in arid and semi-arid areas due to high evaporation rates, and are relatively easy to construct, and require little maintenance and minimal operator attention. In many instances, evaporation ponds are the least costly method of brine disposal, especially in areas with high evaporation rates and low land costs. The ponds could provide an attractant to wildlife and potentially concentrate toxic elements that could limit this disposal method.

Discharge to the Salton Sea. One option for discharge of brine to the Salton Sea area is to build evaporation ponds on the Salton Sea playa to create a salt crust. Something similar was demonstrated by USBR and the Salton Sea Authority in 2002. A second option is to use highly concentrated brine to create energy generating solar ponds on the playa. A third option would be discharge of concentrated bring directly to the Sea. This third strategy was eliminated from further considerations due to habitat, permitting, political, financial, and technical issues.

7.3.3.2 Inter-regional Desalination Plant Projects

The Imperial Region could buy capacity and partner on regional desalination projects. Inter-regional projects may represent viable longer-term opportunities that may provide economies of scale and partnership opportunities with other public and private interests reliant on the Colorado River. Inter-regional projects could include:

- Yuma Desalting Plant
- International Boundary and Water Commission (IBWC) proposed projects in Baja and Sonora, Mexico
- Navagua Desalination and Sea to Sea are proposed concept projects sponsored by different private and public interests

The elements of this strategy may provide long-term opportunities, but participation in such projects are not sponsored by any of the Imperial Region public agencies, would involve complex agreements, would be complex to permit, and thus were not included in the Imperial IRWMP.

7.3.3.3 Other Management Concepts

7.3.3.3.1 Desalination Supply Reliability

A major benefit of desalination of local groundwater or drain water is the reliability of the supply. Future MCI users within the Region need a high degree of reliability, both seasonally and during times of shortage. The large amount of brackish groundwater in storage, and drain water and flow in the New River and Alamo River provide a potentially large volume of brackish feed water. As such, desalination could also provide a response to a number of shortage scenarios. For example, desalination could help respond to potential service interruptions of the All-American Canal.

7.3.3.3.2 Integrate Power and Water Facilities

IID provides power for the Imperial and Coachella Valley regions. The opportunity exists to develop a combined desalination/power plant operation to generate wholesale or off peak power, then purvey both the desalinated water and power to increase project cost-effectiveness. Additional economic analysis is needed to further evaluate cost-effectiveness and feasibility of such project concepts.

7.3.3.3.3 Public/Private Partnerships

Cooperative public/private partnership could be developed to invest in desalination. Economic incentives and pricing would need to be worked out and a business model developed. Private sector interests have proposed desalination of agricultural drainage in exchange for Colorado River water. This could be pursued under public sponsorship.

7.3.4 Constraints

Desalinated brackish groundwater or drainwater maybe a viable option, but there are a range of constraints and issues to be addressed.

7.3.4.1 Cost

Cost is a primary constraint for desalination projects. As part of the IID Capital Projects review, desalination projects were configured by combining source water elements, groundwater banking, storage elements, and operational elements (see Table 12-5).

Desalination cost estimates were developed predominately from publications by USBR for desalination and USEPA for wastewater treatment. The costs calculated in the reconnaissance evaluation for desalination and combined recharge/ desalination project costs ranged from $500 to $1,300 per acre-foot, which is consistent with published data.

Energy use is a major factor in the cost of desalinated water. Based on the information of existing facilities, brackish groundwater desalination consumes about 1,300 to 3,200 KWh of energy per acre-foot, depending largely on source water quality, plant capacity, and technology (California Desalination Task Force, 2003). Summarized energy usage associated with desalinating water is presented in Table 7-4.

Table 7-4. Energy Usage for Desalinating Water by Source Water

Source Water	kWh	
	Per MG	Per AF
Brackish Groundwater	2,840	946
Wastewater	3,067	1,022
Seawater	13,215	4,405

Costs associated with production of desalinated brackish groundwater could be reduced by siting facilities near power plants, which could reduce facility investments and provide a cost trade-off for the sale of energy.

Table 7-5 summarizes the total unit water cost that can be expected from desalting groundwater and wastewater using RO technology, based on a 20 to 30 year plant life expectancy.

Table 7-5.Cost Using Reverse Osmosis Technology

Source Water	Cost	
	Per MG	Per AF
Brackish Groundwater	$1,535 - $2,763	$500 – 900
Wastewater	$1,535 - $6,140	$500 – 2,000
Seawater	$2,763 - $7,675	$900 – 2,500

Source: California Water Plan Update, 2009, Volume 2

The costs of desalination are dependent on numerous other variables including baseline water quality, existing infrastructure, available disposal options, treated water conveyance costs, and energy consumption. The total cost for brackish water desalination, including amortized costs for planning, designing, construction of a desalination facility, operation (i.e., energy, chemicals, disposal, etc.), and distribution of product water is based on site-specific conditions (California Desalination Task Force, 2003). Site-specific pilot and demonstration projects should be developed prior to developing full-scale projects.

7.3.4.2 Regulatory

Inland desalination plants present different challenges than building a similar facility at a coastal location. The issue of greatest concern involves development of a cost-effective brine disposal system that conforms to regional and federal requirements. The RWQCB issues the National Pollution Discharge Elimination System (NPDES) permits for navigable waters and permits Waste Discharge Requirements for land discharges within the Colorado River drainage portion of the state. The RWQCB has included in the discharge permit requirements for land discharges, a prohibition against disposing of brine into evapo-percolation ponds that overlie groundwater that is in hydraulic continuity with the Colorado River System. The RWQCB further stipulates that discharges are to be confined in impervious (lined) evaporation basins. Other regulatory restrictions could arise over the acquisition of land and pipeline construction for delivery of waste streams from a desalination facility. Even at high product water recovery and establishment of brine minimization technology, volumes of highly concentrated plant discharge streams can be very large.

7.3.4.3 Environmental Concerns

The County General Plan Water Element identifies the major environmental issues expected to be of concern with local water system projects:

- Reduction of flow in drains
- Reduction of inflow to Salton Sea
- Increased salinity of drain water
- Impact of reduced flow to fish and wildlife, recreation, and aesthetic values
- Potential impacts to habitat and water quality from brine disposal

7.3.5 Relation to Other Strategies

Implementation of desalinated brackish source water can be integrated with, or may be affected by the following strategies:

- **Groundwater Development, Storage and Conjunctive Use –** Desalination of East Mesa brackish groundwater.
- **Land Use Planning and Management** – Desalination could provide a long-term, verifiable, and sustainable source of supply and support land use agencies when making defensible findings during project environmental review and permitting.

- **Agricultural Water Use Efficiency, Salt and Salinity Management** – Desalination could support other aspects of a salinity management program. Agricultural water conservation will reduce available drain water and increase its salinity.
- **Drinking Water Treatment and Distribution** – Brackish water could be treated and put to beneficial use for new developments or industry.

7.3.6 Support for Adapting to Climate Change

Desalination of brackish water sources would allow the Imperial Region to provide a secondary use of Colorado River water, develop untapped resources, and improve the ability for the Region to respond to variable climate conditions. Regardless of the long-term effects of climate change to Colorado River flows, whether an increase or decrease, developing brackish water sources through desalination would help the Imperial Region respond to vulnerabilities and make maximum beneficial use of the current entitlements by reducing reliance on Colorado River supplies when meeting the demands for cooling water or for other new projects that would increase the total demand for Colorado River water.

7.4 MATCHING WATER QUALITY TO USE

Matching water quality to use could allow the Imperial Region to realize an increase in economic activity by using poor quality water for purposes like algae production and use high quality water, like recycled water, to provide secondary uses for Colorado River water. One common measure of water quality is its suitability for an intended beneficial use; a water quality constituent often is only considered a contaminant when that constituent adversely affects the potential beneficial use of the water. High quality water sources can be directed to drinking and industrial purposes, and lesser quality water can be directed for uses that can take economic advantage of such water. The Water Forum review included matching water quality to:

- Agricultural uses
- Algae production
- Ecosystem uses
- Industrial and commercial uses

7.4.1 Findings and Recommendations

7.4.1.1 Findings

- Evaluate and support the use and development of impaired quality water where cost-effective and where such uses could provide economic benefits to the Imperial Region.
- Conduct pilot and demonstration projects that demonstrate economic use of poor quality water to expand the water supply portfolio and support economic growth.
- Treat and recycle wastewater to a level of quality that is legally acceptable for beneficial use in lieu of the region’s Colorado River supply.

7.4.1.2 Recommendations

The Water Forum made no recommendations on this subject.

7.4.2 Imperial Region – Matching Water Quality to Use

Sources and volumes of impaired water were discussed in the groundwater, recycling and drain water sections of this chapter. Numerous industries are looking to develop businesses and economic use of impaired quality water through use of brackish or highly saline waters. As discussed in the next section, potential projects could provide economic benefits to the Region by putting poor quality water to a beneficial use. There are neither recycled water facilities in the Imperial Region nor direct reuse of wastewater, but a number of projects are being considered by the Cities in partnership with private sector sponsors. A number of algae production facilities that operate in the Region.

7.4.3 Opportunities

Potential opportunities include algae production or thermal energy development projects that would put impaired water quality to economic use. CDWR has identified numerous opportunities for matching water quality to use. How these can be applied to the Imperial Region is discussed below. Use of impaired waters for aquatic habitat and industrial service supply would free up Colorado River supplies to be used for those beneficial uses that depend on high water quality.

7.4.3.1 Matching Water Quality to Agriculture Use

As discussed in the recycled water strategy, marketing of crops limits use of secondary treated municipal wastewater.

7.4.3.2 Matching Water Quality to Algae Production Uses

Algae production is considered an agricultural water by IID and this type of operation can often use higher salinity or contaminated water with other constituents that would preclude the water's use for other purposes. The Imperial Valley has an abundance of land and water, and is situated in one of the best locations in the entire United States for year round solar radiation. Microalgae can transform solar energy into high valued products, while taking advantage of waste nutrients in non-potable water supplies (high salts/nutrients) and on non-arable land (heavy clay soils, high-alkalinity soils, etc.). In addition, the Imperial Region is an advanced agricultural community and has the infrastructure required for an algae-based products industry. Algae production could be used for the bioremediation of environmental pollution resulting from eutrophication (nutrients from agricultural and municipal drainage). Some algae absorb heavy metals, like selenium, that can bioaccumulate. Algae production could essentially pre-treat water prior to discharge to New River, Alamo River, or Salton Sea; could provide viable use of playa lands that are exposed as the Salton Sea recedes; and could be integrated into an inter-regional Salton Sea enhancement plan.

7.4.3.3 Matching Water Quality to Ecosystem Use

Use of salty or brackish water to create habitat and reduce dust emissions would support a Salton Sea enhancement plan. Impaired water quality may be used to support ecosystem enhancement projects that provide habitat and passive recreational features such as bird watching. Ambient, instream water must be suitable to support a wide range of aquatic habitats and conditions. Thus, water quality for instream uses generally must meet physical, chemical, and biological objectives specific to the habitat and instream needs. New River water coming from Mexico is highly contaminated. As part of the New River Improvement Project, this water is being considered for water quality treatment through wetlands and bioengineered systems. In fact, there are two wetland projects on the New River, one near Brawley and one near Imperial.[37]

7.4.3.4 Matching Water Quality to Industrial and Commercial Uses

Economic incentives and/or local policy can be used to support businesses in matching water quality to a use. Cooling water used in energy production is often of lower quality than drinking water. Use of saline water and wastewater for power plant cooling (geothermal and/or solar) is supported by state and federal policy (see Energy Sector Water Use Efficiency Strategy, Chapter 8). Secondary or tertiary treated wastewater can be used for certain types of industrial supplies as defined in the Basin Plan.

7.4.4 Constraints

No major local policies or regulatory impediments prevent or encourage matching quality to appropriate use. Constraints to use of recycled water, brackish groundwater, and drain water were discussed above. The low relative cost of Colorado River water delivered by IID ($20/AF in 2011) discourages development of impaired supplies. The lack of local policy regarding use of alternative sources for appropriate beneficial uses in place of Colorado River water serves as a disincentive to private investment. Cost-effectiveness and level of investments are business decisions of the individuals or industries that would develop and apply strategies to match water of impaired quality to appropriate uses, or treat sources of poor quality water so that it could be used as a substitute for Colorado River supplies.

7.4.5 Relation to Other Strategies

- **Recycled Municipal Water** – Promote the use of recycled or treated wastewater.
- **Renewable Energy Sector Water Use Efficiency** – Promote BMPs for renewable energy cooling water sources for purposes of solar/geothermal plants; make local policies consistent with the state and federal requirements for renewable energy projects in desert environments.
- **Pollution Prevent** – Algae production could make economic use of impaired quality water while also cleaning up or remediating certain contaminants. This could include use of drain water, and New River or Alamo River water. Algae operations could also be part of systems to treat non-point sources of runoff from dairy or animal feeding operations.

[37] < http://ponce.tv/brawley_imperial_wetlands_doc.html>

- **Ecosystems Restoration** – Ecosystem enhancement projects can be developed with water of impaired quality and ecosystem enhancement projects could be designed to provide habitat and water quality benefits.

7.4.6 Support for Mitigating or Adapting to Climate Change

Matching quality to an appropriate use would extend the available supply, provide for economic use of water not being used, and support adaption to climate change by creating uses for recycled water or brackish water. Vulnerabilities from potential increases in temperature, evapotranspiration, or reduced precipitation are related to higher rates of decline in the level of the Salton Sea from direct evaporation and/or because of reduced inflows. This could expose playa and increase dust emissions. Use of brackish water for algae production or creation of brackish water habitat would help adapt to this circumstance. Algae production could also help sequester carbon, but this could be contravened if the algae are used for biofuels.

7.5 CONVEYANCE – LOCAL/REGIONAL[38]

Conveyance provides for the movement of water and includes natural water courses and infrastructure like canals, pipelines, and diversion structures. Conveyance strategies include consideration of large inter-regional facilities like the All-American Canal, Coachella Canal, and Colorado River Aqueduct that move large quantities of water within or between hydrologic regions. It also includes the locally owned and managed conveyance infrastructure such as IID canals used to deliver raw water and city pipelines that take IID raw water to retail customers. Two resource management strategies were defined for the Imperial Region:

- ***Conveyance – Local, Planned –*** includes projects identified in IID and the Cities' capital improvement plans, master plans or other existing plans.
- ***Conveyance – Local, New Projects –*** includes new conveyance infrastructure related to recycling, groundwater banking, or other proposed Imperial IRWMP projects such as interties between drinking water treatment plants or wastewater treatment plants of the Cities.

Concepts for large inter-regional conveyance facilities to import seawater into the Imperial Region have been proposed for inclusion in the Imperial IRWMP.

[38] Conveyance strategies were reviewed by the Imperial Water Forum Projects Work Group 1/19/2011; Discussed at the Water Forum 1/20/1, 2/24/11, 3/24/11, and Findings and Recommendations adopted 4/20/11.

7.5.1 Findings and Recommendations

7.5.1.1 Findings

Findings related to the criteria used to screen the CDWR Resource Management Strategies are listed below:

- ***Imperial IRWMP Objectives*** – Large inter-regional conveyances coupled with water quality treatment could help meet the Imperial IRWMP goals and objectives, but the cost estimates are higher than any historic users would be willing to pay in the near-term. A large inter-regional conveyance designed primarily for the restoration of the Salton Sea is beyond the scope of this Imperial IRWMP.
- ***Complexity*** – Large-scale inter-regional conveyance projects would be very complex and face permitting, economic, and engineering challenges. Projects could involve complex international boundary water issues.
- ***Resolve Conflicts, Colorado River –*** Large inter-regional conveyances could avoid conflicts on the Colorado River by providing a new source of supply. This is balanced by unknowns related to costs and benefits, and potential for legal conflicts between competing interests.
- ***Resolve Conflicts, Imperial Region*** – Until the projects are better defined, it is hard to evaluate whether they would increase or reduce ongoing conflicts or help avoid future conflicts.
- ***Regional Benefits –*** Large inter-regional conveyances have the potential to provide multiple benefits to multiple participants, but this is balanced against unknown environmental, economic, and other impacts, and the complexity of development.
- ***Timeliness*** – Large inter-regional conveyances require further definition and feasibility study to resolve technical, environmental, economic, and institutional issues and would be considered a mid- to long-term prospect.
- ***Political Acceptability, Local*** – Unknown until better defined. Neutral at this time.
- ***Political Acceptability, Colorado River*** – Unknown until better defined. Neutral at this time.
- ***Adaptability to Climate Change*** – New conveyances could transport alternative water supplies to the region and help adapt to uncertainties related to climate change.

Other general Water Forum findings and recommendations are listed below:

- ***Community Benefits*** – IID's conveyance and water distribution system provides benefits to the entire region and needs adequate resources to be maintained.
- ***Local IID Conveyance Infrastructure***
    - No major local conveyance improvements to the IID system were identified as stand-alone projects for inclusion in the Imperial IRWMP.
    - The IID conveyance infrastructure provides regional economic benefits to all water users.
    - IID regional supply, conveyance, and distribution infrastructure is aging and faces a backlog of maintenance. The backlog of maintenance is not being met due to revenue constraints. Additional investment is needed to preserve and protect these assets.

- IID does not currently have a policy for other agencies or interests to use their distribution canals and should adopt a wheeling policy.[39]
- Existing IID drainage facilities convey flood water to the New or Alamo rivers from the developing urban areas, but were not designed as flood/stormwater conveyance and need improvements to meet these objectives.

- ***Integration of Local Conveyance Improvements with Other Strategies***
  - Conveyance needs or requirements for individual or regional projects will be integrated into those projects.
  - Local conveyance will be integrated or evaluated in the context of individual Imperial IRWMP water supply or flood/stormwater management projects.
  - The IID Definite Plan and System Conservation Plan identify conveyance system improvements to conserve water that are not currently being implemented and these improvements could be included in the Imperial IRWMP through the agricultural water use efficiency strategy.

- ***Disadvantaged Community Water Supply and Quality Needs***
  - System reliability – Improvements to local conveyance could provide supply reliability and back-up in the event of catastrophic supply interruptions. Cities could realize regional benefits by planning and designing regional interconnections for domestic or wastewater systems.
  - Water quality – Conveyance system interconnection should also be factored into evaluation of larger regional efforts for wastewater treatment, recycling, and drinking water treatment and distribution.
  - System expansion and annexation – Continue to evaluate connecting areas that surround existing larger water systems and are served by individual pipe connections to the larger municipal water systems.

- ***Large Inter – regional Conveyance –*** Projects should be integrated with other strategies like desalination. These could be long-term prospects for inclusion in updates of the Imperial IRWMP, but such projects are low priority for action at this time.
- ***CALFED Conveyance*** – CALFED conveyance projects are not directly related to the Imperial Region, though increased conveyance as anticipated by CALFED and the CWP could increase reliability of State Water Project and Central Valley Project supplies to southern California, potentially reducing competition for Colorado River supplies.

7.5.1.2 Recommendations

The Water Forum should support IID in defining the long-term maintenance requirements for the regional conveyance infrastructure and a cost distribution model to preserve these assets for the Imperial Region.

[39] IID subsequently developed and has adopted a wheeling policy.

7.5.2 Imperial Region – Conveyance – Local/Regional

Regional conveyance infrastructure was described in Chapter 4. Both the Imperial and Coachella IRWM regions have large conveyance systems to move water within the Colorado River Hydrologic Region and their respective jurisdictions, as does MWD to move water to the south coast Hydrologic Region. The IID conveyance infrastructure provides regional economic benefits to all water users in its water service area.

Some IID infrastructure is aging and faces a maintenance backlog. Maintenance requirements have not been currently met due to revenue constraints and resistance to increasing user water rates. The DACs have identified a need for improving and replacing drinking water and wastewater conveyance systems.

Large interregional conveyance connections between regions create interdependencies and present both opportunities and constraints. Such facilities can both solve and create problems and conflicts. The politics and economics of water in the Imperial Region are shaped by interregional conveyance. The QSA/Transfer Agreements demonstrate the interdependencies. The Colorado River Aqueduct is used by MWD to convey Colorado River water to the urban Southern California Hydrologic Region, including large metropolitan areas on the coast. Water conserved by IID under the QSA/Transfer agreements is conveyed through the Colorado River Aqueduct. The Colorado River Aqueduct is designed to carry a maximum of 1.25 MAFY, and in 2010 delivered 1.1 MAF of water supplies.[40] The remaining capacity is limited to 125,000 AF under very high flow conditions. At present, MWD has fallowing agreements with Palo Verde Irrigation District in addition to the IID/MWD transfer agreement. SDCWA also has a wheeling agreement with MWD for the transport of QSA Transfer Agreement waters that are deliverable to SDCWA. These keep the Colorado River Aqueduct flowing at a minimum of 1.1 MAFY for the term wheeling agreement.

MWD and other agencies in southern California also receive water from the State Water Project, which delivers water from the Sacramento/San Joaquin Delta into the South Coast Region. While CVWD is the fourth largest SWP contractor, it does not have its own aqueduct or pipeline to bring SWP water into the Coachella Valley. Instead, a "bucket for bucket" exchange agreement was reached with MWD to trade MWD SWP entitlements for Colorado River water, which is released from the Colorado River Aqueduct into the Whitewater River for use by CVWD. This water and natural runoff flow to 19 recharge ponds where water percolates into the Coachella Valley aquifer. Given these connections, CALFED conveyance issues can have an impact on the Imperial Region.

[40] Metropolitan Water District of Southern California. “The Metropolitan Water District of Southern California Annual Report 2011.” 2011. p 11.

7.5.3 Opportunities

7.5.3.1 Local Planned Conveyance

7.5.3.1.1 IID System Conservation Plan

There are limited opportunities or needs to further improve regional conveyance infrastructure that are not already anticipated or planned as part the IID System Conservation Plan to improve the IID conveyance system, conserve water, and meet QSA obligations. As such, the proposed improvements are integrated into the agricultural water use efficiency effort (Chapter 8). As discussed in that section, there are some opportunities beyond what is anticipated to meet QSA/Transfer Project obligations that could be implemented as part of the Imperial IRWMP.

7.5.3.1.2 City and County Capital Improvement Programs

As discussed in Chapter 4, the DAC outreach identified needs to improve both the drinking water distribution conveyance systems and the wastewater collection conveyance systems. It was anticipated that stakeholders would define specific projects and submit these during the call for projects to be included in the Imperial IRWMP.

7.5.3.2 Municipal Systems Interconnection

Municipal systems interconnection would include developing interties between municipal drinking water systems or wastewater systems to provide supply reliability, as part of regionalization of wastewater and drinking water treatment, or to provide backup in the event of catastrophic supply interruptions. This could include interconnections for domestic or wastewater systems, or for developing redundant connections to IID raw water supplies.

7.5.4 Constraints

City and County capital improvement plans for the communities are in various levels of development. Funding to complete plans and design improvements has been limited. Obtaining voter approvals for rate changes to fund improvements to and replacement of existing drinking water and wastewater conveyance systems has been challenging. No system intertie plans have been developed and such projects are conceptual at this time.

7.5.5 Integration and Relation to other Strategies

- **Agricultural Water Use Efficiency** – Conveyance improvements and systems operations are part of the Definite Plan and System Conservation Program.
- **Regional Flood Control** – Address capacity and policy issues for use of IID drain facilities for conveying stormwater.

- **Water Transfers** – The existing large-scale inter-regional conveyance projects could support development of alternative sources of supply to the Imperial Region by facilitating inter-regional transfers.
- **Ecosystem Enhancement** – In-region conveyance may be part of projects to create habitat to mitigate impacts from other projects.

7.5.6 Support for Mitigating or Adapting to Climate Change

The existing conveyance system or improved conveyance related to local projects would enhance operational flexibility and improve the ability for the Imperial Region to respond to variable climate conditions. Identifying interconnections between cities for wastewater and treated water would also support adaptive management, and response to catastrophic supply interruptions of reductions in supply.

7.6 SURFACE STORAGE

Surface storage includes new reservoirs or other surface storage facilities. Imperial strategies considered for further project development were for municipal system storage for raw or treated water.

7.6.1 Findings and Recommendations

General Water Forum findings and recommendations are listed below.

- ***Small Local Storage Projects***
    - Cities in the region have identified a need for raw or treated water storage facilities to meet state and local requirements and support responses to supply interruption and damages due to catastrophic events such as was experienced in the 2010 earthquake.
    - Small local storage projects will be integrated into other efforts, including the agricultural water use efficiency strategy through the IID Definite Plan and System Conservation Plan.

- ***Large Local or Regional Surface Water Reservoirs*** – Large surface water reservoirs would not be cost-effective or feasible in the Imperial Region when compared to other supply and groundwater storage opportunities. Constraints and the basis for eliminating these from further consideration include:
    - No local runoff or yield of Imperial Region watersheds, high evaporation rates.
    - Development of surface storage of imported water would include high cost for construction and pumping lifts to reservoir sites.
    - Potential for significant environmental impacts, and major permitting and regulatory compliance issues.

- ***Colorado River Storage*** – No opportunities exist for additional large-scale reservoir facilities on the Colorado River.

- ***CALFED surface storage –*** CALFED surface storage is unrelated to the Imperial Region, though increased surface storage statewide could increase reliability of SWP and Central Valley supplies to southern California, potentially reducing competition for Colorado River supplies.

7.6.2 Imperial Region Conditions

The DAC outreach identified a need for increasing raw and/or treated water storage to meet requirements. Each of the municipal systems has different needs.

Small local operational storage projects on the IID delivery system are integrated into the agricultural water use efficiency strategy through the IID System Conservation Plan.

An operational storage facility was built along the All-American Canal. The Brock Reservoir (previously referred to as the Drop 2 reservoir) was cooperatively developed by a number of partners including the Southern Nevada Water Authority, Central Arizona Project, and Metropolitan Water District of Southern California. The project cost an estimated $172 million and will yield as much as 70,000 acre-feet per year. Construction was completed in 2010. Brock Reservoir provides operational storage to recapture and reuse Colorado water that was ordered, but not actually captured by the calling party. Without Brock Reservoir the water would have been delivered to Mexico. This project provides inter-regional and interstate benefits to Colorado River water users. No other operational storage opportunities were identified.

The Colorado River system contains numerous reservoirs that provide an aggregate of approximately 60 million acre-feet of storage (or roughly four years of Colorado River average flow). The Lower Colorado River reservoir system, consisting of Lake Mead and Lake Powell, are capable of storing 26.2 million acre-feet and 24.3 million acre-feet, respectively.

7.6.3 Opportunities and Constraints

7.6.3.1 Surface Storage Local – Small for Raw or Treated Water

Stakeholder assessment and outreach to the DACs in the Region indicate that Cities and water retailers need additional raw water storage to accommodate outages. The need for this has been integrated into the Improve Water Quality objective discussed in Chapter 10. Communications with the Cities in the Region have identified a need to consider additional raw or treated water storage facilities to meet state and local requirements and support responses to supply interruption and damages due to catastrophic events as was experienced in the 2010 earthquake. A regional project to integrate individual systems storage for raw and treated water and support DACs would meet local needs and Imperial IRWMP objectives. It was anticipated that stakeholders would define specific projects and submit these during the call for projects for inclusion in the Imperial IRWMP.

7.6.4 Support for Mitigating or Adapting to Climate Change

The ability for IID to store surface water in Lake Mead would support adaption to climate change, but this strategy is constrained by existing agreements and federal operational requirements. Local storage of raw water on the IID distribution system would support operational flexibility and increase supply reliability, and help respond to catastrophic supply interruptions (e.g., increased flooding and impacts to delivery infrastructure).

7.6.5 Integration and Relation to other Strategies

- **Groundwater Development, Storage, Banking, and Conjunctive Use** – Water that would be available to IID for surface storage of existing Colorado River supplies would be better stored in available groundwater basins.
- **Agricultural Water Use Efficiency** – Operational storage in the IID system is integrated with the agricultural water conservation.

7.7 PRECIPITATION ENHANCEMENT

The precipitation enhancement resource management strategy is not applicable to the Imperial Region and was eliminated from consideration (see Chapter 6).

IMPERIAL IRWMP

INTEGRATED REGIONAL WATER MANAGEMENT PLAN

GEI Consultants