Preliminary Analysis of Water Supply Reliability

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- MWD's 2020 IRP process
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Overview

- I present here my preliminary analysis of data relating to whether any substantive differences exist with respect to the overall water supply reliability between the San Diego County Water Authority (SDCWA) and Eastern Municipal Water District (EMWD).
- This is a work in progress.
- Because SDCWA and EMWD both depend on supplemental supplies from the Metropolitan Water District of Southern California (MWD) I also analyze data relating to the overall water supply reliability of MWD.
- My analysis draws on information from the 2020 Urban Water Management Plans (UWMPs) being prepared by SDCWA and MWD, and the 2020 Integrated Resources Planning Process (IRP) being conducted by MWD.
  - I have not had access to the draft of EMWD's 2020 Urban Water Management Plan.

IRP vs UWMP

- There is an important difference between the analysis in the UWMPs versus MWD's IRP analysis.
- UWMPs assess the water supply reliability over the next 20 years in five-year increments for normal years, a single dry-year, and for multiple dry water years.
- In the analysis in the UWMPs developed by SDCWA and MWD there is no indication of the likelihood of any actual water shortage, in the sense of projected supply in a year being less than projected demand, whether in the case of a single dry-year or multiple dry-years.
  - The analysis in the UWMPs is entirely *deterministic*.
  - Uncertainties are not quantified or modeled explicitly in the UWMPs.
- By contrast, the explicit identification of risk and modeling of supply risks forms a core component of the IRP process for water.

MWD's 2020 IRP Process

- This is MWD's fifth IRP activity.
- MWD first conducted an IRP process in 1996. It updated this with another IRP process in 2004, and then repeated the process in 2010 and 2015.
  - In 2020, MWD staff released a retrospective assessment of the 2015 IRP.
- All the IRPs contain modeling of supply variability and uncertainty, with regard especially to (but not limited to) the delivery of State Water Project (SWP) water and Colorado River water.
- The 2020 IRP combines this with a scenario modelling approach.

Scenario Planning in the 2020 IRP – An Approach for Exploring Uncertainty for Water Planning and Policy Discussion

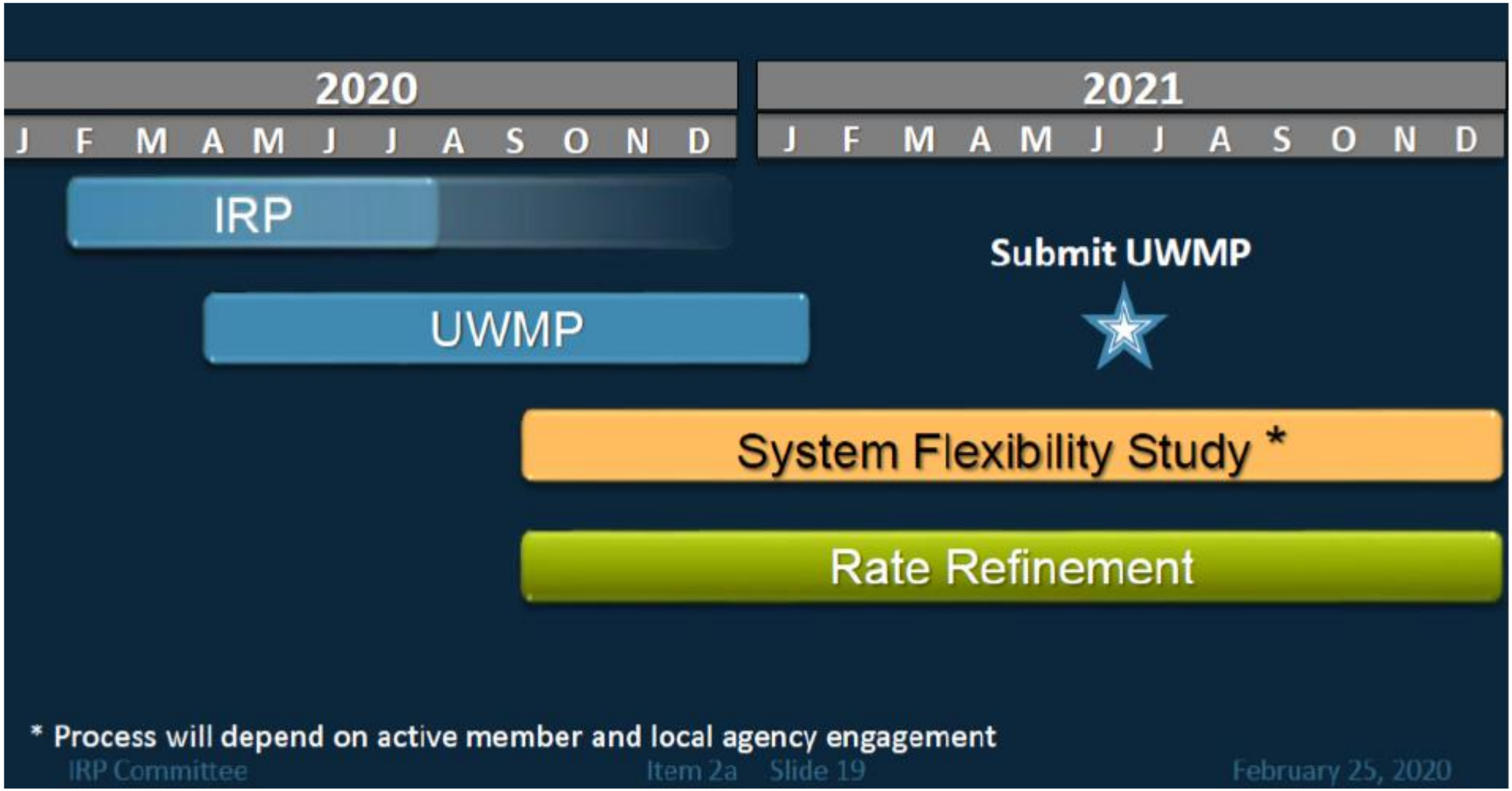
- The 2020 IRP will build on lessons learned by using a Decision Support Planning Method known as Scenario Planning. In a Scenario Planning approach, multiple alternative futures are envisioned and explored. This approach results in a greater understanding of a wider range of potential outcomes.
- In turn, those outcomes will allow a greater understanding of potential challenges to water supply reliability and the impacts of potential policy direction.

- With Scenario Planning, multiple futures are envisioned and systematically explored.
- Scenarios are not forecasts or predictions; rather, they offer dynamic views of the future by exploring various trajectories of change that lead to a broadening range of plausible alternative futures.
- Scenario Planning offers advantages over traditional deterministic forecasting through deliberative consideration of a wider range of potential outcomes, which in turn allow for more thorough understanding of potential challenges to water supply reliability.
- In short, Scenario Planning will provide the 2020 IRP to integrate highly uncertain and uncontrollable factors, such as climate change, into water resource decision making.

2020 IRP methodology

- Under the given scenario (A-D), for each MWD Member Agency, and for each calendar year from 2020 through 2045, the IRP projects:
  1. The Member Agency's total demand for water, broken down by components.
     - This is based on demographic and economic projections, calibrated in part to historical data for the period 2010-2019, and then projected forward for each year from 2020 through 2045.
  2. The Member Agency's local supply of water, broken down by components.
     - This incorporates hydrologic variability in streamflow using 96 years of hydrological conditions corresponding to the period 1922-2017.
     - For each calendar year from 2020 through 2045, supplies in that year are projected using the 96 years of hydrological conditions of the hydrological record.
- The difference between (1) and (2) measures the Agency's annual demand on MWD.

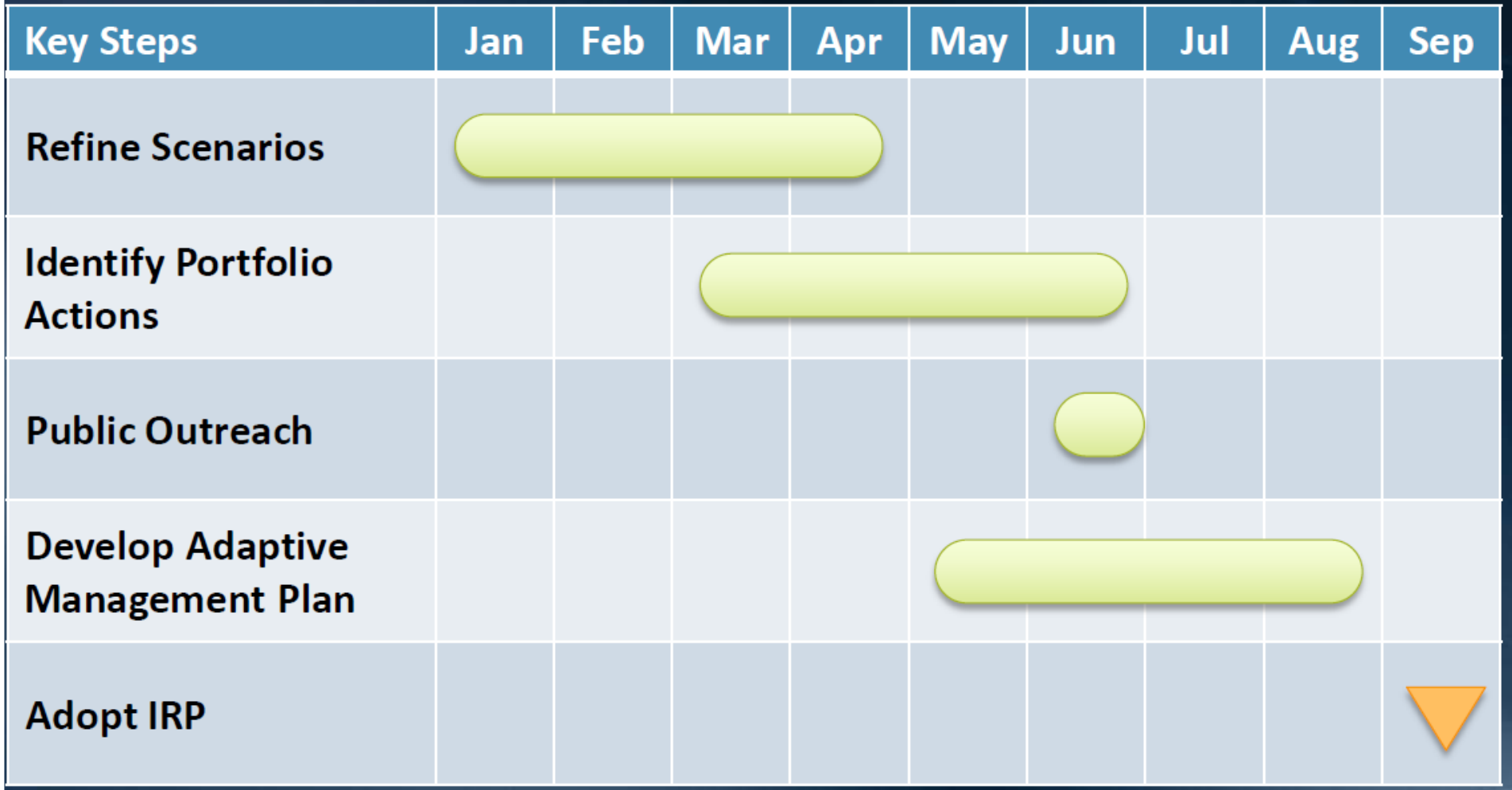
MWD's original schedule was upended by COVID-19



As of 1/26/21

Schedule for Remaining Work

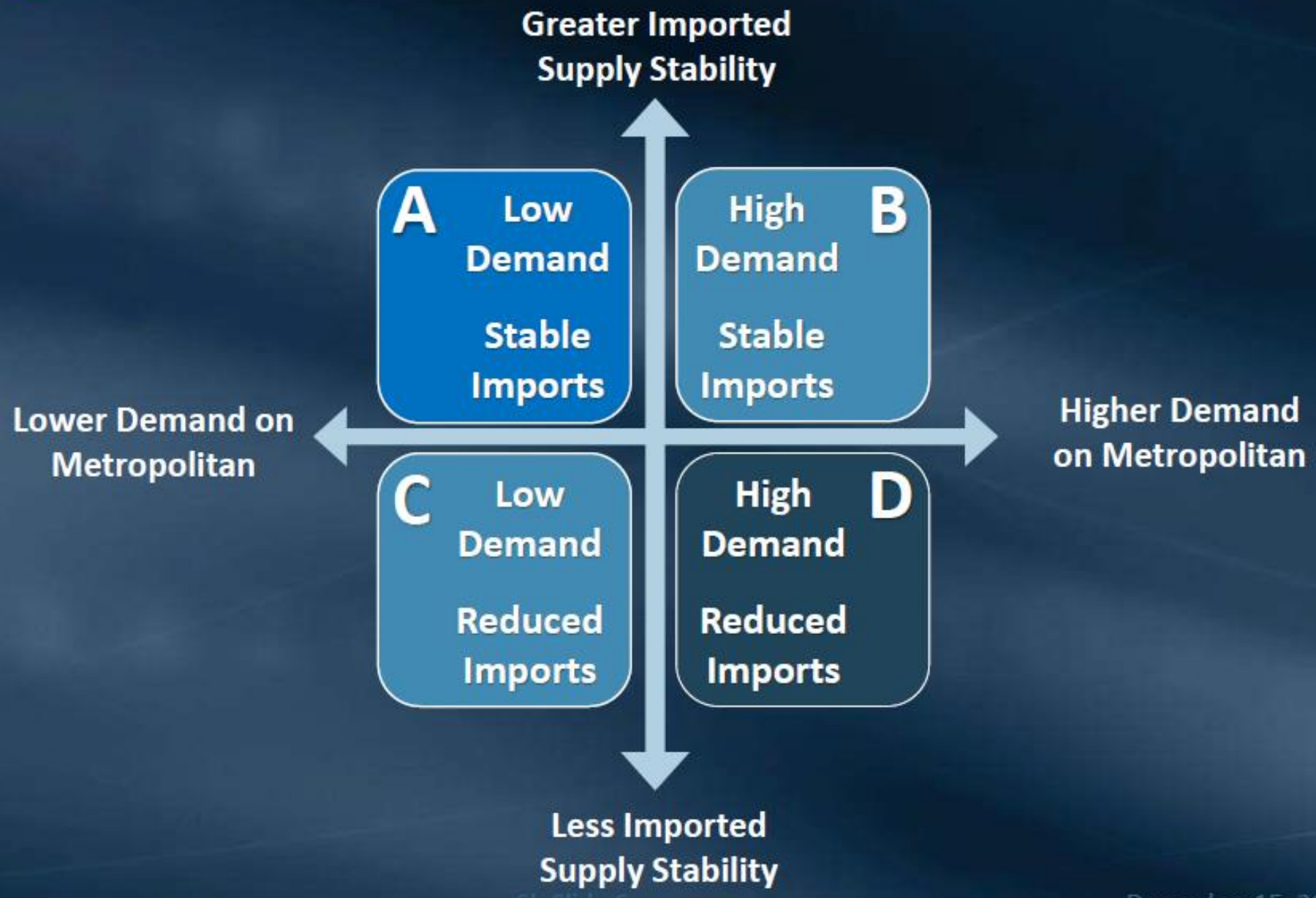
2021



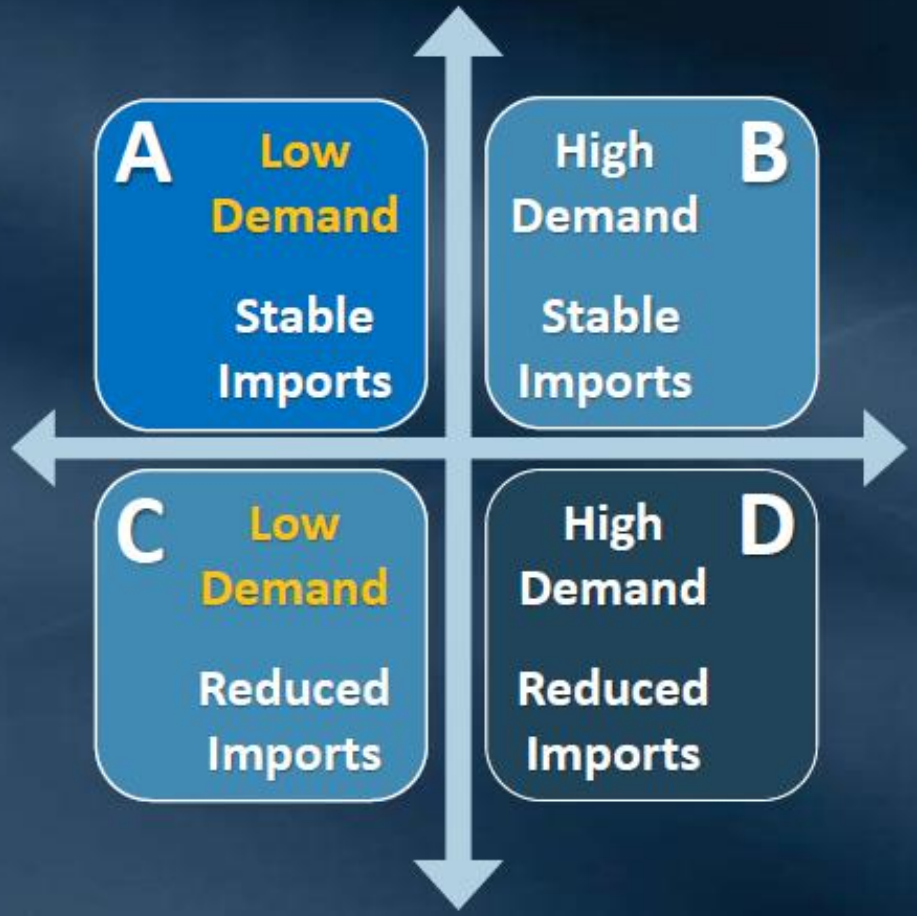
Four scenarios were used in the 2020 IRP

- The scenarios were based on two sets of drivers

Framing the Scenarios



Driving the Scenarios



A - B

Gradual Climate Impacts & Low Regulatory Impacts

B - D

High Economic Growth

C - D

Severe Climate Impacts & High Regulatory Impacts

A - C

Slow Economic Growth

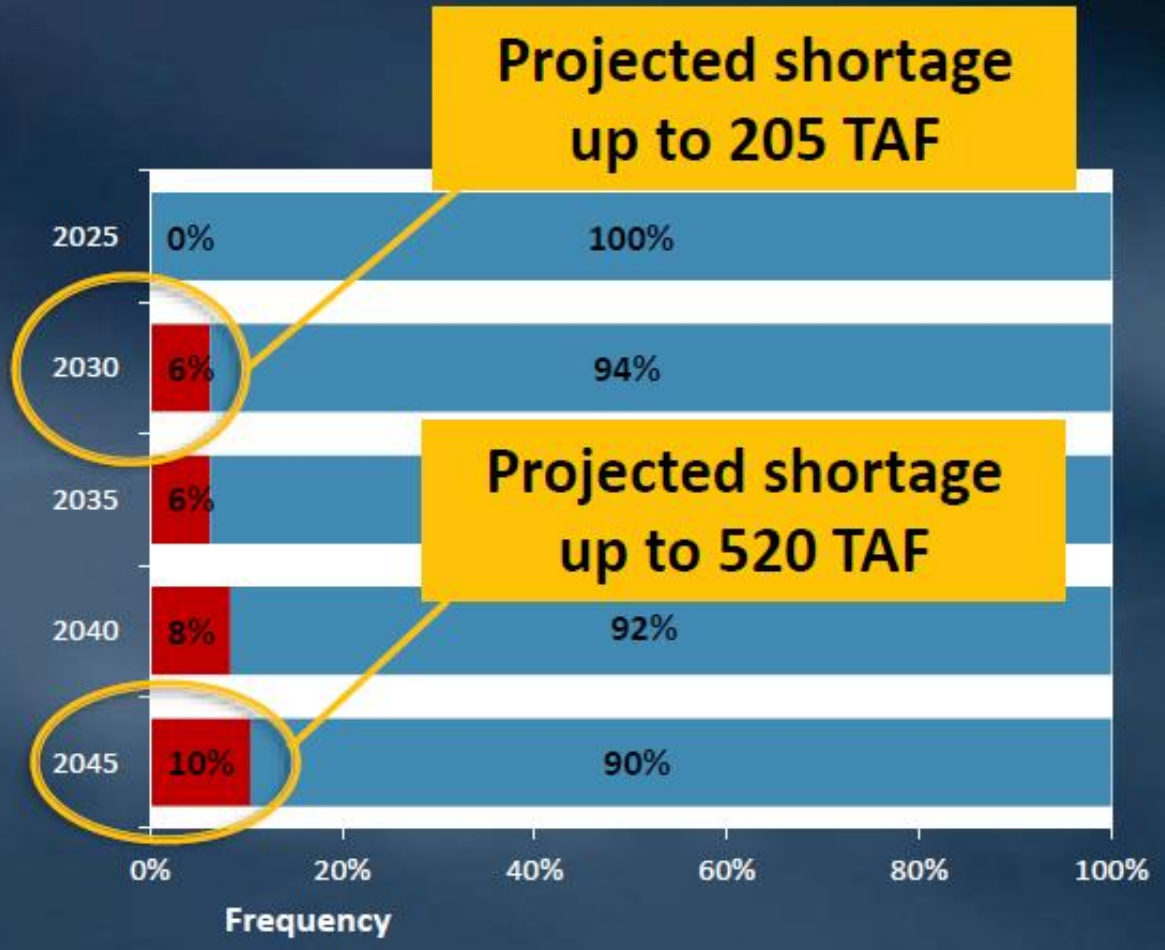
Reporting on the 2020 IRP

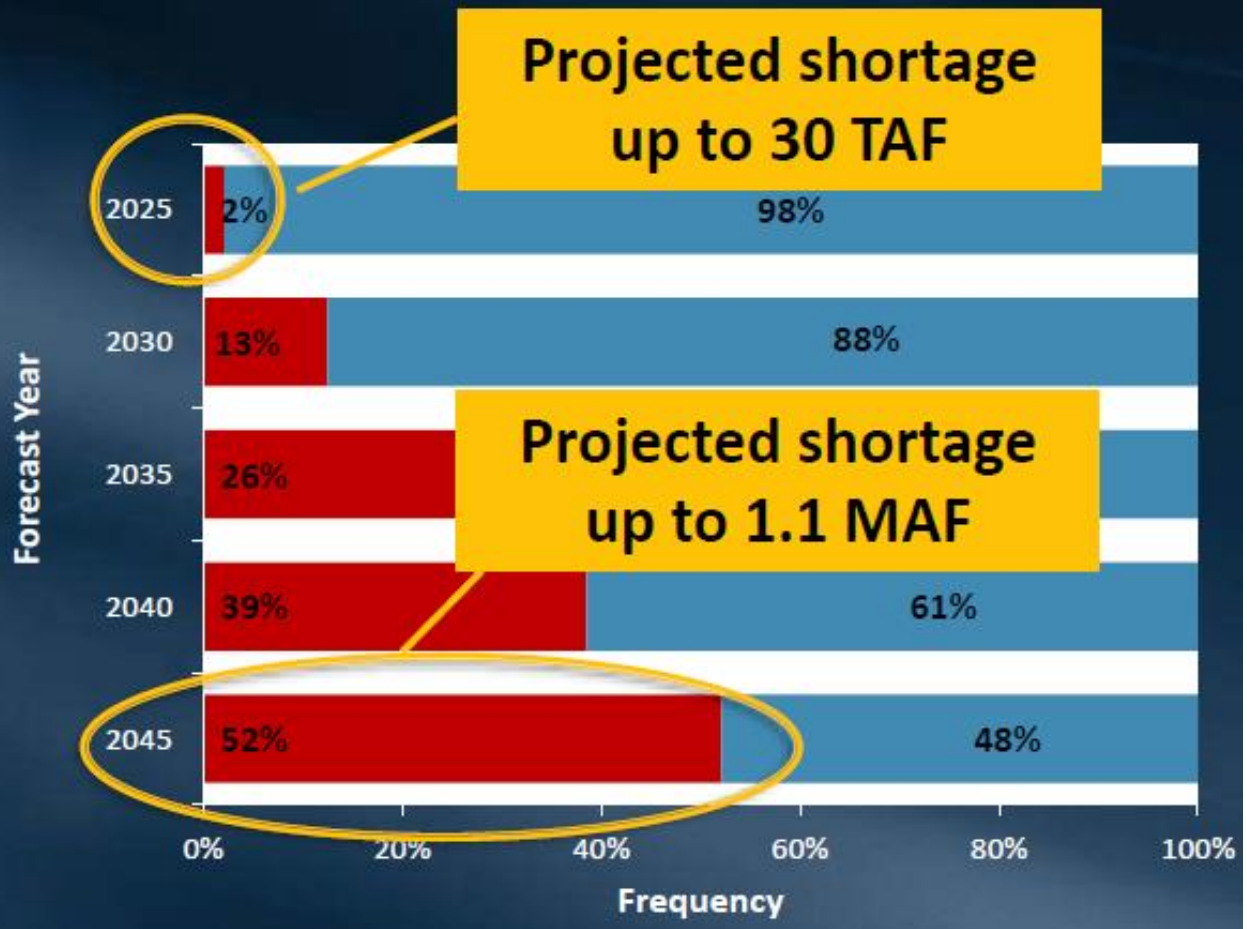
- The 2020 IRP Process has involved regular presentations to MWD Member Agencies and to the MWD Board.
- These presentations, together with other relevant material, are all posted on http://www.mwdwatertomorrow.com/IRP/index.html
  - As of 5-5-21, the most recent items were posted on March 23, 2021.
- The data used to generate the preliminary results of the scenario analyses were posted on the IRP web page in January of this year.
- I downloaded these data files: they are the input for my analysis below.

Preliminary IRP results: some gaps between demand & supply

- In scenarios B and D, but not in A or C.

Preliminary "Gap" Analysis





My assessment of reliability

- I replicate the IRP analysis, but focus specifically on SDCWA and EMWD in relation to MWD.
- An assessment of reliability focuses not on what is most likely to happen but, rather, on what could happen that would stress the system, and how well the system would deal with this.
  - A reliability assessment is in the nature of a stress test.
- For this purpose, IRP Scenarios B and D are the most relevant ones.

- My analysis uses data from scenarios B & D supplemented by information from the SDCWA and MWD 2020 UWMPs.
- I focus on annual outcomes over the six-year period 2030-2035.
  - The set of annual outcomes during this period is book-ended by the outcomes in 2030 and in 2035.
  - I report the outcomes for those two years, viewed as a range of possibilities rather than a prediction for a specific calendar year.
- I use the 96-year simulations of hydrological/climate change variability taken from the IRP Scenarios B and D.
  - I summarize the variability using the **median** year (50% of years are less, 50%are more), the **lower 5-percentile** (5% of years are less, 95% are more) and the **upper 95-percentile** (95% of years are less, 5% are more).

Assumptions

- In principle, the high percentile years are what is relevant for water demand, while the low percentile years are relevant for water supply.
  - These measure the risk in a water reliability assessment.
- However, I assume that, in the event of a future drought, there will again be something like the 2015-2016 Conservation Mandate for urban water systems.
  - Consequently, I focus on median year demands, not higher percentile demands.
  - With a Conservation Mandate, the high demand outcomes will probably not be realized.
- Because of IID's senior right to Colorado River water, SDCWA will in all circumstances receive 278,700 AF of Colorado River water.
- MWD will in all circumstances receive 550,000 AF of Colorado River water. In addition to State Water Project water, it will be able to obtain sufficient water from its storage reserves and from water market purchases to meet the full net demand from Member Agencies.

This analysis

- The analysis presented below is preliminary, and is a work in progress.
- It is subject to revision.
- To the extent that I obtain new or improved information, I will present an update at our next meeting, in June.
- Today's analysis takes the form of 3 spreadsheets plus a Technical Memorandum.
  - Those spreadsheets and Technical Memorandum are summarized in this presentation.
- The spreadsheets provide data on:

  SDCWA water supply reliability

  EMWD water supply reliability

  MWD water supply reliability

What I now present

- SDCWA
  - SDCWA UWMP water supply
  - MWD IRP analysis of SDCWA water supply
  - SDCWA UWMP water demand
  - MWD IRP analysis of SDCWA water demand
  - Estimate of SDCWA net demand on MWD
- EMWD
  - MWD IRP analysis of EMWD water demand
  - MWD IRP analysis of EMWD water supply
  - MWD IRP analysis of EMWD net demand on MWD
- MWD
  - MWD IRP analysis of Member Agencies' water demand
  - MWD IRP analysis of Member Agencies' local water supply
  - MWD IRP analysis of Member Agencies' net demand on MWD
  - MWD IRP analysis of MWD water supply

SDCWA - supply from 2020 UWMP

SDCWA RELIABILITY - SUPPLY (af/yr)						
	NORMAL YEAR		SINGLE DRY YEAR		MULTIPLE DRY YEAR	
ITEM	2030	2035	2030	2035	2030	2035
SDCWA SUPPLY - non-COLORADO RIVER						
Carlsbad Desal Plant	50,000	50,000	50,000	50,000	50,000	50,000
Member Agency Supplies						
Surface water	46,357	47,059	6,004	6,004	6,004	6,004
Potable Reuse	53,202	53,202	53,202	53,202	53,202	53,202
Water Recycling	47,363	47,463	47,363	47,463	47,363	47,463
Seawater Desal	6,000	6,000	6,000	6,000	6,000	6,000
Groundwater	23,300	23,300	15,281	15,281	15,242	15,242
Groundwater Recovery	9,000	9,000	9,000	9,000	9,000	9,000
San Luis Rey Water Transfers	15,800	15,800	15,800	15,800	15,800	15,800
TOTAL excluding Colorado River supply	251,022	251,824	202,650	202,750	202,611	202,711
COLORADO RIVER						
IID Water Transfer	200,000	200,000	200,000	200,000	200,000	200,000
ACC and CC Lining Projects	78,700	78,700	78,700	78,700	78,700	78,700
Total Colorado River	278,700	278,700	278,700	278,700	278,700	278,700
TOTAL SUPPLY OTHER THAN FROM MWD	529,722	530,524	481,350	481,450	481,311	481,411

SDCWA: MWD IRP supply analysis

	SCENARIO B		SCENARIO D	
MWD IRP SUPPLY - non-COLORADO RIVER	**2030**	**2035**	**2030**	**2035**
Seawater Desal	66,720	66,720	44,416	44,416
Groundwater	13,300	13,300	13,400	13,400
Groundwater Recovery	21,884	24,613	20,644	23,373
Recycling Total	99,292	130,508	94,078	104,687
Subtotal	201,196	235,141	172,538	185,876
Surface water - median year	48,764	48,764	41,357	41,357
Surface water - 5-percentile year	21,347	21,347	14,725	14,725
TOTAL excluding Colorado River supply				
Median Year	249,960	283,905	213,895	227,233
5-percentile year	222,543	256,488	187,263	200,601
TOTAL including Colorado River supply				
Median Year	528,660	562,605	492,595	505,933
5-percentile year	501,243	535,188	465,963	479,301

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- Normal year/Scenario B median year: supply = 538-562,000 AF

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- Dry-year/Scenario D 5-percentile year: supply = 465 – 481,000 AF

SDCWA: Demand

ITEM	2030	2035		
SDCWA TOTAL DEMAND				
NORMAL YEAR				
Regional Baseline Demand	650,211	676,537		
Additional Conservation	66,946	73,047		
DEMAND WITH CONSERVATION	583,265	603,490		
SINGLE DRY YEAR DEMAND	623,788	644,207		
MULTIPLE DRY YEAR DEMAND	632,392	655,606		
MWD IRP	SCENARIO B		SCENARIO D	
SDCWA DEMAND	**2030**	**2035**	**2030**	**2035**
Median year	690,986	706,277	689,520	704,808
95-percentile (high) year	711,802	727,558	710,335	726,088

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95-percentile (high) year	711,802	727,558	710,335	726,088

- MWD IRP demand numbers are higher than SDCWA UWMP
  - They are closer to UWMP demand without additional conservation.
- I will use (i) IRP median year demand for 2030 and 2035, and (ii) SDCWA UWMP's dry-year demand for 2035.

- I compare (i) IRP median year demand and (ii) SDCWA UWMP's dry-year demand with SDCWA non-MWD supply based on (a) IRP median year supply estimate, and (b) IRP 5-percentile year supply estimate

	ITEM	2030	2035			DATA SOURCE
	FROM SDCWA UWMP					
	SDCWA TOTAL DEMAND					Draft 2020 UWMP
	SINGLE DRY YEAR DEMAND	623,788	644,207			Table 9-2
A	MULTIPLE DRY YEAR DEMAND	632,392	655,606			Tables 9-4, 9-5
	FROM MWD IRP	SCENARIO B		SCENARIO D		
	SDCWA DEMAND	2030	2035	2030	2035	
B	Median year	690,986	706,277	689,520	704,808	
	95-percentile (high) year	711,802	727,558	710,335	726,088	
	SDCWA SUPPLY					
C	Median year	528,660	562,605	492,595	505,933	
D	5-percentile (low) year	501,243	535,188	465,963	479,301	
	SDCWA NET DEMAND ON MWD - IRP DATA					
E	Median year demand & supply	162,326	143,672	196,925	198,875	= B - C
F	Median year demand, 5-percentile supply	189,743	171,089	223,557	225,507	= B - D
	SDCWA NET DEMAND ON MWD - UWMP DATA					
G	Multiple dry year demand, median supply			139,797	149,673	= A - C
H	Multiple dry year demand, 5-percentile supply			166,429	176,305	= A - D

		SCENARIO B		SCENARIO D		
	SDCWA NET DEMAND ON MWD - IRP DATA					
E	Median year demand & supply	162,326	143,672	196,925	198,875	= B - C
F	Median year demand, 5-percentile supply	189,743	171,089	223,557	225,507	= B - D
	DEMAND ON MWD AS % OF TOTAL DEMAND					
	Median year demand & supply	23.5%	20.3%	28.6%	28.2%	= E/C
	Median year demand, 5-percentile supply	27.5%	24.2%	32.4%	32.0%	= F/C
	SDCWA NET DEMAND ON MWD - UWMP DATA					
G	Multiple dry year demand, median supply			139,797	149,673	= A - C
H	Multiple dry year demand, 5-percentile supply			166,429	176,305	= A - D
	DEMAND ON MWD AS % OF TOTAL DEMAND					
	Multiple dry year demand, median supply			22.1%	22.8%	= G//A
	Multiple dry year demand, 5-percentile supply			26.3%	26.9%	= H/A

- SDCWA net demand on MWD amounts to ~30% of its total demand with IRP Scenario D demand data, ~24% of total demand with IRP Scenario B demand data, and ~25% of total demand with UWMP demand data.

EASTERN MWD – IRP analysis

MWD IRP	SCENARIO B		SCENARIO D	
EMWD DEMAND	**2030**	**2035**	**2030**	**2035**
Median year	334,580	354,795	327,993	347,548
95-percentile (high) year	342,336	363,036	337,364	357,400
EMWD SUPPLY	162,538	178,955	144,355	156,914
EMWD NET DEMAND ON MWD				
Median year	172,042	175,840	183,638	190,634
DEMAND ON MWD AS % OF TOTAL DEMAND				
Median year	51.4%	49.6%	56.0%	54.9%

MWD – IRP analysis

	SCENARIO B		SCENARIO D	
	2030	2035	2030	2035
TOTAL DEMAND -- ALL AGENCIES EXCEPT SDCWA				
Median year	3,819,668	3,926,258	3,689,399	3,793,401
LOCAL SUPPLIES -- ALL AGENCIES EXCEPT SDCWA				
Median year	2,330,230	2,387,719	2,077,862	2,091,576
5-percentile (low)	2,162,992	2,219,846	1,899,461	1,913,174
NET DEMAND ON MWD - ALL AGENCIES EXCEPT SDCWA				
Median year demand and supply	1,489,438	1,538,539	1,611,537	1,701,825
Median year demand, 5-percentile (low) supply)	1,656,676	1,706,412	1,789,938	1,880,227
SDCWA NET DEMAND ON MWD				
Median year demand & supply	162,326	143,672	196,925	198,875
TOTAL DEMAND ON MWD				
Median year	**1,651,764**	**1,682,211**	**1,808,462**	**1,900,700**
SDCWA AS SHARE OF TOTAL DEMAND ON MWD				
Median year	9.8%	8.5%	10.9%	10.5%
EMWD AS SHARE OF TOTAL DEMAND ON MWD				
Median year	10.4%	10.4%	10.2%	10.0%

	SCENARIO B		SCENARIO D	
	2030	2035	2030	2035
MWD SUPPLY				
Colorado River Aqueduct	550,000	550,000	550,000	550,000
State Water Project - median year	1,149,537	1,149,537	835,976	835,976
State Water Project - lowest 25% of years	790,169	790,169	575,962	575,962
CRA/SWP Subtotal - median year	**1,699,537**	**1,699,537**	**1,385,976**	**1,385,976**
CRA/SWP Subtotal - 25-percentile (low)	**1,340,169**	**1,340,169**	**1,125,962**	**1,125,962**
Additional supply from storage/water market purchases				
Median year demand, median year supply	NA	NA	422,486	514,724
As % of Total MWD supply	0.0%	0.0%	23.4%	27.1%
Median year demand, 25-percentile supply	311,595	342,042	682,500	774,738
As % of Total MWD supply	18.9%	20.3%	37.7%	40.8%

- MWD meets total demand every year, supplementing CRA/SWP deliveries with additional supplies from storage reserves and/or water market purchases.
- The additional supplies account for ~25% of MWD needs in median supply year, under Scenario D, and ~40% in 25-percentile supply year under Scenario D.

Summary

- SDCWA's net demand for water from MWD amounts to about 24-30% of its total need for water.
- EMWD's net demand for water from MWD amounts to about 50-55% of its total need for water.
- MWD's need for additional supply from storage reserves and/or water market purchases amounts to 25% of its total need for water in a median supply year, and ~40% of its total need in a low supply year.
- While the amounts of net demand on MWD coming from SDCWA and EMWD are of a very similar magnitude – each about 10% of the total demand from all Member Agencies – the implied reliability of supply for the two agencies is not quite the same.
- It seems to me that SDCWA has a higher likelihood than EMWD of always being able to fill its entire need for supplemental water.