

Recommendation: Receive and file.

---

## OTHER BUSINESS

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7. Directors' Comments
8. CLOSED SESSION CONFERENCE WITH LEGAL COUNSEL – ANTICIPATED LITIGATION – Pursuant to Government Code Section 54956.9 (d)(4): initiation of litigation. (*One (1) potential case*).
9. Adjourn

\*\*\*\*\*

Availability of agenda materials: Agenda exhibits and other writings that are disclosable public records distributed to all or a majority of the members of the above-named Committee in connection with a matter subject to discussion or consideration at an open meeting of the Committee are available for public inspection in the District's office, 15600 Sand Canyon Avenue, Irvine, California ("District Office"). If such writings are distributed to members of the Committee less than 72 hours prior to the meeting, they will be available from the District Secretary of the District Office at the same time as they are distributed to Committee Members, except that if such writings are distributed one hour prior to, or during, the meeting, they will be available at the entrance of the meeting room at the District Office. The Irvine Ranch Water District Committee Room is wheelchair accessible. If you require any special disability-related accommodations (e.g., access to an amplified sound system, etc.), please contact the District Secretary at (949) 453-5300 during business hours at least seventy-two (72) hours prior to the scheduled meeting. This agenda can be obtained in an alternative format upon written request to the District Secretary at least seventy-two (72) hours prior to the scheduled meeting.

January 27, 2020

Prepared by: D. Johnson / K. Welch

Submitted by: F. Sanchez / P. Weghorst

Approved by: Paul A. Cook



## SUPPLY RELIABILITY PROGRAMS COMMITTEE

### WATER BANKING PROJECT FACILITIES, CAPACITIES, OPERATIONS AND PROGRAMS

#### SUMMARY:

Staff has prepared information related to IRWD's water banking facilities, capacities, operations and exchange programs. The information is regularly updated to reflect changes in the status of IRWD's projects, programs and operations. At the Committee meeting, staff will review this information. Staff will also provide an update on efforts to secure additional water for recharge at IRWD's water banking projects.

#### BACKGROUND:

To facilitate the discussion with the Committee, staff has prepared reference materials in tabular, map and schematic formats to describe IRWD's water banking facilities, capacities, operations, storage, and exchange programs. The reference materials are updated regularly to reflect changes in the status of the projects, programs and operations. The following is an overview of the reference materials.

#### Capacity and Operations Tables:

A table presenting storage, recharge and recovery capacities of existing and planned IRWD water banking projects, including capacities available to IRWD in the Kern Water Bank, is attached as Exhibit "A". Exhibits "B" and "C" provide an update on water banking recovery and recharge operations, as well as the balance of the water stored in the Kern Water Bank. Exhibit "B" provides before-loss estimates of water recharged at the water banking projects, and Exhibit "C" provides after-loss estimates of water recharged at the projects. Both Exhibits "B" and "C" include a column that provides totals for each water type and storage location. Changes shown in red on Exhibits "B" and "C" reflect water recharged by Central Coast Water Authority in December 2019, as well as the initial State Water Project allocation of 10% for 2020. This allocation is expected to increase and will affect the amount of water available to IRWD from Dudley Ridge Water District.

Exhibit "D" graphically depicts how storage of State Water Project (SWP) and non-SWP water has changed in the Strand and Stockdale Integrated Banking Projects through time. The table provided as Exhibit "E" shows how capacities in the water banking projects have been dedicated to IRWD's existing and proposed exchange programs.

#### Project Maps:

To support the tables provided as Exhibits "A", "B", "C" and "E", as well as the figure provided as Exhibit "D", staff has prepared maps that depict project wells and pipelines, recharge basins

and Cross Valley Canal turnout locations, along with the most current recharge rates. These maps are provided as Exhibits “F”, “G” and “H”, respectively. The facilities shown on the maps are associated with the Strand Ranch, Stockdale West, Stockdale East and Drought Relief Projects.

Program Agreement Diagrams:

Schematic diagrams have been prepared that depict the IRWD water banking and exchange programs with Rosedale-Rio Bravo Water Storage District, Buena Vista Water Storage District, Dudley Ridge, and Metropolitan Water District. These diagrams are provided as Exhibits “I”, “J”, “K”, “L” and “M”, as described in the List of Exhibits. Next month, staff will include a new schematic diagram for the 1-for-1 Exchange Program with Dudley Ridge.

Delivery of Water to the Water Banks in 2019:

Total 2019 water deliveries for recharge at the Strand and Stockdale West projects was 13,960 acre-feet (AF). Buena Vista delivered Kern River water to the Strand Ranch and Stockdale West projects from April 11, 2019 through June 30, 2019. A total of 11,949 AF was delivered, of which IRWD retains one-half, which is consistent with the terms of the existing long-term exchange program agreement with Buena Vista.

IRWD took delivery of its 1,311 AF of 2019 SWP supplies associated with the Jackson Ranch in Dudley Ridge at the Strand Ranch in July and August 2019. Under the 2019 Short-Term Unbalanced Exchange Program with Central Coast Water Authority, 700 AF of Central Coast’s 2019 SWP supplies were delivered to the Strand Ranch in December 2019.

Other Recharge Opportunities:

IRWD has been pursuing additional opportunities to secure water for recharge. At the Committee meeting, staff will provide an update on efforts to secure water from:

- Antelope Valley-East Kern Water Agency;
- Mojave Water Agency
- Dudley Ridge Water District; and
- Other sources.

FISCAL IMPACTS:

None.

ENVIRONMENTAL COMPLIANCE:

Not applicable.

RECOMMENDATION:

Receive and file.

LIST OF EXHIBITS:

- Exhibit “A” – Recharge, Storage and Recovery Capacities of Current and Anticipated Water Banking Projects
- Exhibit “B” – Water Banking Storage, Recharge and Recovery Operations before Losses
- Exhibit “C” – Water Banking Storage, Recharge and Recovery Operations after Losses
- Exhibit “D” – Historic Water Storage in Strand and Stockdale Projects
- Exhibit “E” – Dedicated Capacities of Current Water Banking Projects
- Exhibit “F” – Map of Water Banking Project Wells and Pipelines
- Exhibit “G” – Map of Water Banking Recharge Basins and Cross Valley Canal Turnout Facilities
- Exhibit “H” – Map of Water Banking Recharge Rates
- Exhibit “I” – Diagram of IRWD-Rosedale Water Banking and Exchange Program Agreements
- Exhibit “J” – Diagram of Long-Term Water Exchange Program with BVWSD and Diagram of One-Year Program to Augment Recharge Using Stockdale West Recharge Facilities with BVWSD
- Exhibit “K” – Diagram of Unbalanced Exchange Program Diagram with DRWD
- Exhibit “L” – Diagram of Coordinated Operating, Water Storage, Exchange and Delivery Agreement with Metropolitan Water District
- Exhibit “M” – Diagram of Template Wheeling Agreement with Metropolitan Water District

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# Exhibit "A"

**TABLE 1**  
**Current and Anticipated Water Banking Project**  
**Recharge, Storage and Recovery Capacities**  
 January 16, 2020

WATER BANKING PROJECT	OWNERSHIP AND WELL INFO			ALLOCATED CAPACITY (AF)					1 <sup>ST</sup> PRIORITY RECOVERY CONDITIONS (CFS)		2 <sup>ND</sup> PRIORITY RECOVERY CONDITIONS (CFS)	
	IRWD OWNED	WELLS EXISTING	WELLS PROPOSED OR UNDER CONST.	TOTAL STORAGE CAPACITY	ANNUAL RECHARGE 1 <sup>ST</sup> PRIORITY	ANNUAL RECHARGE 2 <sup>ND</sup> PRIORITY	ANNUAL RECOVERY 1 <sup>ST</sup> PRIORITY	ANNUAL RECOVERY 2 <sup>ND</sup> PRIORITY	RECOVERY CAPACITY AS PLANNED <sup>1</sup>	ESTIMATED RECOVERY CAPACITY (APR. 2019 CONDITIONS) <sup>2</sup>	RECOVERY CAPACITY AS PLANNED	RECOVERY CAPACITY CURRENT CONDITIONS
Strand Ranch	Yes	7	-	50,000	17,500	-	17,500	-	40.0	40.0	-	-
Stockdale West	Yes	3	-	26,000	27,100	-	11,250	-	15.0	15.0	-	-
Stockdale East	No	-	2	-	-	19,000	-	7,500	-	-	10.0	-
IRWD Acquired Storage Account <sup>3</sup>	No	-	-	50,000	-	-	-	-	-	-	-	-
Drought Relief Project Wells <sup>3</sup>	No	3	-	-	-	-	-	-	15.0	15.0	-	-
Kern Water Bank Storage Account <sup>5</sup>	No	-	-	9,495	3,200	-	6,330	-	-	-	-	-
<b>TOTALS</b>		13	2	126,000	44,600	19,000	28,750	7,500	70.0	70.0	10.0	0.0
Partner Capacities <sup>4</sup>				38,000	22,300	9,500	10,850	0	35.5	25.0	-	-
IRWD Capacities				88,000	22,300	9,500	17,900	7,500	34.5	25.0	-	-
IRWD's recovery <i>during</i> 6 month partner recovery period (AF)									12,420	9,000	-	-
IRWD's recovery <i>after</i> 6 month partner recovery period (AF)									5,480	6,733	-	-
<b>TOTALS (AF)</b>									17,900	15,733	-	-
Number of months needed to recover IRWD's total AF after partners' recovery (Assumes IRWD has use of total recovery capacity after partners' recovery)									8.6	10.2	-	-
Strand Ranch monthly recharge amount assuming 0.3 ft/day average recharge rate (AF)											4,518	
Stockdale West monthly recharge amount assuming 0.3 ft/day average recharge rate (AF)											2,331	

<sup>1</sup> Based on designed Strand recovery capacity assuming 370' bgs. Assumes 5 cfs for each of the Stockdale West and Drought Relief wells in order to meet IRWD's Water Banking, Transfers, and Wheeling policy position. Assumes partners' water is recovered over 6 months.

<sup>2</sup> Strand Ranch and Stockdale West wells currently idle.

<sup>3</sup> IRWD has use of Acquired Storage and Drought Relief Project wells until January 12, 2039, unless the term of the agreement is extended.

<sup>4</sup> One half of storage capacity at Stockdale West and Strand Ranch will be allocated for partners.

<sup>5</sup> Kern Water Bank capacities based on 6.58% of Dudley Ridge Water District's 9.62% share of the Kern Water Bank. Annual recharge amount is based on an average of recharge rates for high and low groundwater level conditions. Not included in storage capacity, recharge, and recovery totals to match IRWD's Water Banking Policy Position Paper.

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# Exhibit "B"

**TABLE 2**  
**IRWD's Water Banking Storage, Recharge and Recovery Operations - BEFORE LOSSES**  
January 20, 2020

TRANSACTIONS	WATER BANKING ENTITY					TOTAL BY WATER TYPE AND STORAGE LOCATION
	IRWD		BUENA VISTA (BVWSD)	CENTRAL COAST (CCWA)	DUDLEY RIDGE WATER DISTRICT (DRWD) <sup>3</sup>	
	SWP <sup>1</sup>	NON-SWP <sup>2</sup>	NON-SWP	SWP	SWP	
BEGINNING WATER IN STORAGE 2019 (AF)						
Total Kern Water Bank	-	4,656	-	-	-	4,656
Total MWD System <sup>4</sup>	8,349	-	-	-	879	9,228
Total Kern County	3,567	17,704	5,202	289	2,698	29,460
TOTAL STORED WATER (1/1/2019)	11,916	22,360	5,202	289	3,577	43,344
(RECOVERY) AND RECHARGE IN 2019 (AF)						
MWD Water to Jackson Ranch <sup>5</sup>	-	-	-	-	(440)	(440)
Kern Water Bank Deliveries <sup>6</sup>		97				97
2019 SWP Allocation (75%) <sup>3</sup>	656	-	-	-	656	1,311
Kern River Water	-	5,975	5,975	-	-	11,949
SWP Table A (CCWA 2019 Exch.)	350			350	-	700
TOTAL 2019 TRANSACTIONS	1,006	6,072	5,975	350	216	13,617
Total Kern Water Bank	-	4,753	-	-	-	4,753
Total MWD System	8,349	-	-	-	439	8,788
Total Kern County	4,573	23,679	11,177	639	3,354	43,420
TOTAL STORED WATER (1/1/2020)	12,922	28,432	11,177	639	3,793	56,961
(RECOVERY) AND RECHARGE IN 2020 (AF)						
MWD Water to Jackson Ranch (estimated)	-	-	-	-	-	-
Kern Water Bank Deliveries	-	-	-	-	-	-
2020 SWP Allocation (10 %) <sup>3</sup>	87	-	-	-	87	174
Kern River water	-	-	-	-	-	-
TOTAL ESTIMATED 2020 TRANSACTIONS	87	-	-	-	87	174
ESTIMATED WATER IN STORAGE 2020 (AF)						
Total Kern Water Bank	-	4,753	-	-	-	4,753
Total MWD System	8,349	-	-	-	439	8,788
Total Kern County	4,660	23,679	11,177	639	3,441	43,594
TOTAL ESTIMATED STORED WATER TO DATE	13,009	28,432	11,177	639	3,880	57,135

**NOTES:**

-MWD = Metropolitan Water District of Southern California.

<sup>1</sup> IRWD's SWP includes 437 AF from CVWD that stays in Kern County.

<sup>2</sup> IRWD's Non-SWP total includes 3,158 AF of Kern County Water Agency Article 21 Water.

<sup>3</sup> DRWD water supply will be returned by MWD or IRWD's Strand Ranch to IRWD's Jackson Ranch. IRWD's 2013-2016 SWP allocation amounts are stored in the MWD system. IRWD's 2017 through 2019 SWP allocation water is stored in Kern County. It is assumed that IRWD's 2020 SWP allocation will be stored in Kern County.

<sup>4</sup> Beginning balance of water stored in MWD system includes: 4,494 AF from 2014 Exchange, 3,206 AF of 2014 borrowed SWP, 649 AF of IRWD's 2013-2016 SWP allocations through DRWD.

<sup>5</sup>Water returned to DRWD by MWD for use on IRWD's Jackson Ranch.

<sup>6</sup>A portion of IRWD's 2019 SWP deliveries from DRWD include 97 AF of Article 21 water, which was delivered to the Kern Water Bank.

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# Exhibit "C"

**TABLE 3**  
**IRWD's Water Banking Storage, Recharge and Recovery Operations - AFTER LOSSES**  
January 20, 2020

TRANSACTIONS	WATER BANKING ENTITY					TOTAL BY WATER TYPE AND STORAGE LOCATION
	IRWD		BUENA VISTA (BVWSD)	CENTRAL COAST (CCWA)	DUDLEY RIDGE WATER DISTRICT (DRWD) <sup>3</sup>	
	SWP <sup>1</sup>	NON-SWP <sup>2</sup>	NON-SWP	SWP	SWP	
BEGINNING WATER IN STORAGE 2019 (AF)						
Total Kern Water Bank	-	4,233	-	-	-	4,233
Total MWD System <sup>4</sup>	7,393	-	-	-	879	8,272
Total Kern County	3,046	15,564	4,532	246	2,395	25,783
TOTAL STORED WATER (1/1/2019)	10,439	19,797	4,532	246	3,274	38,288
(RECOVERY) AND RECHARGE IN 2019 (AF)						
MWD Water to Jackson Ranch <sup>5</sup>	-	-	-	-	(440)	(440)
Kern Water Bank Deliveries <sup>7</sup>	-	87	-	-	-	87
2019 SWP Allocation (75%) <sup>3</sup>	557	-	-	-	557	1,114
Kern River Water	-	5,078	5,377	-	-	10,455
SWP Table A (CCWA 2019 Exch.)	298	-	-	298	-	595
TOTAL 2019 TRANSACTIONS	855	5,166	5,377	298	117	11,812
Total Kern Water Bank	-	4,320	-	-	-	4,320
Total MWD System	7,393	-	-	-	439	7,832
Total Kern County	3,901	20,642	9,909	543	2,952	37,947
TOTAL STORED WATER (1/1/2020)	11,294	24,963	9,909	543	3,391	50,100
(RECOVERY) AND RECHARGE IN 2020 (AF)						
MWD Water to Jackson Ranch (estimated)	-	-	-	-	-	-
Kern Water Bank Deliveries	-	-	-	-	-	-
2020 SWP Allocation (10%) <sup>3</sup>	74	-	-	-	74	148
Kern River Water	-	-	-	-	-	-
TOTAL ESTIMATED 2020 TRANSACTIONS <sup>6</sup>	74	-	-	-	74	148
ESTIMATED WATER IN STORAGE 2020 (AF)						
Total Kern Water Bank	-	4,320	-	-	-	4,320
Total MWD System	7,393	-	-	-	439	7,832
Total Kern County	3,975	20,642	9,909	543	3,026	38,095
TOTAL ESTIMATED STORED WATER TO DATE	11,368	24,963	9,909	543	3,465	50,248

**NOTES:**

-Water in storage has been adjusted to account for losses. IRWD's water stored in Kern County is adjusted 15% for losses (5% for out of county loss, 6% surface loss, and 4% reserve loss); Water stored for DRWD and BVWSD in Kern County is adjusted 10% (6% for surface loss and 4% for reserve loss); KWB losses are 10%; no losses for water directly delivered to MWD system.

-MWD = Metropolitan Water District of Southern California.

<sup>1</sup> IRWD's SWP includes 389 AF from CVWD that stays in Kern County.

<sup>2</sup> IRWD's Non-SWP total includes 2,842 AF of Kern County Water Agency Article 21 Water.

<sup>3</sup> DRWD water supply will be returned by MWD or IRWD's Strand Ranch to IRWD's Jackson Ranch. IRWD's 2013-2016 SWP allocation amounts are stored in the MWD system.

IRWD's 2017 through 2019 SWP allocation water is stored in Kern County. It is assumed that IRWD's 2020 SWP allocation will be stored in Kern County.

<sup>4</sup> Beginning balance of water stored in MWD system includes (net of CVC losses): 3,920 AF of 2014 Exchange, 2,824 AF of 2014 borrowed SWP, 649 AF of IRWD's 2013-2016 SWP allocations through DRWD.

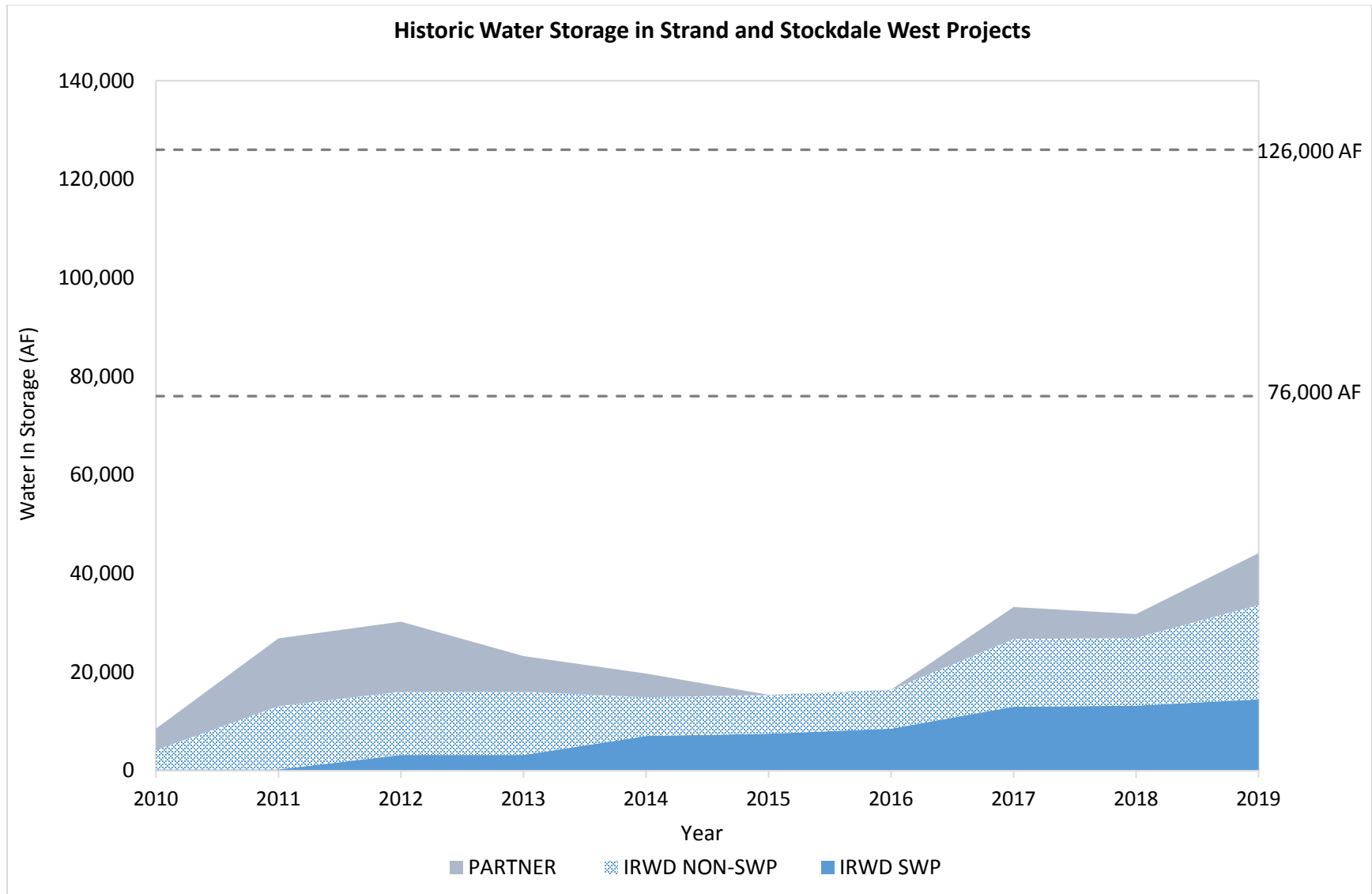
<sup>5</sup> Water returned to DRWD by MWD for use on IRWD's Jackson Ranch.

<sup>6</sup> 2020 transactions may be adjusted for conveyance losses in CVC.

<sup>7</sup> A portion of IRWD's 2019 SWP deliveries from DRWD include 97 AF of Article 21 water, which was delivered to the Kern Water Bank.

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## Exhibit “D”



\*After losses

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# Exhibit "E"

Program	Dedicated Storage Capacity Strand Ranch (AF)	Dedicated Storage Capacity Stockdale West (AF)	Dedicated Storage Capacity Leased Storage Account (AF)	Kern Water Bank Storage Capacity (AF)
Total Capacity	50,000	26,000	50,000	9,495
BVWSD	40,000	-	-	-
DRWD	10,000	-	-	-
AVEK	-	20,000	-	-
CVWD	-	5,000	-	-
Total Dedicated	50,000	25,000	-	-
Total Remaining	-	1,000	50,000	9,495

## RECHARGE CAPACITY

Program	Dedicated Recharge Capacity Strand Ranch (AF)	Dedicated Recharge Capacity Stockdale West (AF)	Dedicated Recharge Capacity Leased Storage Account (AF)	Kern Water Bank Recharge Capacity (AF)
Total Capacity	17,500	27,100	-	3,200
BVWSD	17,500	-	-	-
DRWD	-	-	-	-
AVEK	-	20,000	-	-
CVWD	-	5,000	-	-
Total Dedicated	17,500	25,000	-	-
Total Remaining	-	2,100	-	3,200

## RECOVERY CAPACITY

Program Partner	Dedicated Recovery Capacity Strand Ranch (AF)	Dedicated Recovery Capacity Stockdale West (AF)	Dedicated Recovery Capacity Leased Storage Account (AF)	Kern Water Bank Recovery Capacity (AF)
Total Capacity	17,500	11,250	-	6,330
BVWSD	6,667	-	-	-
DRWD	-	-	-	-
AVEK	-	3,333	-	-
CVWD	-	833	-	-
IRWD	10,833	7,084	-	6,330
Total Dedicated	17,500	11,250	-	6,330
Total Remaining	-	-	-	-

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# Exhibit "F"



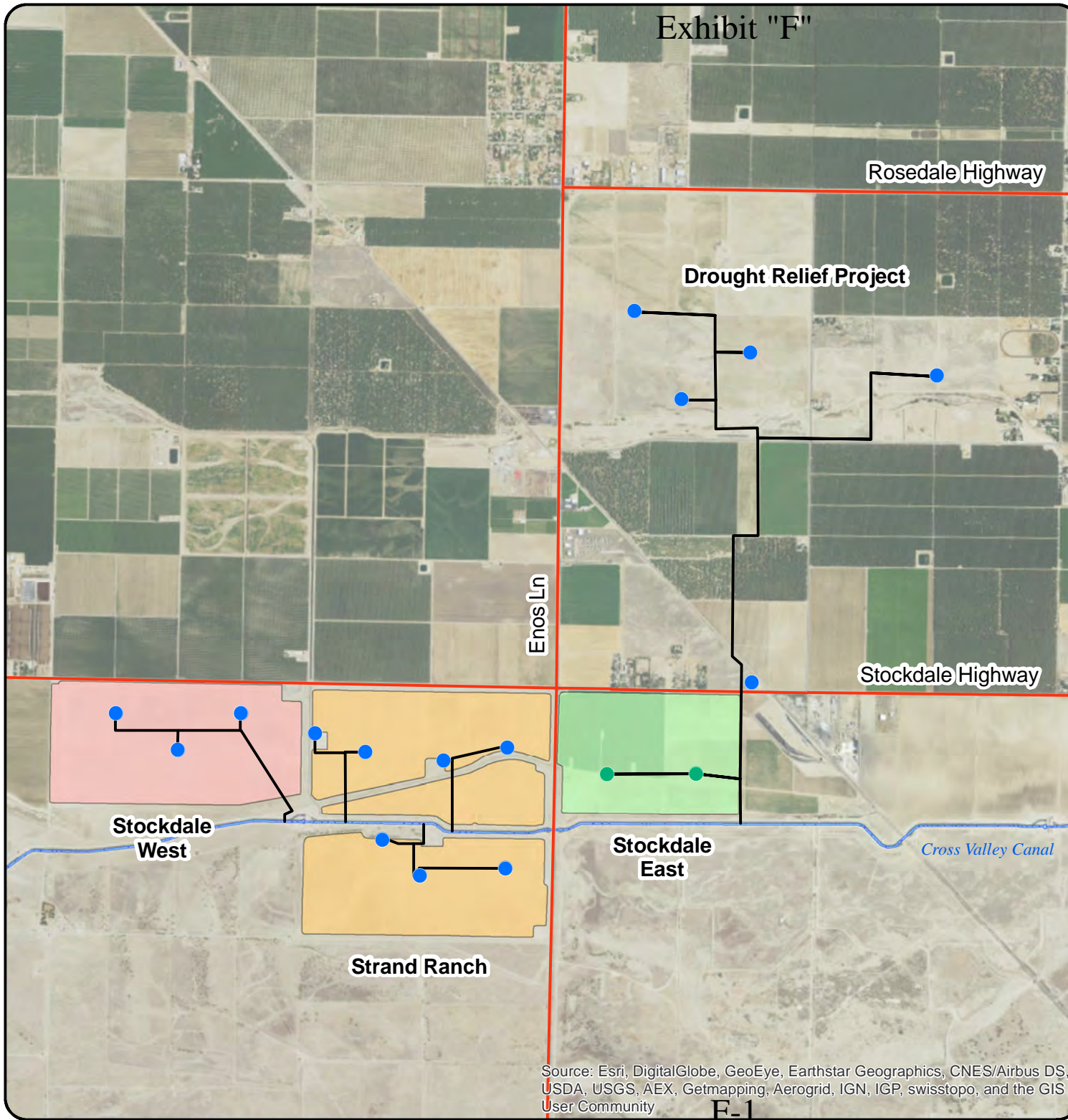
Irvine Ranch  
WATER DISTRICT

## Location Map: IRWD Water Banking Projects Wells and Turnin Pipelines

### MAP FEATURES

- Existing Extraction Well
- Planned Extraction Well
- Well Discharge Pipelines
- Stockdale East
- Stockdale West
- Strand Ranch

This figure shows the location of IRWD's water banking project sites as well as existing and proposed extraction wells.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

F-1



0 0.25 0.5 1 Miles

NAD 83 State Plane Zone 5 (feet)  
Central Meridian: -118

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Exhibit "G"

Rosedale Highway



Irvine Ranch  
WATER DISTRICT

**Location Map:  
IRWD Water Banking Projects  
Recharge Basins & Turnout  
Facilities**

**MAP FEATURES**

- ▲ Turnouts
- Stockdale West
- Strand Ranch

This figure shows the location of recharge basins as well as existing and anticipated pipelines and turnout facilities.

Existing Siphon  
50 CFS Capacity  
From Strand

Stockdale West  
Turnout  
100 CFS Capacity

Existing North & South  
Strand Ranch  
Turnout Facilities  
100 CFS Capacity Each

Cross Valley Canal

Stockdale Highway

Enos Ln

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

G-1



0 0.25 0.5 1  
Miles

NAD 83 State Plane Zone 5 (feet)  
Central Meridian: -118

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# Exhibit "H"

Rosedale Highway



## Location Map: IRWD Water Banking Projects Recharge Rates

### MAP FEATURES

- ▲ Turnouts
- Stockdale West
- Strand Ranch

This figure shows the location of recharge basins and their associated recharge rates as of June 18, 2019.

Stockdale West  
0.11 feet/day  
15 CFS

Strand Ranch North  
0.29 feet/day  
40 CFS

Strand Ranch South  
0.13 feet/day  
15 CFS

Stockdale Highway

Cross Valley Canal

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



0 0.25 0.5 1  
Miles

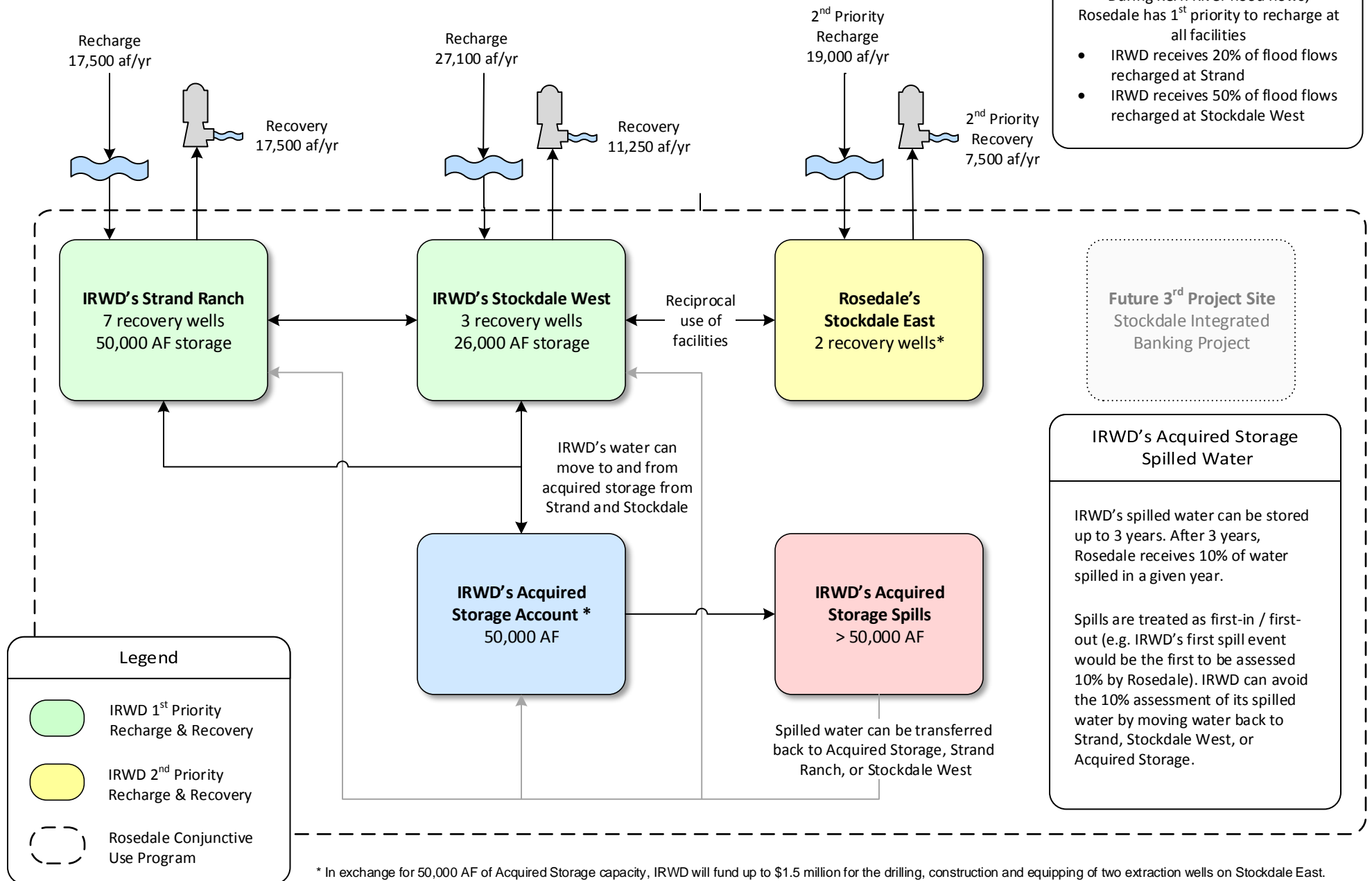
NAD 83 State Plane Zone 5 (feet)  
Central Meridian: -118

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# Exhibit "I"

## IRWD-Rosedale Water Banking and Exchange Program Agreements

Effective 1/12/2009 through 1/12/2039 (Strand Ranch)  
2/4/2016 through 1/12/2039 (Stockdale West)

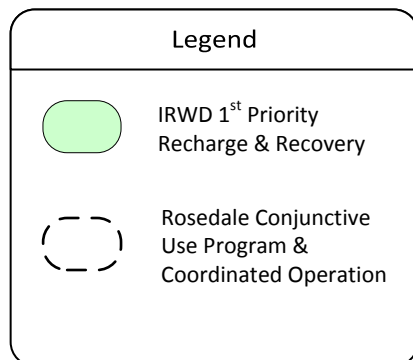
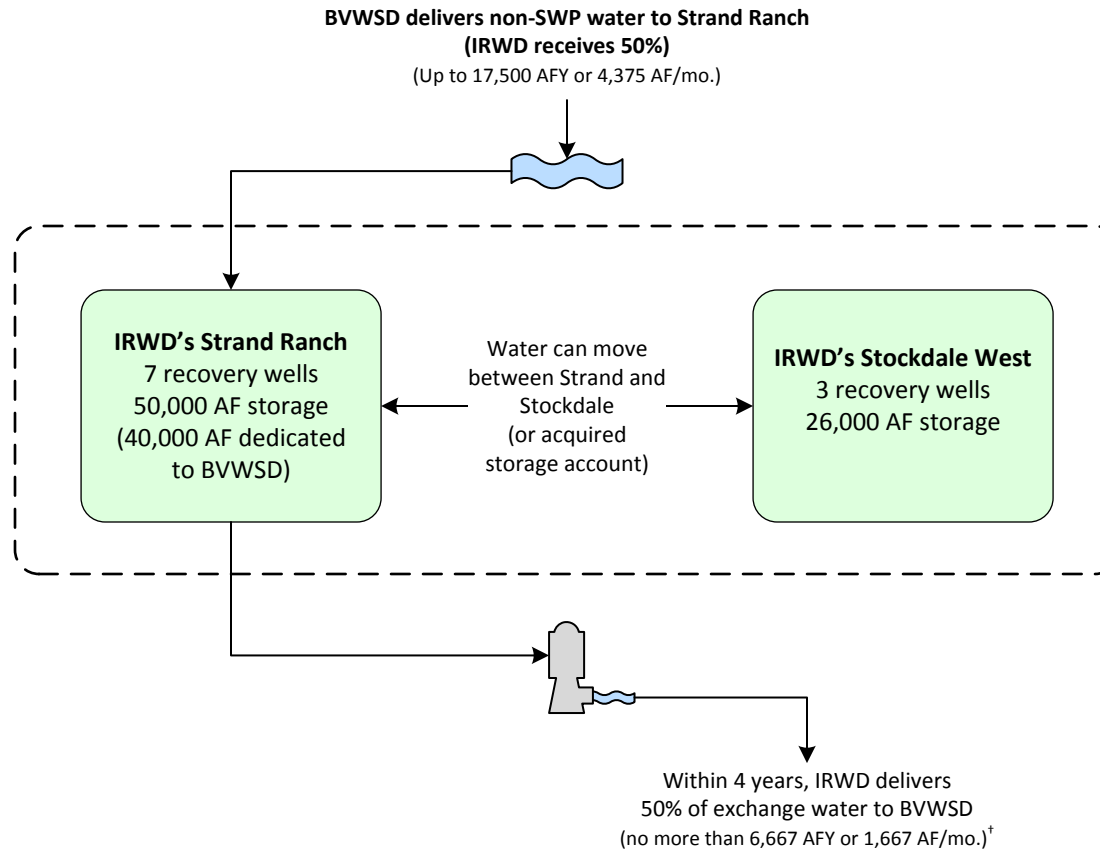


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# Exhibit "J"

## Buena Vista Water Storage District Long Term Water Exchange Program

Effective 1/1/2011 through 1/12/2039

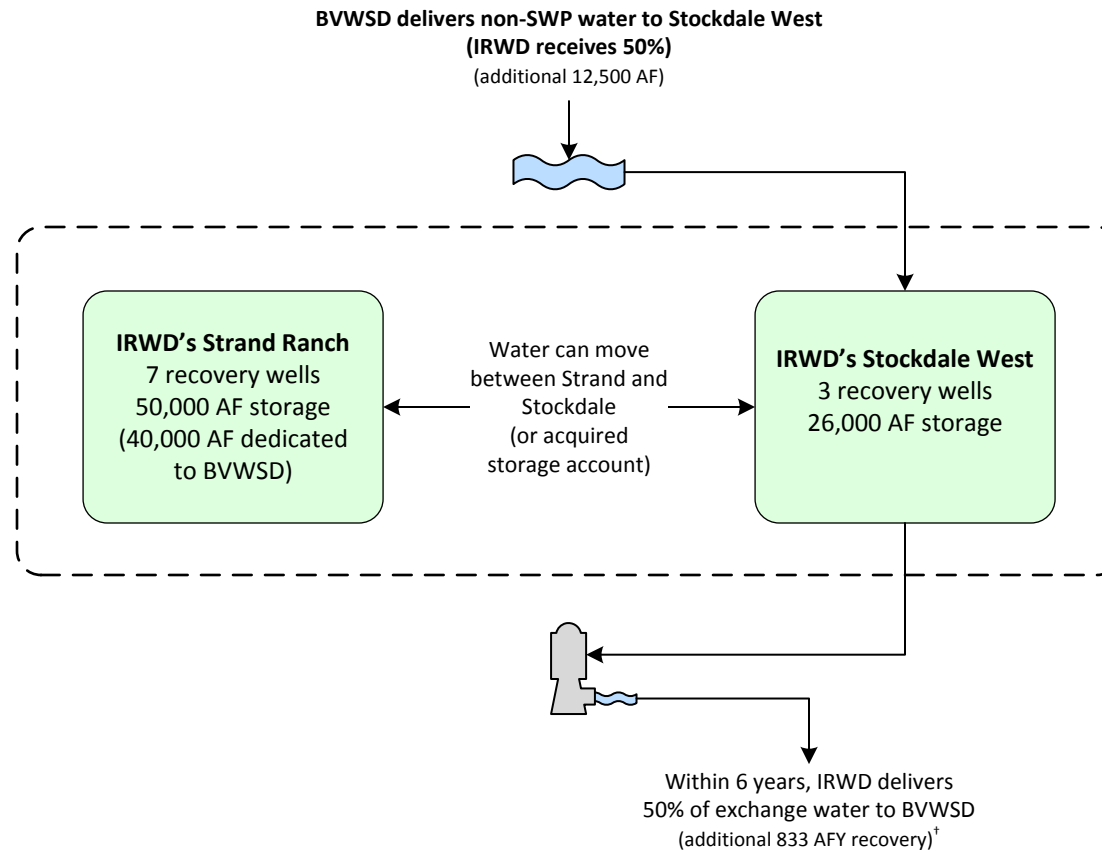




<sup>†</sup>IRWD shall remit one-half of the exchanged supply less one-half of reasonable losses back to BV no later than December 31<sup>st</sup> of the 4<sup>th</sup> year following the associated recharge event. IRWD pays for recovery of water returned to BV. Water to be remitted back to BV may remain in storage at Strand Ranch beyond the 4<sup>th</sup> year, in exchange for a greater percent being transferred to IRWD as compensation per the table shown to the right:

Year Following Recharge Event	Percent Transferred to IRWD	Percent Returned to BV During or Before Indicated Year
1	50%	50%
2	50%	50%
3	50%	50%
4	50%	50%
5	60%	40%
6	70%	30%
7	80%	20%
8	90%	10%
9	100%	0%

# Buena Vista Water Storage District One-Year Program to Augment Recharge Using Stockdale West Recharge Facilities

Effective 4/1/2017 through 3/30/2018



Legend	
	IRWD 1 <sup>st</sup> Priority Recharge & Recovery
	Rosedale Conjunctive Use Program & Coordinated Operation

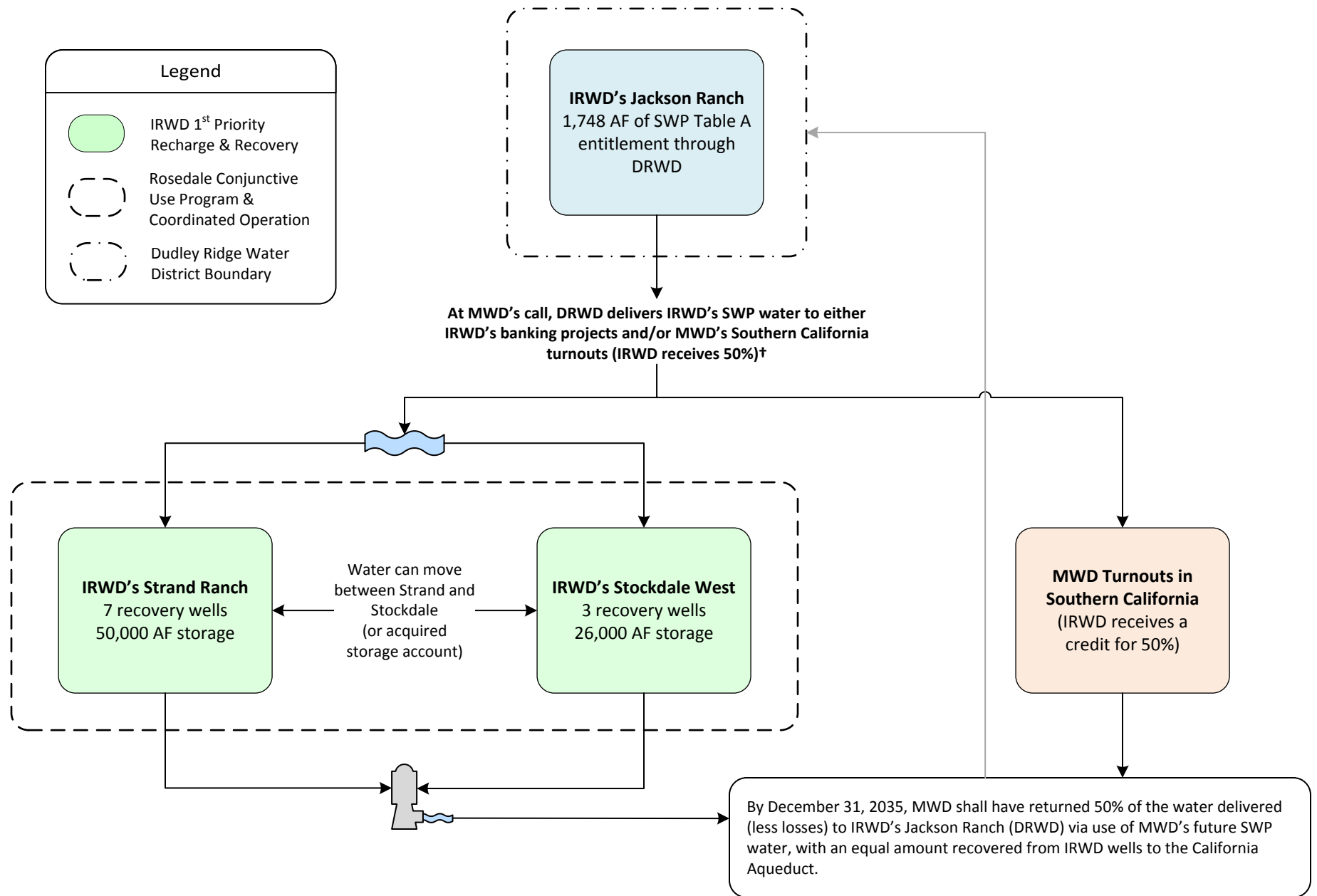
<sup>†</sup>IRWD shall remit one-half of the exchanged supply less one-half of reasonable losses back to BV no later than December 31<sup>st</sup> of the 6<sup>th</sup> year following the associated recharge event. IRWD pays for recovery of water returned to BV. Water to be remitted back to BV may remain in storage at Strand Ranch beyond the 6<sup>th</sup> year, in exchange for a greater percent being transferred to IRWD as compensation per the table shown to the right:

Year Following Recharge Event	Percent Transferred to IRWD	Percent Returned to BV During or Before Indicated Year
1	50%	50%
2	50%	50%
3	50%	50%
4	50%	50%
5	50%	50%
6	50%	50%
7	75%	25%
8	100%	0%
9	100%	0%

# Exhibit "K"

## Dudley Ridge Water District (DRWD) Unbalanced Exchange Program

Up to 12,240 AF delivered from 6/7/2018 through 12/31/2027



†Consistent with IRWD-MWD coordinated operating agreement.

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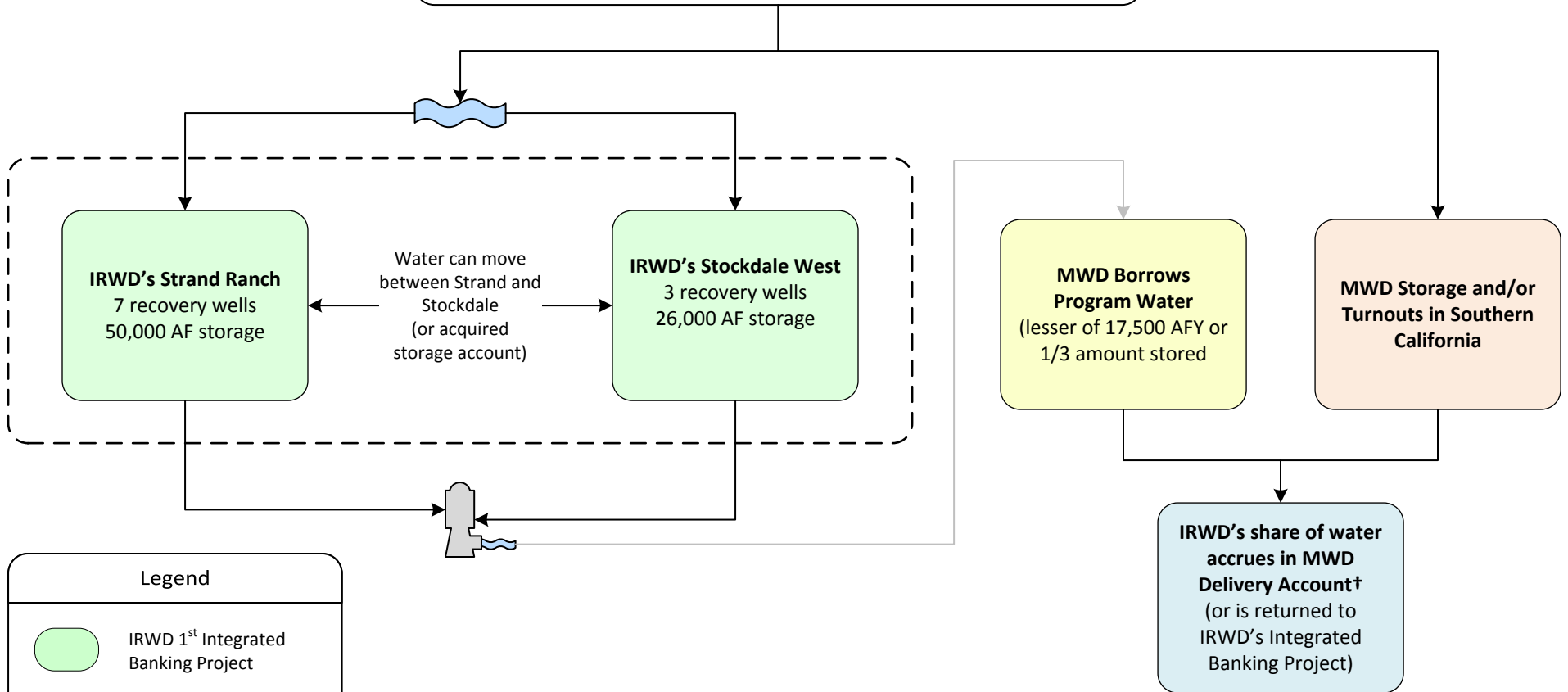
# Exhibit "L"

## Coordinated Operating, Water Storage, Exchange and Delivery Agreement Between MWD, MWDOC and IRWD Effective 5/1/2011 through 11/4/2035

With MWD's consent, IRWD secures SWP water (Program Water) through exchanges with IRWD Banking Partners for use as extraordinary supply under MWD Water Supply Allocation Plan

MWD has three options for the use and storage of Program Water:

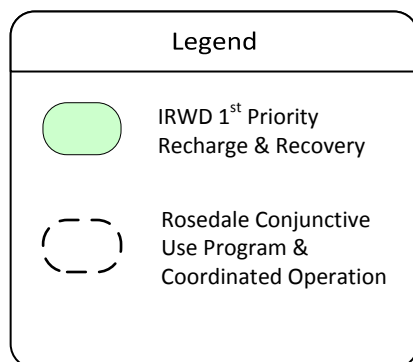
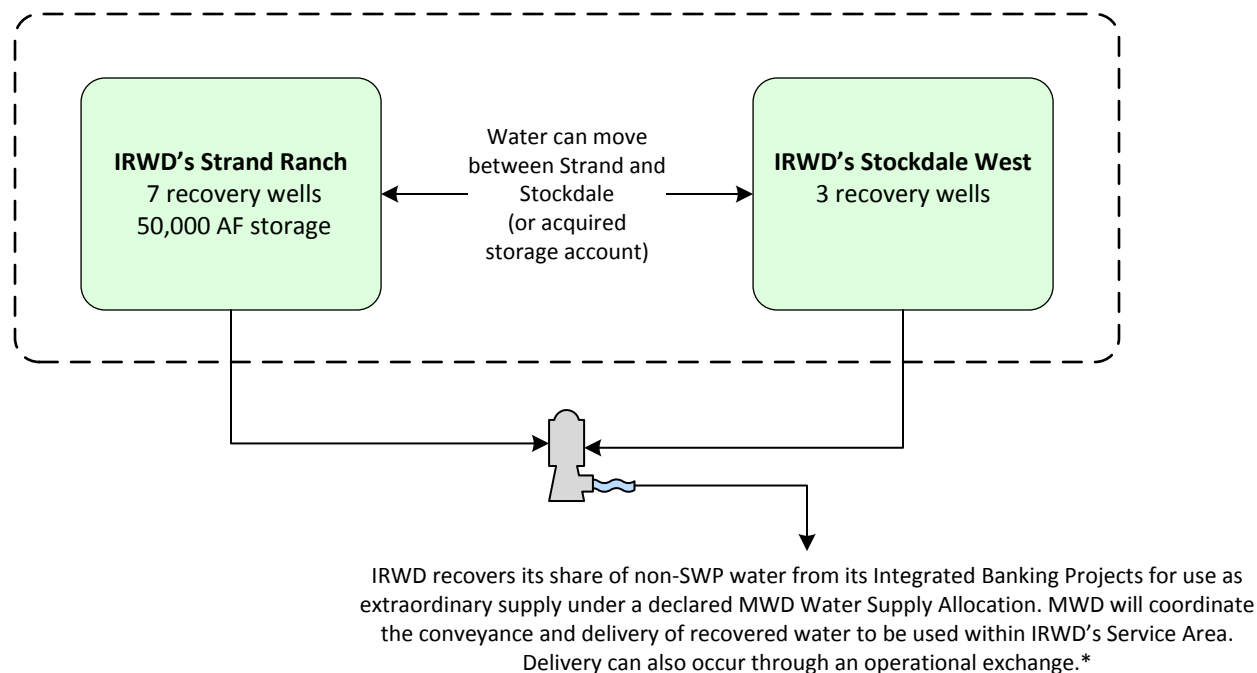
- Storage of water in IRWD's Integrated Banking Project
- Delivery to Southern California for immediate use and/or storage in MWD system
- Borrow a portion of Program water, with accrual in MWD Delivery Account



- Under an MWD Allocation, when IRWD calls for water, IRWD must first recover Program Water from the Integrated Banking Project before receiving water from the MWD Delivery Account.
- MWDOC shall pass through extraordinary supply credits for IRWD's benefit.
- † IRWD's banking partner share of Program Water to be returned by MWD.

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**Exhibit "M"**  
**Agreement for Conveyance of Water Between MWD, MWDOC, and IRWD (Wheeling Agreement)**  
Template for future agreements



\*The recovered water must be used within IRWD's service area. IRWD to pay MWD wheeling charges, including system access rate, water stewardship rate, and treatment surcharge (if applicable), for each acre foot of recovered water wheeled by MWD. IRWD will pay the actual costs of power incurred by MWD to convey recovered water in the California Aqueduct to IRWD delivery points.

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January 27, 2020

Prepared by: R. Bennett / K. Welch

Submitted by: F. Sanchez / P. Weghorst

Approved by: Paul A. Cook



## SUPPLY RELIABILITY PROGRAMS COMMITTEE

### OVERVIEW OF SUBSIDENCE ISSUES IN THE CALIFORNIA AQUEDUCT

#### SUMMARY:

IRWD and Rosedale-Rio Bravo Water Storage District are jointly planning the Kern Fan Groundwater Storage Project (Kern Fan Project), a 100,000-acre-foot groundwater storage project in Kern County. The project will provide water supply reliability, emergency response, and ecosystem benefits through the capture, storage, and management of State Water Project (SWP) Article 21 supplies. A critical component of the project is its ability to divert water from the California Aqueduct into a new canal to be constructed as part of the project. In June 2017, the California Department of Water Resources (DWR) prepared a report titled *California Aqueduct Subsidence Study* (2017 Report) that summarizes how subsidence is impacting capacity in the Aqueduct. In March 2019, DWR released a Supplemental Report to the 2017 study. At the Committee meeting, staff will provide an overview of the findings of the 2017 and 2019 reports.

#### BACKGROUND:

Subsidence in the San Joaquin Valley has been recorded and studied since the 1920s. U.S. Geological Survey studies from as far back as the mid-1950s have identified aquifer compaction caused by groundwater overdraft as the primary driver for the majority of land subsidence in the Central Valley. Between 1926 and 1970, some areas in the Central Valley experienced subsidence exceeding 28 feet. Exhibit “A” shows the location of subsidence caused by groundwater withdrawals during this period.

#### California Aqueduct Subsidence:

The location and design of the California Aqueduct considered potential subsidence issues by trying to avoid areas with known subsidence, and with the construction of higher-than-normal embankments, concrete-lined freeboard, and consolidation ponds. Subsidence was expected to continue during construction of the Aqueduct in the 1960s, and then reduce significantly once the canal was completed and surface water could be delivered to the region, thus reducing the need for groundwater.

After water deliveries from the California Aqueduct began and groundwater pumping was reduced, subsidence rates decreased during normal to wet hydrologic years. In contrast, subsidence increased at rates averaging 1.1 inches per year in Aqueduct Pools 17 through 20 during dry to critical hydrologic years. The ongoing slow subsidence has reduced the Aqueduct’s freeboard in some reaches to a point that canal embankment and liner raises were required in 1982 in Pools 17 through 20, and in 1989 and 1996 in Pools 22 through 24. Exhibit “B” shows the location and magnitude of historic subsidence in the Pools that were evaluated in DWR’s reports.

### Hydraulic Impacts:

In order to quantify the impact of subsidence on the California Aqueduct flow capacity and lined freeboard, a hydraulic model was developed by DWR for the 2017 Report that was enhanced for the 2019 Supplemental Report. The model extends from the outlet of the Dos Amigos Pumping Plant at Pool 14 to the forebay of the Buena Vista Pumping Plant at Pool 30. The model includes 164.2 miles of Aqueduct and all associated check structures, siphons, canal transitions, turnout locations and pumping plants located within the study reach.

### *Reductions in Flow Capacity:*

To estimate the impact of subsidence on the California Aqueduct's flow capacity, the model was run twice: once using the design flow rate and again using a reduced flow rate. The original design of the Aqueduct required three feet of freeboard. In the DWR 2017 and 2019 studies, a freeboard of 0.5 feet was evaluated in the areas of subsidence. Exhibit "C" presents the results of DWR's hydraulic analyses by depicting the original and the reduced flow rates that were evaluated in the 2017 and 2019 studies that are required to maintain a freeboard of 0.5 feet in each Aqueduct Pool. The reduction of flow capacity in Pool 28, where the Kern Fan Project may be expected to divert and the Cross Valley Canal currently diverts, was estimated to be approximately 450 cubic feet per second (cfs) in the 2017 Report and 790 cfs in the 2019 Supplemental Report.

### *Impacts to Future Deliveries:*

The 2019 Supplemental Report concluded that future subsidence may force annual delivery schedules to be much flatter, and ultimately may impede the ability of the system to make maximum deliveries and to deliver full Table A allocations (which exceed maximum historical maximum deliveries). As an example, Exhibit "D" shows that one foot of additional subsidence in Pools 24 and 25 would require normal monthly delivery volumes in the summer to be redistributed to shoulder months in order to deliver the historical maximum. The report does not include a similar chart for Pool 28 where the Kern Fan Project diversions will occur.

### *Impacts of Increasing Freeboard:*

Flow reductions in the California Aqueduct would be significantly greater if the minimum freeboard were increased from the 0.5 feet that was analyzed in the DWR reports to the original design of 3.0 feet. Exhibit "E" shows that with an increase in the freeboard from 0.5 feet to 3.0 feet, reductions in flow capacity in Pool 20 are nearly linear with a total reduction of flow capacity of 1,400 cfs.

At the Committee meeting, staff will present an overview of the findings from DWR's 2017 and 2019 reports. Staff will also provide an update on discussions with DWR regarding the proposed new Aqueduct turnout for the Kern Fan Project.

FISCAL IMPACTS:

None.

ENVIRONMENTAL COMPLIANCE:

Not applicable.

RECOMMENDATION:

Receive and file.

LIST OF EXHIBITS:

Exhibit “A” – Locations of Subsidence Caused by Groundwater Withdrawals from 1926 to 1970

Exhibit “B” – DWR Study Location and Magnitude of Subsidence

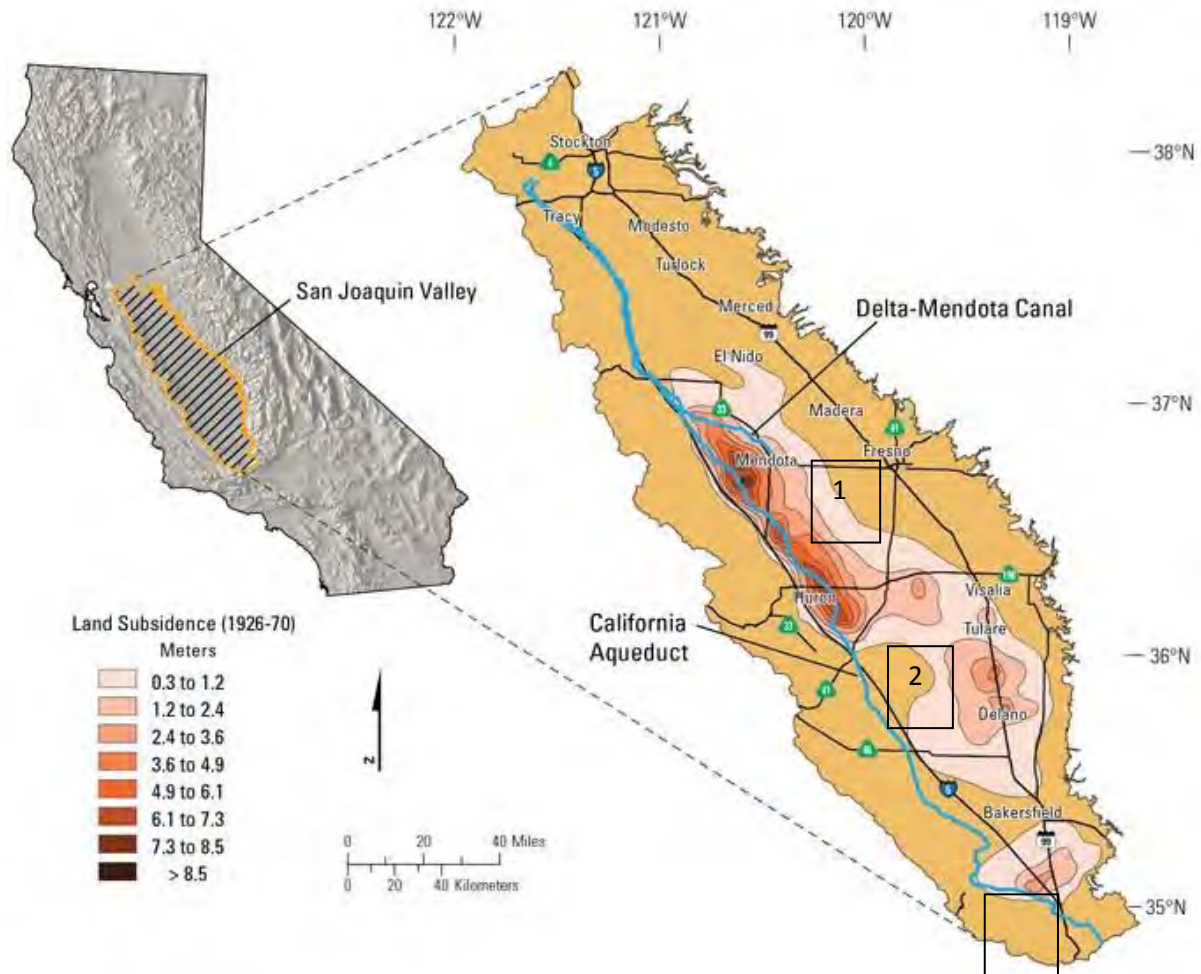
Exhibit “C” – Hydraulic Impacts of Original and Reduced Aqueduct Capacity

Exhibit “D” – Redistribution of Monthly Flows with 1-Foot Additional Subsidence in Pool 24  
and Pool 25

Exhibit “E” – Reductions in Pool 20 Flow Capacity with Increases in Freeboard

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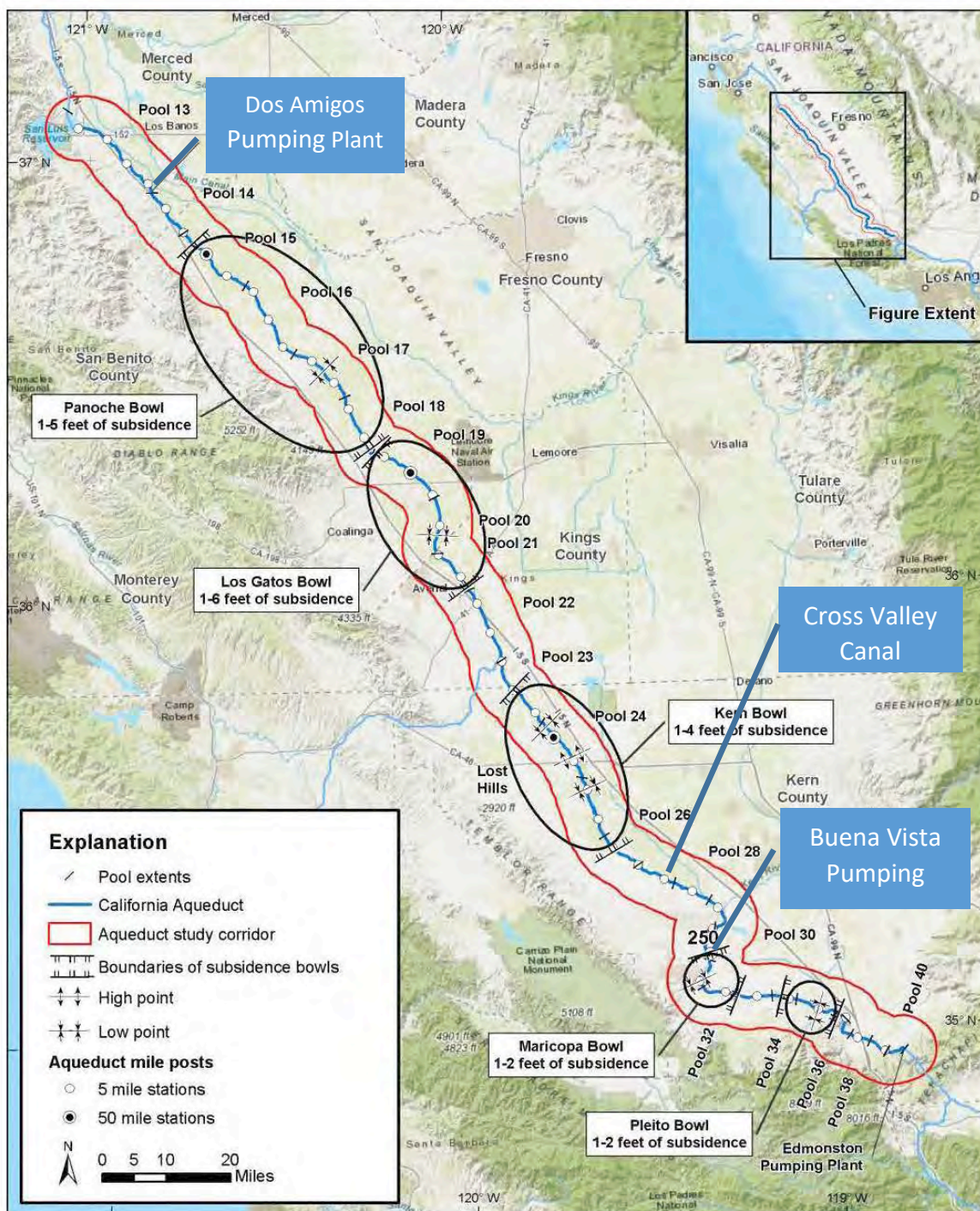
**Exhibit "A"**  
**Location of Subsidence Caused by Groundwater Withdrawals from 1926 to 1970**



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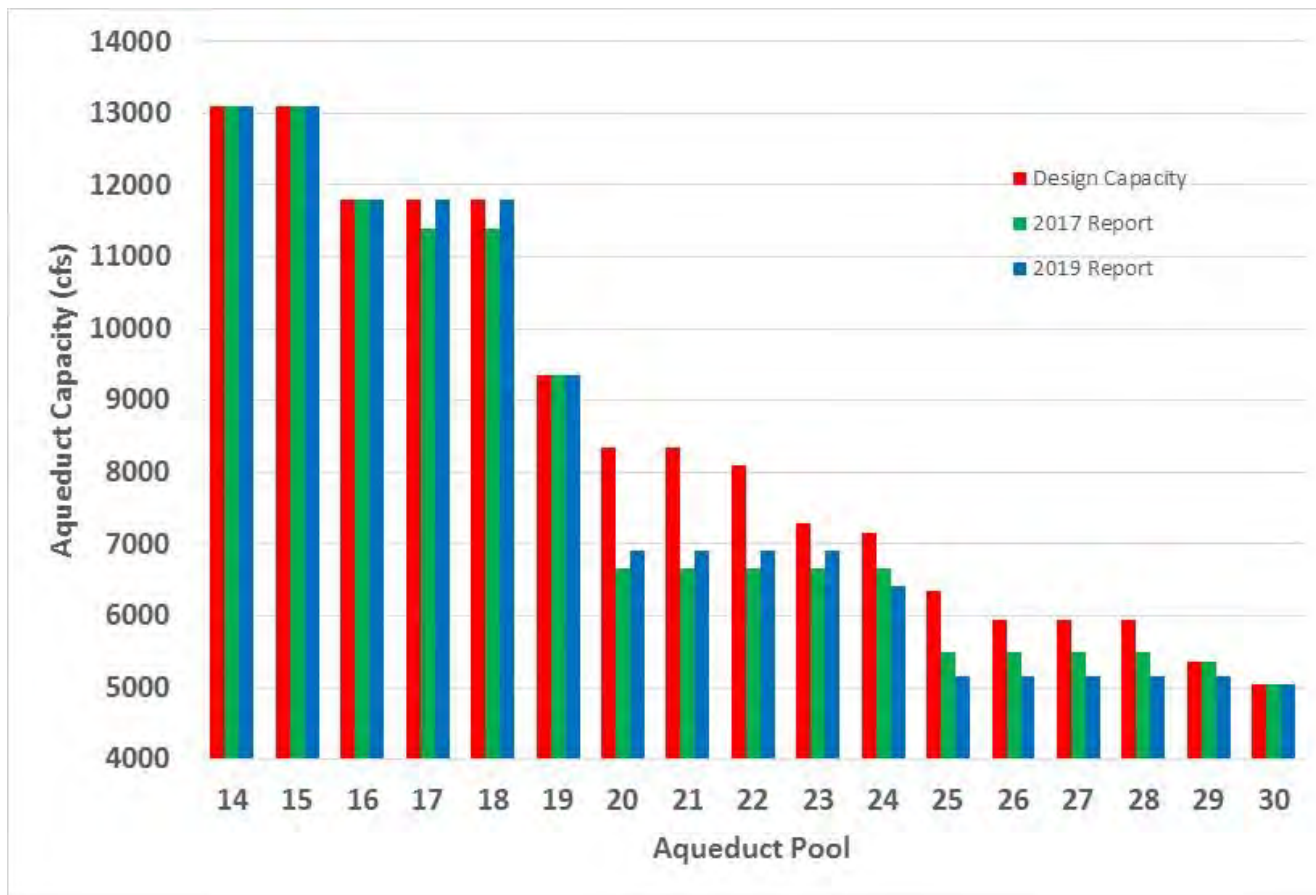
## Exhibit "B"

### DWR Study Location and Magnitude of Subsidence



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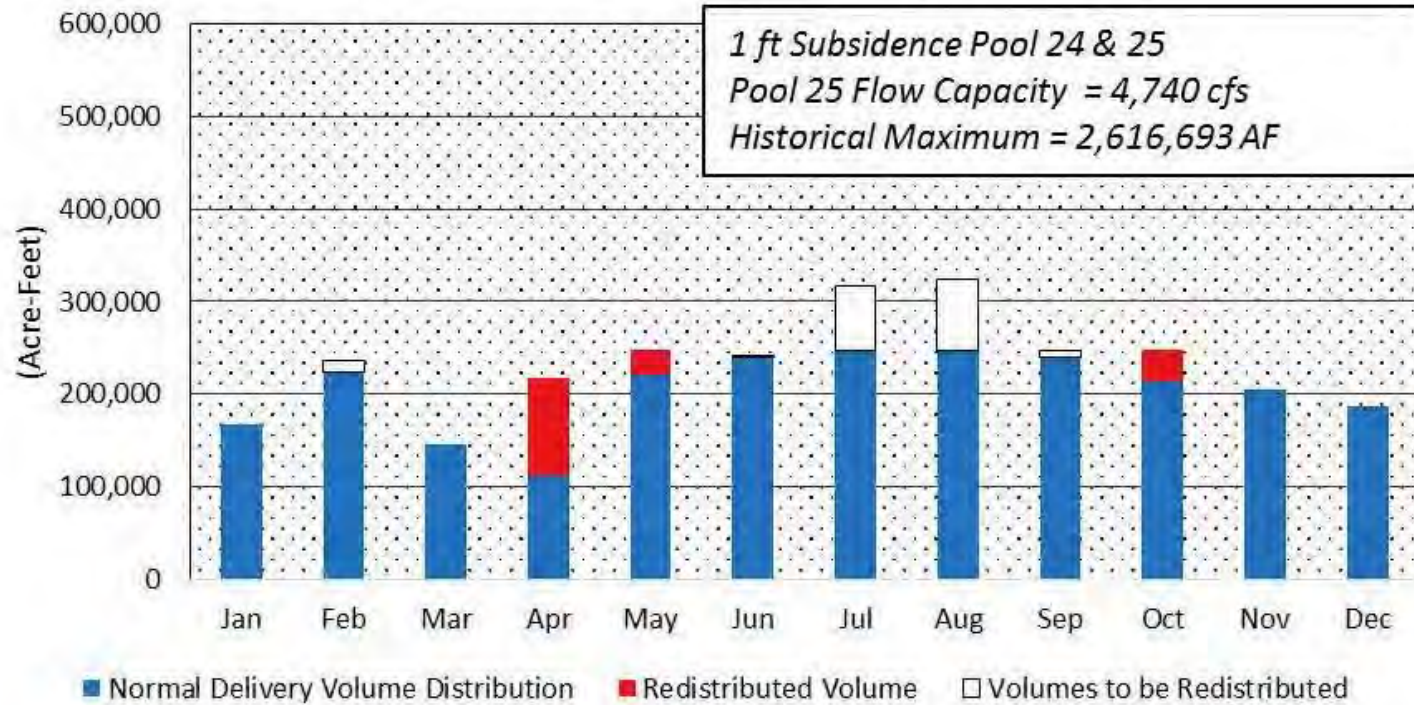
**Exhibit "C"**  
**Hydraulic Impact**



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## Exhibit "D"

### Redistribution of Monthly Flows with 1 ft Additional Subsidence in Pool 24 & 25



***\*All Volume Redistributed***

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## Exhibit "E"

### Reductions in Pool 20 Flow Capacity with Increased Freeboard

