Modeling Drought Response Strategies

Austin Water Resources Planning Task Force

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Richard Hoffpauir, Ph.D., P.E.

Drought Response Strategies

- Drought response strategies were modeled for the purposes of exemplifying simulated net benefits on storage in lakes Buchanan and Travis under repeated drought conditions.
- Simulating several groupings or “tiers” can uncover strategy synergies or interferences.
- As a set, the strategies form one example of a tiered drought response plan option.

Assumptions for Austin DCP Implementation

Projected Diversions in Thousand Acre-Feet (TAF) - Rounded to Nearest 0.5 TAF							
Stage	**Assumption: Modeled Highland Lakes Combined Storage Level Trigger (AF)**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Conservation Stage	Full to 1.4 MAF	155.0	158.0	159.5	161.0	162.5	164.0
Stage 1	1.4 MAF to 900,000	150.5	153.5	155.0	156.0	157.5	159.0
Stage 2	900,000 to 600,000	142.0	144.5	145.5	147.0	148.5	149.5
Stage 3	600,000 to 500,000	124.5	125.5	127.0	128.5	129.5	131.0
Interim*	500,000 to 400,000	109.0	110.0	111.0	112.0	113.0	114.5
Stage 4⁺	400,000 and below	99.5	100.5	101.0	102.5	103.5	104.5

***Includes conceptual "Interim" stage - potentially includes hand-watering only**

⁺Includes estimated reductions of indoor use correlating to community response to drought severity

Note: 1 acre-foot (AF) = 325,851 gallons

* As of 5/2014, estimates subject to change

Tier 1 Strategies

Strategy Description	Simulated Amount	Simulated Implementation
Longhorn Dam gate improvements to increase efficiency of downstream releases	Savings of 6,000 acre-feet per year (afy) from improved release efficiency	Start of simulation, June 2014
Operating range of Lake Walter E. Long adjusted to allow for approx. 3' of drawdown before calling for LCRA stored water	Top 3,700 acre-feet of lake capacity is filled with local and run-of-river water only.	June 2014
Increased Austin municipal conservation	1,500 afy in DCP Stage 2 1,500 afy in DCP Stage 3 1,000 afy in DCP Stage 3i 1,000 afy in DCP Stage 4	January 2015
Increase Austin municipal direct reuse, "Completing the Core"	1,800 afy in all DCP stages	January 2020

Tier 2 Strategies

Strategy Description	Simulated Amount	Simulated Implementation
Capture local inflows in Lady Bird Lake, including from Barton Springs and Deep Eddy. "Excess flow" is diverted on Lady Bird Lake. Excess flow is simulated as water is not required for passage to downstream senior water rights and not needed to meet downstream LCRA environmental flow requirements.	Variable amount of excess flow diversion per month	January 2016
Walter Long Off-Channel Storage (Enhanced Capacity) Decker power plant is offline when this strategy is in effect. During the simulation period LCRA stored water is not called for maintaining storage contents in Lake Long while the power plant is offline. Decker Creek inflows, Colorado River "excess flows", and reclaimed water are stored in Lake Long. Releases of stored water are made to Decker Creek to meet downstream water right demands and to meet LCRA instream flow and bay & estuary inflow requirements.	Top 25' of Lake Long is used for releasing to Decker Creek, approx. 23,400 acre-feet of lake capacity.	January 2016

Tier 3 Strategy

Strategy Description	Simulated Amount	Simulated Implementation
Indirect Potable Reuse – SAR to Lady Bird Lake Indirect reuse on Lady Bird Lake for potable water supply. Indirect reuse simulated as a constant monthly amount. Releases of stored water from Lake Long used to offset decreased return flow discharge above the Bastrop gage.	20 Mgd, approx. 22,400 afy	Begins when combined storage drops below 420,000 acre-feet, and ceases if combined storage rises above 650,000 acre-feet
Indirect Potable Reuse – SAR to Lady Bird Lake Modeled as a separate strategy from the one listed above, and intended to simulate exhausting the environmental flow release benefits from Lake Long.	40 Mgd, approx. 44,800 afy	Begins when combined storage drops below 420,000 acre-feet, and ceases if combined storage rises above 650,000 acre-feet

Baseline Modeling Assumptions

- Combined Storage initialized to 787,000 acre-feet, as observed on June 1, 2014
- All simulations begin June 1, 2014 and end January 1, 2024
- Dry/reference year demands when not simulating curtailment due to lake combined storage below 600,000 acre-feet, i.e., pro-rata curtailment due to a declaration of a drought worse than the drought of record (DWDR) by LCRA
- Austin municipal demand growth
- Austin municipal demands reduced according to Austin's DCP stages
- Other firm customer demands reduced initially by 20% under DWDR. Reduction by 30% below 500,000 acre-feet of combined storage.
- Interruptible stored water cutoff under DWDR
- LCRA WMP Emergency Order for cutoff of interruptible stored water if DWDR not in effect
- LCRA temporary amendments for additional diversion points of LCRA run-of-river rights below the Highland Lakes
- LCRA Emergency Order to reduce the spring instream flow requirement between Bastrop and Columbus from 500 to 300 cfs for 6-consecutive weeks
- Corpus Christi run-of-river diversion of 35,000 afy begins, July 2015

Baseline Modeling Improvements

The baseline model was updated and refined since being presented to the AWRPTF in May 2014. The following is a list of the changes incorporated into the June 2014 baseline model.

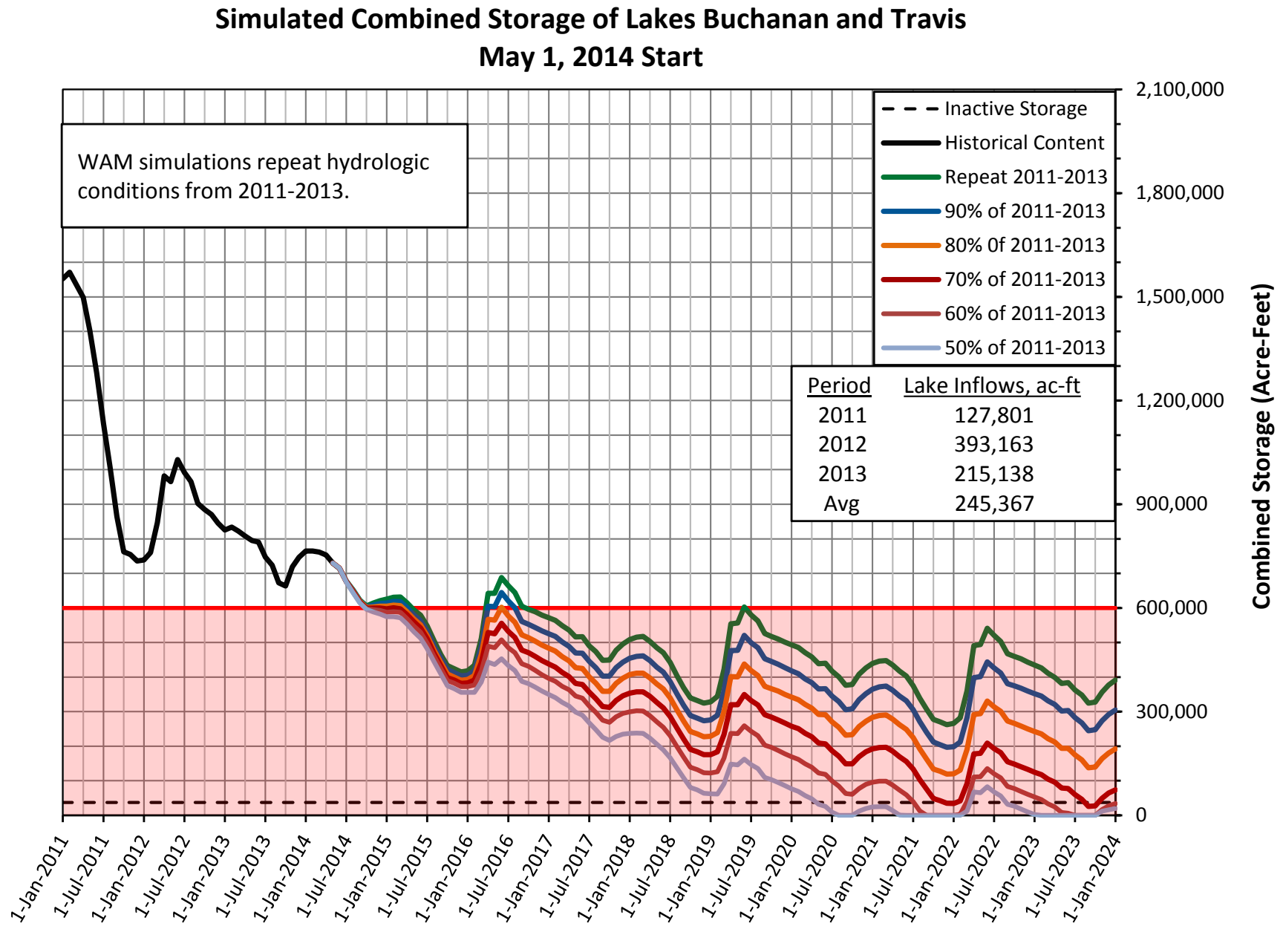
- TCEQ updated and released a new naturalized hydrology dataset for the Colorado River WAM in May 2014. The TCEQ naturalized hydrology covers the entire Colorado River Basin and tributaries for the period of 1940-2013. The previous naturalized hydrology dataset used for the baseline model was developed by LCRA for stream segments in the Lower Colorado basin only and covered 1940-2012. The baseline model used proxy hydrology for 2013 prior to incorporating the TCEQ updated hydrology dataset.

- The percent reductions of the 2011-2013 hydrology repeats were previously created by reducing only the Highland Lake inflows by the stated percentage. The new baseline hydrology adjusts stream flows at all gages in the basin by the stated percentage.

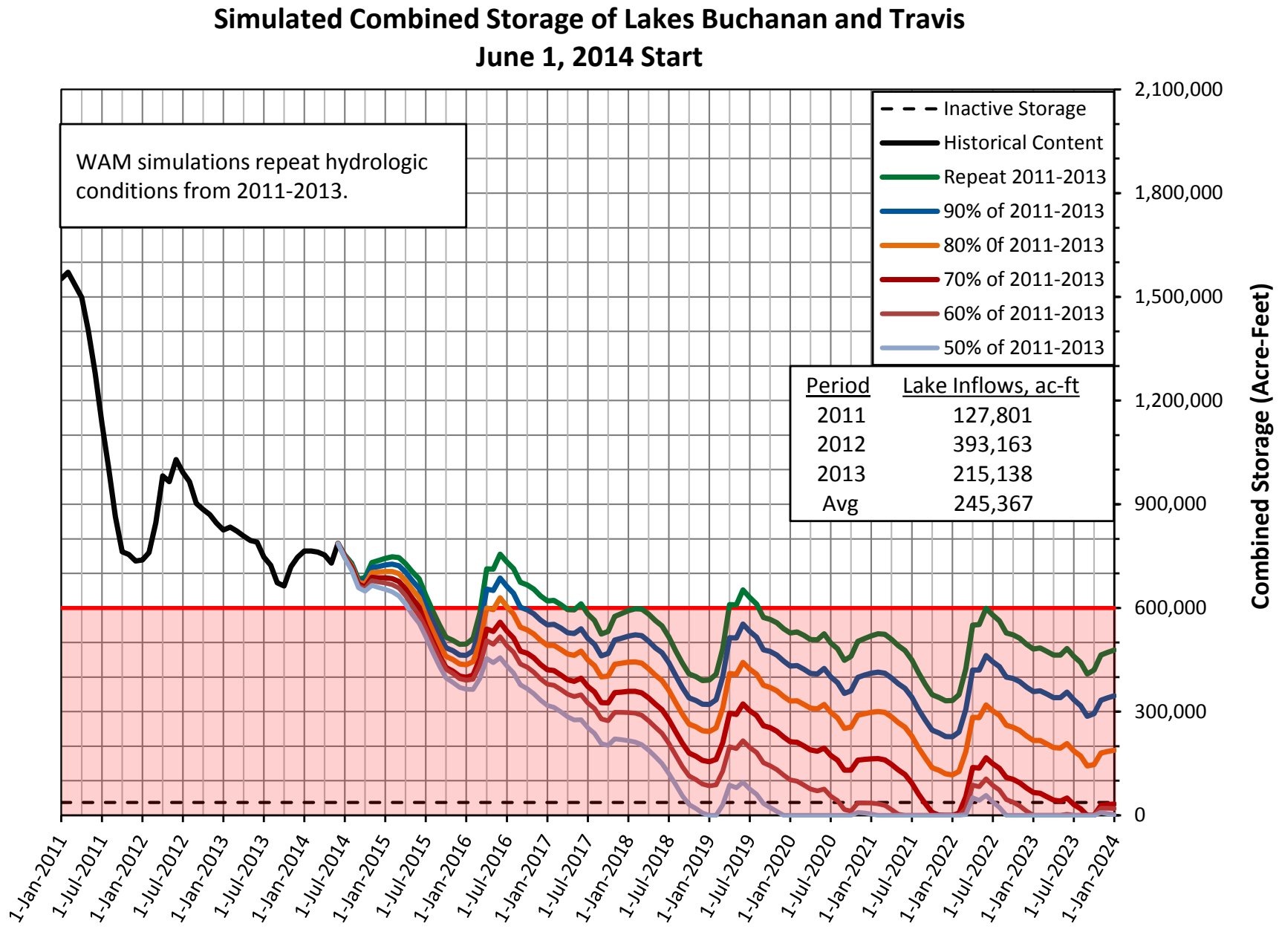
Baseline Modeling Improvements (continued)

- LCRA's groundwater supply in Bastrop county is simulated as a source for meeting power plant demands on Lake Bastrop. LCRA groundwater is simulated as 5,000 afy, and increased to 10,000 afy if drought conditions exist in Bastrop county on January 1 of each year.
- The previous baseline model did not apply stored water curtailment to lower basin power plants. Power plants are now simulated with the same 20% and 30% pro-rata reductions as all other firm customers.
- The previous baseline model represented the discharge of Barton Springs and Deep Eddy as a constant monthly amount based on a dry year average. The new baseline model represents the actual discharge of Barton Springs and Deep Eddy for all months, 1940-2013.
- The previous baseline model did not reduce LCRA instream flow and bay & estuary inflow requirements during pro-rata curtailment. The new baseline reduces LCRA instream and B&E requirements by 20% and 30% when combined storage falls below 600,000 and 500,000 acre-feet, respectively.

Baseline Model Results - May 2014 Version

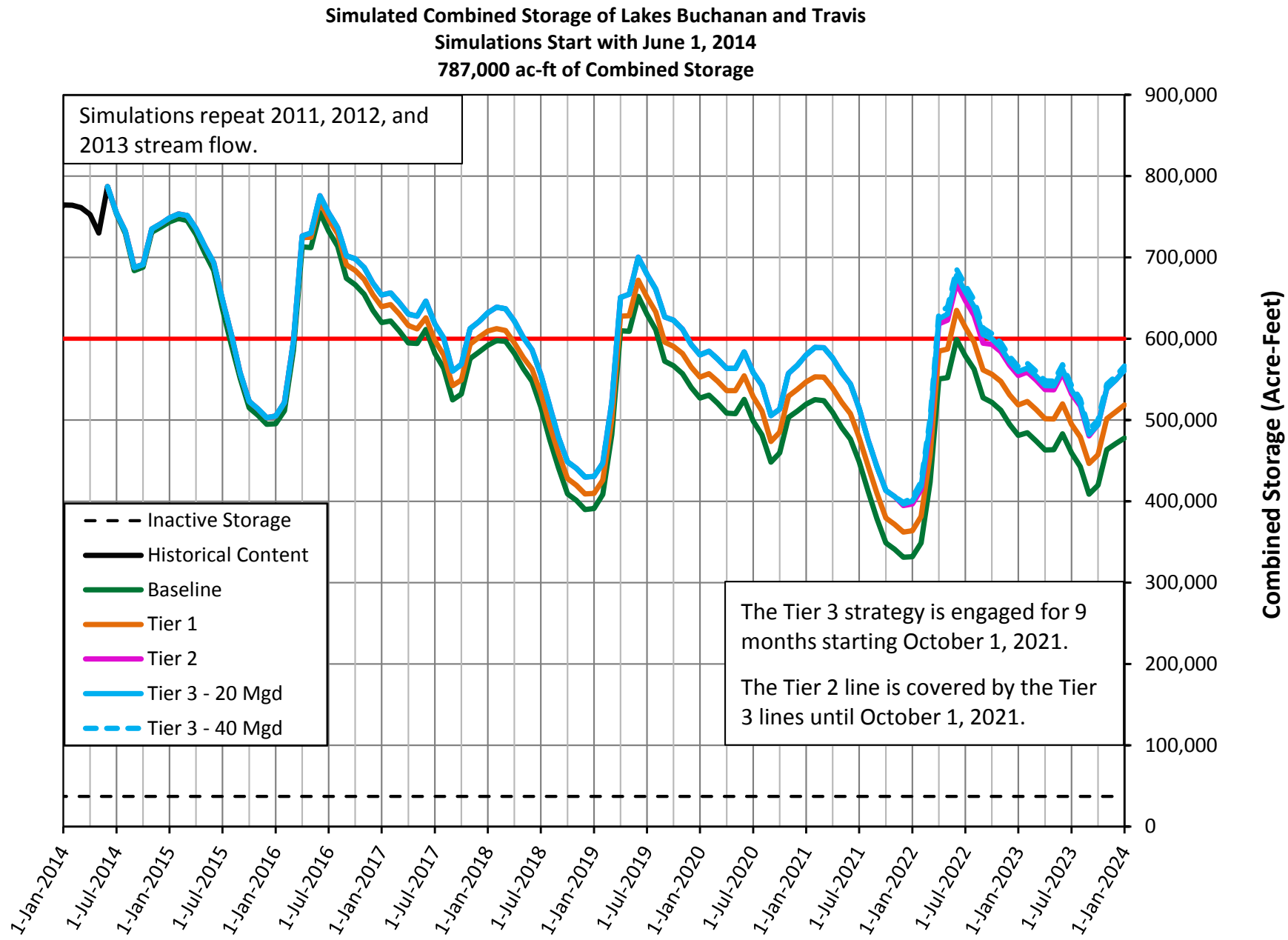


Baseline Model Results - June 2014 Version



Results from Strategy Simulations

- The baseline and strategy tiers were simulated with two hydrologic conditions repeating for 9 full years, 2015 through 2023:
  - 2011-2013 stream flow repeating
  - 70% of 2011-2013 stream flow repeating
- Hydrology for June-December 2014 is simulated by the hydrology of June-December 2013. The 70% stream flow reduction is also applied.

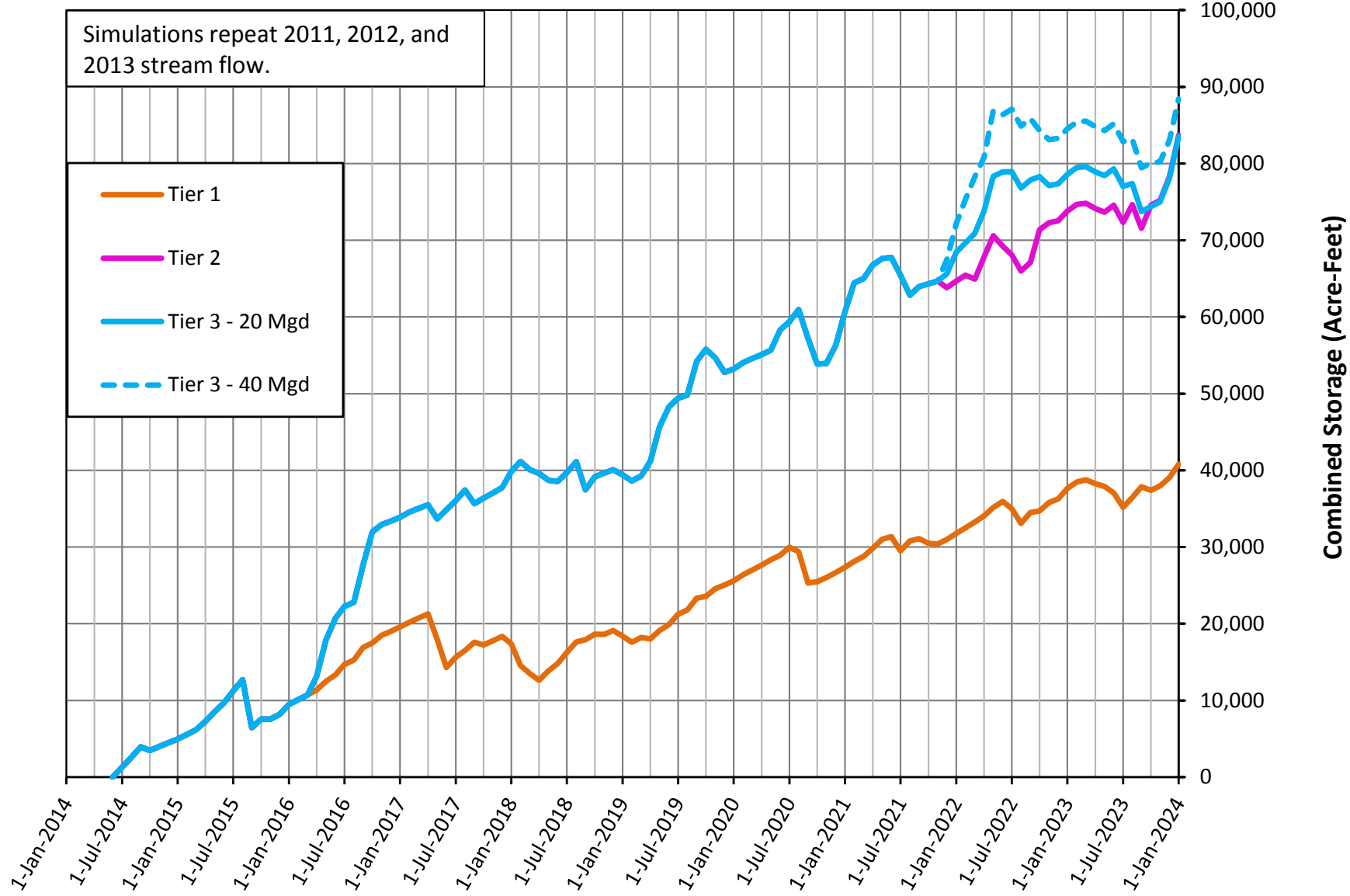

Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage
Simulations repeat 2011, 2012, and 2013 stream flow.
Inactive Storage
Historical Content
Baseline
Tier 1
Tier 2
Tier 3 - 20 Mgd
Tier 3 - 40 Mgd
The Tier 3 strategy is engaged for 9 months starting October 1, 2021.
The Tier 2 line is covered by the Tier 3 lines until October 1, 2021.
Combined Storage (Acre-Feet)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1-Jan-2014
1-Jul-2014
1-Jan-2015
1-Jul-2015
1-Jan-2016
1-Jul-2016
1-Jan-2017
1-Jul-2017
1-Jan-2018
1-Jul-2018
1-Jan-2019
1-Jul-2019
1-Jan-2020
1-Jul-2020
1-Jan-2021
1-Jul-2021
1-Jan-2022
1-Jul-2022
1-Jan-2023
1-Jul-2023
1-Jan-2024

Time Spent at Various Combined Storage Levels

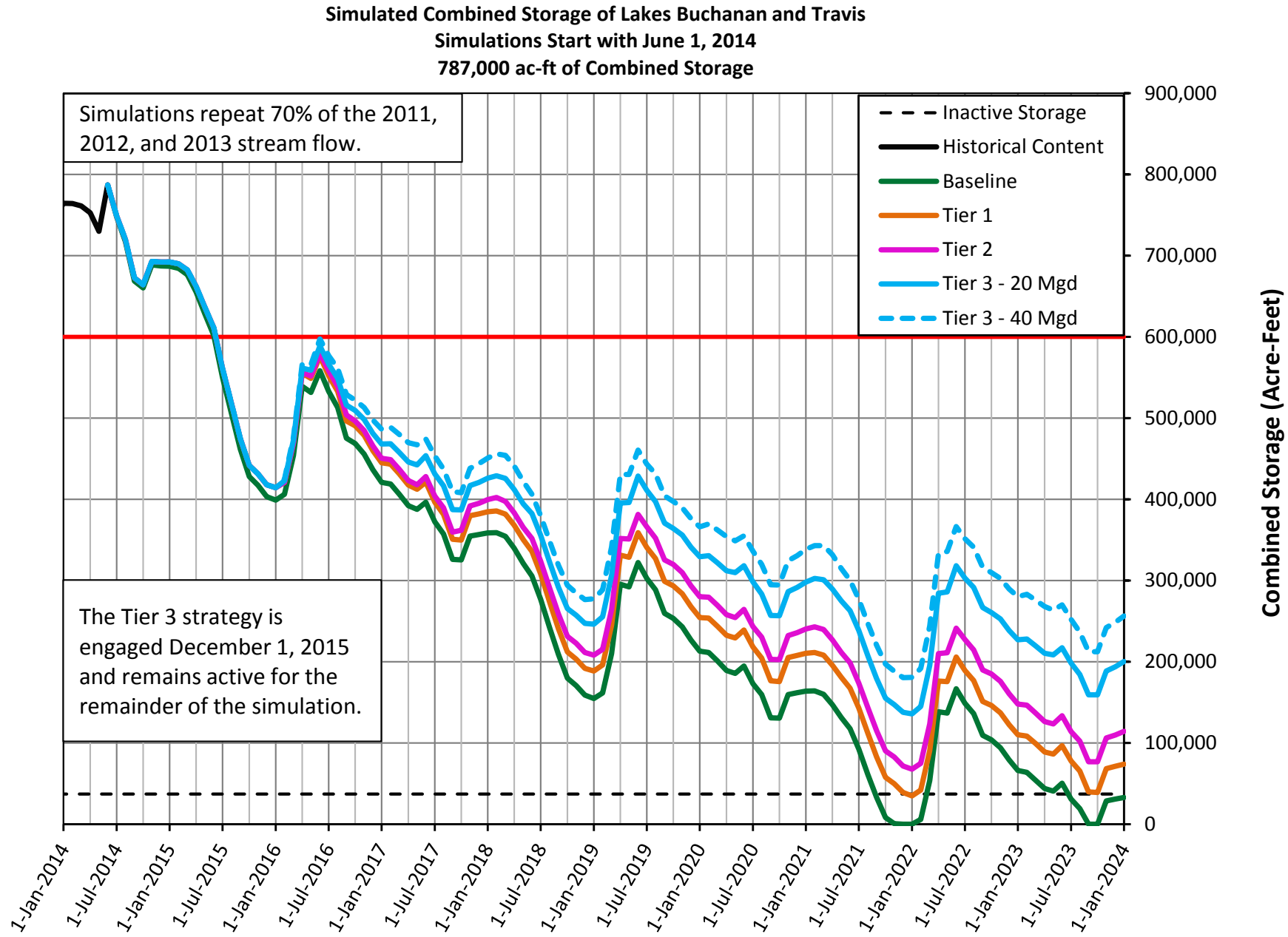
	Baseline	Tier 1	Tier 2	Tier 3 20 Mgd	Tier 3 40 Mgd
Storage			*Number of Months*		
At or Abv. 600k	32	41	52	54	54
500 - 599k	45	53	48	46	48
400 - 499k	31	17	14	15	13
Blw. 400k	8	5	2	1	1
	116	116	116	116	116

Storage			*Percent of Total Months*		
At or Abv. 600k	28%	35%	45%	47%	47%
500 - 599k	39%	46%	41%	40%	41%
400 - 499k	27%	15%	12%	13%	11%
Blw. 400k	7%	4%	2%	1%	1%
	100%	100%	100%	100%	100%

Difference from Baseline in Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage



Results for Simulations with 70% of the 2011-2013 Stream Flow

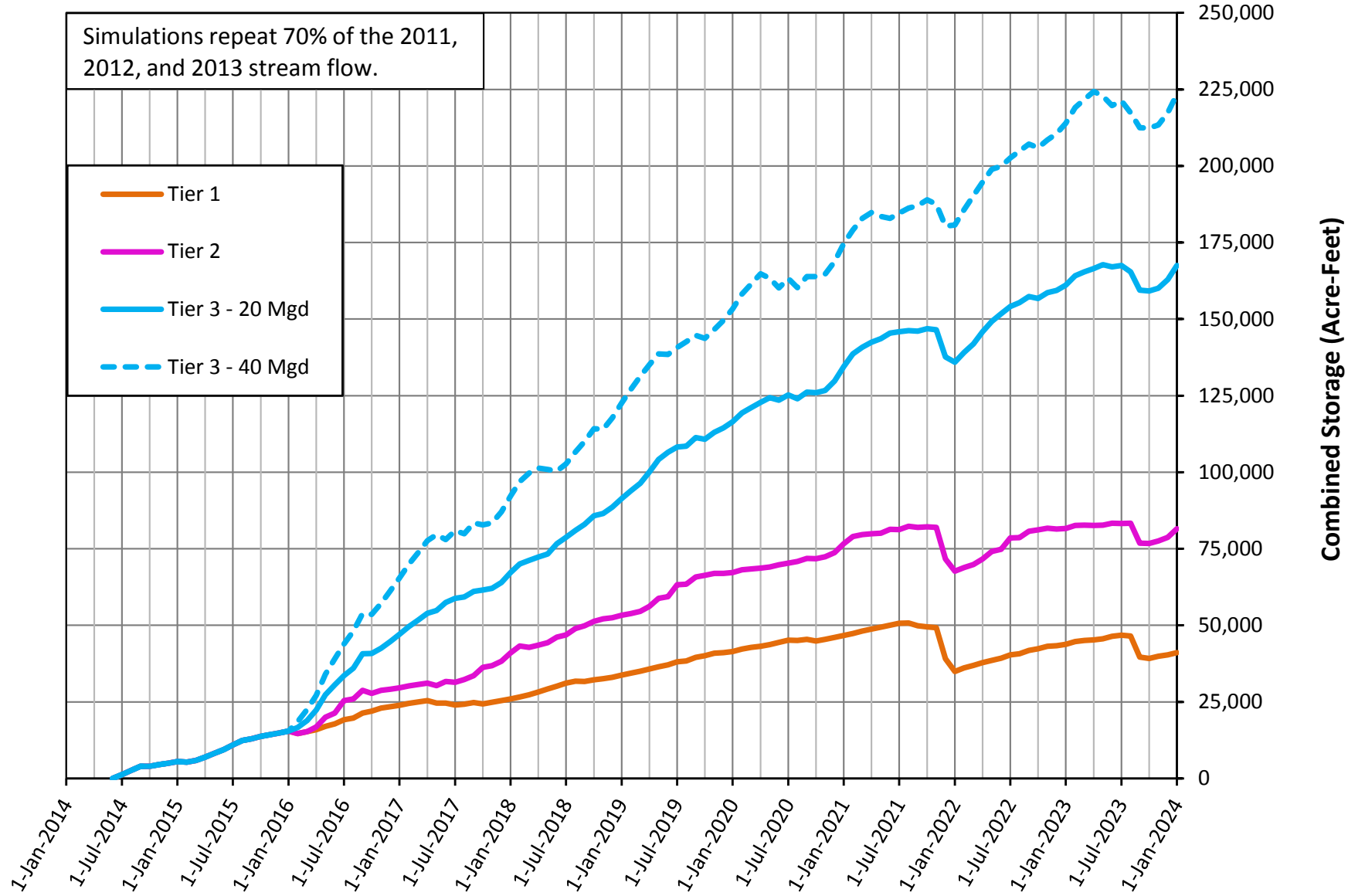

Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage
Simulations repeat 70% of the 2011, 2012, and 2013 stream flow.
The Tier 3 strategy is engaged December 1, 2015 and remains active for the remainder of the simulation.
Inactive Storage
Historical Content
Baseline
Tier 1
Tier 2
Tier 3 - 20 Mgd
Tier 3 - 40 Mgd
Combined Storage (Acre-Feet)
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1-Jan-2014
1-Jul-2014
1-Jan-2015
1-Jul-2015
1-Jan-2016
1-Jul-2016
1-Jan-2017
1-Jul-2017
1-Jan-2018
1-Jul-2018
1-Jan-2019
1-Jul-2019
1-Jan-2020
1-Jul-2020
1-Jan-2021
1-Jul-2021
1-Jan-2022
1-Jul-2022
1-Jan-2023
1-Jul-2023
1-Jan-2024

Time Spent at Various Combined Storage Levels

	Baseline	Tier 1	Tier 2	Tier 3 20 Mgd	Tier 3 40 Mgd
Storage			*Number of Months*		
At or Abv. 600k	13	13	13	13	13
500 - 599k	7	7	8	9	10
400 - 499k	13	17	18	25	32
Blw. 400k	83	79	77	69	61
	116	116	116	116	116

Storage			*Percent of Total Months*		
At or Abv. 600k	11%	11%	11%	11%	11%
500 - 599k	6%	6%	7%	8%	9%
400 - 499k	11%	15%	16%	22%	28%
Blw. 400k	72%	68%	66%	59%	53%
	100%	100%	100%	100%	100%

Difference from Baseline in Simulated Combined Storage of Lakes Buchanan and Travis
Simulations Start with June 1, 2014
787,000 ac-ft of Combined Storage



Observations

- As strategies increase combined storage, firm demands and environmental flow requirements can increase. The benefit of the strategy can be measured in:
  - absolute gain in combined storage, and
  - the number of months spent at levels:
    - above the trigger for pro-rata reductions and implementing Austin's DCP stages, and
    - at higher levels of environmental flow maintenance
- The 70% stream flow scenario results in combined storage below 500,000 acre-feet for most of the simulation. Includes assumption pro-rata curtailment reduces instream flow and bay & estuary inflow requirements by 30% at these levels.

Observations (Continued)

- Diverting excess flows, either from spring flow discharge on Lady Bird Lake or downstream from Colorado River for storage in Lake Long retains most Highland Lakes storage at times when LCRA's Water Management Plan requires reductions in environmental flows.

- Excess flow diversion on Lady Bird Lake and indirect potable reuse on Lady Bird Lake work synergistically with operation of Lake Long as an excess flow storage and release facility. Releases from Lake Long increase the number of months when upstream spring flow can be counted as excess. Likewise, releases from Lake Long offset the decrease in return flows below Longhorn Dam due to indirect potable reuse.

Potential Refinements and Additions

- Adding off season (fall through spring) operation of Lake Austin for capturing runoff of local rainfall could improve the use of excess flows generated from the creeks below Mansfield Dam.
- In the model, the operating assumptions for making stored water releases from Lake Long can be optimized to potentially increase the benefit of the strategy.
- Again, the set of strategies modeled here form just one example of a tiered drought response plan option. Different strategies, tiers, implementation triggers, and other elements can be modeled to evaluate other strategy sets and options.

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