Preliminary Assumptions used to Model Retail Demands, Local and Imported Supplies for Scenarios A, B, C & D

	Scenario A (Low Demands, Stable Imports)	**Scenario B** (High Demands, Stable Imports)	**Scenario C** (Low Demands, Reduced Imports)	**Scenario D** (High Demands, Reduced Imports)
Scenario Description	*This scenario is driven by a combination of plentiful regional and local supplies, a struggling economy, low population growth, and a continuing water use ethic across the state.*	*This scenario reflects increasing retail demands across the region resulting from population growth and a strong economy. Fortunately, climate change impacts have been manageable and imported supplies have remained stable. Increased reliance on Metropolitan resulting from groundwater contamination has also driven up demands for imported water.*	*This scenario combines slow population growth and a weak economy with successful efforts among member agencies to manage water use behavior and drought-proof their local supplies. It couples a struggling economy with the rapid onset of climate change impacts that have affected imported supplies more drastically than less-vulnerable local system.*	*This scenario is driven by severe climate change impacts to both imported and local supplies during a period of population and economic growth. Demands on Metropolitan are increasing due to rapidly increasing demands and diminishing yield from local supplies. Efforts to develop new local supplies to mitigate losses underperform. Losses of regional imported supplies are equally dramatic.*
DEMOGRAPHIC ASSUMPTIONS				
Population	• Population growth resembles historically low rates experience in 2018 and 2019 ○ Reduction of 8 percent as compared to SCAG-SANDAG forecast. -~45k people per year	• Population swells from an influx of people from other parts of the United States and other countries and job opportunities ○ Assumed half of climate migrants assigned to California would go to Metropolitan's service area and spread evenly across the years 2021-2065 (~80,000 climate migrants per year starting 2021)[i] ○ Increase of 9 percent compared to SCAG-SANDAG forecast • +~180K people per year	• Population growth resembles historically low rates experience in 2018 and 2019 ○ Reduction of 8 percent as compared to SCAG-SANDAG forecast. -~45k people per year	• Population swells from an influx of people from other parts of the United States and other countries and job opportunities ○ Assumed half of climate migrants assigned to California would go to Metropolitan's service area and spread evenly across the years 2021-2065 (~80,000 climate migrants per year starting 2021)[ii] ○ Increase of 9 percent compared to SCAG-SANDAG forecast ○ +~180K people per year
Households	• Generally, assumes relatively few homes built over next 25 years • Homebuilding that occurs will be toward affordable apartments and condominiums along mass transit lines within urban centers ○ Assumes coastal and middle subregions will have single-family (SF) households peak at 2025, with all further growth in subregions consisting entirely of new multi-family (MF) homes. ○ Inland subregions continue to have growth mix including some SF homes after 2025 but at a slower rate than in SCAG-SANDAG forecasts. ○ SF households reassigned as MF households: 70% coastal, 20% middle, and 10% inland.	• Total households calculated by taking regionwide annual persons per household ratio for 2045 (given by SCAG and SANDAG forecasts) and multiplying ratio by increased population. ○ Assumes 33% to be SF and 67% MF ▪ SF distribution by subregion: 45% inland, 22% coastal, 33% middle. ▪ MF distribution by subregion: 22% inland, 45% coastal, 33% middle. ▪ New households distributed proportionately among member agencies based on original SCAG/SANDAG shares within respective areas. • Overall effect is an increase in single family homes compared to SCAG-SANDAG forecast	• Generally, assumes relatively few homes built over next 25 years • Homebuilding that occurs will be toward affordable apartments and condominiums along mass transit lines within urban centers ○ Assumes coastal and middle subregions will have single-family (SF) households peak at 2025, with all further growth in subregions consisting entirely of new multi-family (MF) homes. ○ Inland subregions continue to have growth mix including some SF homes after 2025 but at a slower rate than in SCAG-SANDAG forecasts. • SF households reassigned as MF households: 70% coastal, 20% middle, and 10% inland.	• Total households calculated by taking regionwide annual persons per household ratio for 2045 (given by SCAG and SANDAG forecasts) and multiplying ratio by increased population. ○ Assumes 33% to be SF and 67% MF ▪ SF distribution by subregion: 45% inland, 22% coastal, 33% middle. ▪ MF distribution by subregion: 22% inland, 45% coastal, 33% middle. ▪ New households distributed proportionately among member agencies based on original SCAG/SANDAG shares within respective areas. ○ Overall effect is an increase in single family homes compared to SCAG-SANDAG forecast
Employment	• Low-growth employment was calculated by multiplying a modified Working-Age Residential Population (WARP) percentage by reduced residential population (see above). • Workforce participation rate percentage in 2045 was reduced from 75% to 70%.	• Assumes economy will be able to absorb rapidly increasing population without surges of unemployment and overall employment levels remain strong.	• Low-growth employment was calculated by multiplying a modified Working-Age Residential Population (WARP) percentage by reduced residential population (see above). • Workforce participation rate percentage in 2045 was reduced from 75% to 70%.	• Assumes economy will be able to absorb rapidly increasing population without surges of unemployment and overall employment levels remain strong.

	• Total employment was calculated by multiplying 70% reduced workforce participation rate with reduced household population (see above).	• Unemployment calculated by multiplying Working-Age Residential Population (WARP) percentage by increased residential population (see above). • Workforce participation rate in 2014 kept at 75% (consistent with SCAG forecast assumptions) • Total employment calculated by multiplying 75% workforce participation rate with enhanced household population (see above).	• Total employment was calculated by multiplying 70% reduced workforce participation rate with reduced household population (see above).	• Unemployment calculated by multiplying Working-Age Residential Population (WARP) percentage by increased residential population (see above). • Workforce participation rate in 2014 kept at 75% (consistent with SCAG forecast assumptions) • Total employment calculated by multiplying 75% workforce participation rate with enhanced household population (see above).
DEMAND ASSUMPTIONS				
Climate Effects	• Use observed range of weather influence on consumptive demands from 1922-2017 (referred to as “climate bumps”) • These “climate bumps” raise or lower forecasted demand depending on weather variables such as temperature and precipitation. • Did not modify the observed relationship between weather variables and demands	• Use observed range of weather influence on consumptive demands from 1922-2017 (referred to as “climate bumps”) • These “climate bumps” raise or lower forecasted demand depending on weather variables such as temperature and precipitation. • Did not modify the observed relationship between weather variables and demands	• Use observed range of weather influence on consumptive demands from 1922-2017 (referred to as “climate bumps”) • These “climate bumps” raise or lower forecasted demand depending on weather variables such as temperature and precipitation. • Did not modify the observed relationship between weather variables and demands	• Use observed range of weather influence on consumptive demands from 1922-2017 (referred to as “climate bumps”) • These “climate bumps” raise or lower forecasted demand depending on weather variables such as temperature and precipitation. • Did not modify the observed relationship between weather variables and demands
Municipal & Industrial	• Very low M&I consumptive retail demands reaching 2.91 MAF by 2045. • Assumes water-saving behavior from 2019 will continue, resulting in no rebound effect modelled for water use.	• High M&I consumptive retail demands reaching 4.24 MAF by 2045. • Assumes 40% rebound effect in water use between 2019 and 2030.	• Very low M&I consumptive retail demands reaching 2.91 MAF by 2045. • Assumes water-saving behavior from 2019 will continue, resulting in no rebound effect modelled for water use.	• High M&I consumptive retail demands reaching 4.24 MAF by 2045. • Assumes 40% rebound effect in water use between 2019 and 2030.
Agricultural Demand	• Agricultural demands reflect recent averages and info from 2015 UWMP.	• Agricultural demands reflect recent averages and info from 2015 UWMP.	• Agricultural demands reflect recent averages and info from 2015 UWMP.	• Agricultural demands reflect recent averages and info from 2015 UWMP.
Seawater Barrier Demand	• Used barrier demands from discussions with member agencies. • Some barrier demands are met 100% by recycled water and are thus the same as recycled water projections. • Includes existing and under construction recycled water projects for seawater barrier based on 2020 Local Supply Survey	• Used barrier demands from discussions with member agencies. • Some barrier demands are met 100% by recycled water and are the same as recycled water projections. (See recycled water assumptions) • Assumed no change to barrier demands due to sea level rise.	• Used barrier demands from discussions with member agencies. • Some barrier demands are met 100% by recycled water and are thus the same as recycled water projections. • Includes existing and under construction recycled water projects for seawater barrier based on 2020 Local Supply Survey	• Used barrier demands from discussions with member agencies. • Some barrier demands are met 100% by recycled water and are the same as recycled water projections. (See recycled water assumptions) • Assumed no change to barrier demands due to sea level rise.

Groundwater Replenishment Demand	• Recharge demands assumed to be average recharge levels observed from 2010-2012.
	• Passive recharge is fixed to 2010-2012 average (high natural replenishment)
	• Includes existing and under construction recycled water projects for replenishment based on 2020 Local Supply Survey
	• Demand for replenishment water from MWD is based on past discussions with member agencies.
		• Recharge demands assumed to be average recharge levels observed from 2010-2012.
		• Passive recharge is fixed to 2010-2012 average (high natural replenishment)
		• Includes existing and under construction recycled water projects for replenishment based on 2020 Local Supply Survey
		• Demand for replenishment water from MWD is based on past discussions with member agencies.
			• Despite high over drafting, limited natural replenishment, and available economic resources, demand for imported replenishment is drastically lower.
			  ○ Reduced imported supplies limits the amount of water for sale for replenishment purposes.
			  ○ Widespread basin contamination disincentivizes basin managers for buying water to replenish basins.
			  ○ Full inventory of recycled water and groundwater replenishment projects are developed, however at a limited capacity.
			• Recharge demands assumed to be average recharge levels observed from 2014-2016.
				• Despite high over drafting, limited natural replenishment, and available economic resources, demand for imported replenishment is drastically lower.
				  ○ Reduced imported supplies limits the amount of water for sale for replenishment purposes.
				  ○ Widespread basin contamination disincentivizes basin managers for buying water to replenish basins.
				  ○ Full inventory of recycled water and groundwater replenishment projects are developed, however at a limited capacity.
				• Recharge demands assumed to be average recharge levels observed from 2014-2016.
				• Passive recharge is a linear trend to average levels of 2014-2016 (low natural replenishment) by 2045.

			• Passive recharge is a linear trend to average levels of 2014-2016 (low natural replenishment) by 2045.	
		LOCAL SUPPLY ASSUMPTIONS		
Climate Effects	• Updated LA and San Diego annual precipitation history to include 1922 to 2017 • Defined a "wet" year to be greater than 25% of observed average. • Defined a "dry" year to be less than 25% of observed average • Defined a "normal" year to be within 25% of observed average. • Local "wet", "dry", and "normal" years have impacts on certain local supplies. Details found in each respective local supply	• Updated LA and San Diego annual precipitation history to include 1922 to 2017 • Defined a "wet" year to be greater than 25% of observed average. • Defined a "dry" year to be less than 25% of observed average • Defined a "normal" year to be within 25% of observed average. • Local "wet", "dry", and "normal" years have impacts on certain local supplies. Details found in each respective local supply	• Updated LA and San Diego annual precipitation history to include 1922 to 2017 • Defined a "wet" year to be greater than 25% of observed average. • Defined a "dry" year to be less than 25% of observed average • Defined a "normal" year to be within 25% of observed average. • Local "wet", "dry", and "normal" years have impacts on certain local supplies. Details found in each respective local supply • Modified precipitation history (1922-2017) to estimate increased "wet" or "dry" years due to climate change. • Years lower than the median are made drier by up to 10% and years above the median are made wetter by 20% using a linear trend	• Updated LA and San Diego annual precipitation history to include 1922 to 2017 • Defined a "wet" year to be greater than 25% of observed average. • Defined a "dry" year to be less than 25% of observed average • Defined a "normal" year to be within 25% of observed average. • Local "wet", "dry", and "normal" years have impacts on certain local supplies. Details found in each respective local supply • Modified precipitation history (1922-2017) to estimate increased "wet" or "dry" years due to climate change. • Years lower than the median are made drier by up to 10% and years above the median are made wetter by 20% using a linear trend
Surface Water	• San Diego County Water Authority ○ Updated San Diego Surface Water Factor table with updated precipitation history ○ Assumed long-term average is 51,180 AFY based on SDCWA's 2015 UWMP • Inland Empire Utilities Agency ○ Normal year: 32,800 AF ○ Dry year: 20,000 AF ○ Wet Year: 49,900 AF • All other surface water sources ○ Assume 2010-2012 production average	• San Diego County Water Authority ○ Updated San Diego Surface Water Factor table with updated precipitation history ○ Assumed long-term average is 51,180 AFY based on SDCWA's 2015 UWMP • Inland Empire Utilities Agency ○ Normal year: 32,800 AF ○ Dry year: 20,000 AF ○ Wet Year: 49,900 AF • All other surface water sources • Assume 2010-2012 production average	• San Diego County Water Authority ○ Updated San Diego Surface Water Factor table with modified precipitation history ▪ Used modified precipitation history reflecting more "wet" and "dry years" ○ Assumed long-term average is 43,928 AFY (15% reduction of 51,180 AFY based on SDCWA's 2015 UWMP) • Inland Empire Utilities Agency ○ Normal year: 27,880 AF (15% reduced from 32,800 AF) ○ Dry year: 17,000 AF (15% reduced from 20,000 AF) ○ Wet Year: 42,415 AF (15% reduced from 49,900 AF) • All other surface water sources • Assume 2015-2019 production average	• San Diego County Water Authority ○ Updated San Diego Surface Water Factor table with modified precipitation history ▪ Used modified precipitation history reflecting more "wet" and "dry years" ○ Assumed long-term average is 43,928 AFY (15% reduction of 51,180 AFY based on SDCWA's 2015 UWMP) • Inland Empire Utilities Agency ○ Normal year: 27,880 AF (15% reduced from 32,800 AF) ○ Dry year: 17,000 AF (15% reduced from 20,000 AF) ○ Wet Year: 42,415 AF (15% reduced from 49,900 AF) • All other surface water sources ○ Assume 2015-2019 production average
Groundwater	• Orange County Basin ○ Assume 75% BPP • All other basins ○ Production based on 2010-2012 average. Linear trend from 2020 projected to 2045. ○ Agencies pump to full adjudication when information is available ○ PFAS impacts for first 5 years in Central Basin (about 15,000 AF) • Calleguas includes 9,000 AFY of groundwater delivered to Port Hueneme Water Agency and	• Orange County Basin ○ Assume 75% BPP • All other basins ○ Production based on 2010-2012 average. Linear trend from 2020 projected to 2045. ○ Agencies pump to full adjudication when information is available ○ PFAS impacts for first 5 years in Central Basin (about 15,000 AF) • Calleguas includes 9,000 AFY of groundwater delivered to Port Hueneme Water Agency and Oxnard	• Orange County Basin ○ Assume 75% BPP initially, degrades to 65% linearly by 2045 • All other basins ○ Production based of 2014-2016 average. Linear trend from 2020 projected to 2045. • Calleguas includes groundwater delivered to Port Hueneme Water Agency and Oxnard from United Conservation WD; previously considered a Non-MWD Import	• Orange County Basin ○ Assume 75% BPP initially, degrades to 65% linearly by 2045 • All other basins ○ Production based of 2014-2016 average. Linear trend from 2020 projected to 2045. • Calleguas includes groundwater delivered to Port Hueneme Water Agency and Oxnard from United Conservation WD; previously considered a Non-MWD Import

	Oxnard from United Conservation WD; previously considered a Non-MWD Import	from United Conservation WD; previously considered a Non-MWD Import		
Groundwater Recovery	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Only included projects currently producing water and future projects already under construction or that have signed a Local Resources Program agreement. Did not include future projects still in planning phases.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Included full inventory of local projects, reduced ultimate yield of future projects (under construction, CEQA, and Conceptual only) by 20% reflecting successful development of local projects.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Only included projects currently producing water and future projects already under construction or that have signed a Local Resources Program agreement. Did not include future projects still in planning phases.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Included full inventory of local projects, reduced ultimate yield by 20% and reduced projection by an additional 20% reflecting severe climate and regulatory setbacks to local project development and operation.
Recycled Water	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Only included projects currently producing water and future projects already under construction or that have signed a Local Resources Program agreement. Did not include future projects still in planning phases.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Included full inventory of local projects, reduced ultimate yield of future projects (under construction, CEQA, and Conceptual only) by 20% reflecting successful development of local projects.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Only included projects currently producing water and future projects already under construction or that have signed a Local Resources Program agreement. Did not include future projects still in planning phases.	• Used 2020 Local Supply Survey updated inventory • Projected using local projects projections model • Included full inventory of local projects, reduced ultimate yield by 20% and reduced projection by an additional 20 % reflecting severe climate and regulatory setbacks to local project development and operation.
Seawater Desalination	• Included only one existing/under construction project (Claude "Bud" Lewis) • Assumed facility to operate at 85% of capacity in normal and wet years, and full capacity during dry years.	• Included full inventory of seawater desalination projects reported in 2020 Local Supply Survey, reduced ultimate yield of future projects (under construction, CEQA, and Conceptual only) by 20% reflecting successful development of local projects. • Assumed all facilities would operate at the reduced ultimate yield in all years.	• Included only one existing/under construction project (Claude "Bud" Lewis) • Assumed facility to operate at 85% of capacity in normal and wet years, and full capacity during dry years.	• Included full inventory of seawater desalination projects reported in 2020 Local Supply Survey, reduced ultimate yield by 20% and reduced by projection by an additional 20% reflecting severe climate and regulatory setbacks to local project development and operation. • Assumed all facilities would operate at the reduced ultimate yield in all years.
Los Angeles Aqueduct	• Used forecast provided by LADWP in August 2020. Only includes one forecast sequence through 96 hydrologies (1922-2017). ○ No adjustments made.	• Used forecast provided by LADWP in August 2020. Only includes one forecast sequence through 96 hydrologies (1922-2017). ○ No adjustments made.	• Used forecast provided by LADWP in August 2020. Only includes one forecast sequence through 96 hydrologies (1922-2017). ○ Adjusted by decreasing years below median linearly by 10% and increasing years above median linearly by 20%	• Used forecast provided by LADWP in August 2020. Only includes one forecast sequence through 96 hydrologies (1922-2017). ○ Adjusted by decreasing years below median linearly by 10% and increasing years above median linearly by 20%
IMPORTED WATER SUPPLY ASSUMPTIONS				
State Water Project	• 2019 Delivery Capability Report Assumptions ○ No Conveyance Project	• 2019 Delivery Capability Report Assumptions ○ No Conveyance Project	• 2019 Delivery Capability Report Assumptions ○ No Conveyance Project ○ Additional climate change impacts ○ More restrictive South Delta ○ Increase in outflow requirements	• 2019 Delivery Capability Report Assumptions ○ No Conveyance Project ○ Additional climate change impacts ○ More restrictive South Delta ○ Increase in outflow requirements
Colorado River Aqueduct	• August 2020 CRSS Modeling Run ○ Full Hydrology ○ Upper Basin Drought Operations plan in place through planning horizon	• August 2020 CRSS Modeling Run ○ Full Hydrology ○ Upper Basin Drought Operations plan in place through planning horizon	• August 2020 CRSS Modeling Run ○ Stress Test Hydrology ○ Upper Basin Drought Operations plan in place through planning horizon	• August 2020 CRSS Modeling Run ○ Stress Test Hydrology ○ Upper Basin Drought Operations plan in place through planning horizon

2045 Demographic Input Comparisons

Year 2045 Projections	2019 Actual	SCAG-SANDAG	Scenario A & C	Scenario B & D
Population, Total	19.2 M	22.0 M	20.4 M	24.1 M
Population, Household	18.8 M	21.7 M	20.0	23.7 M

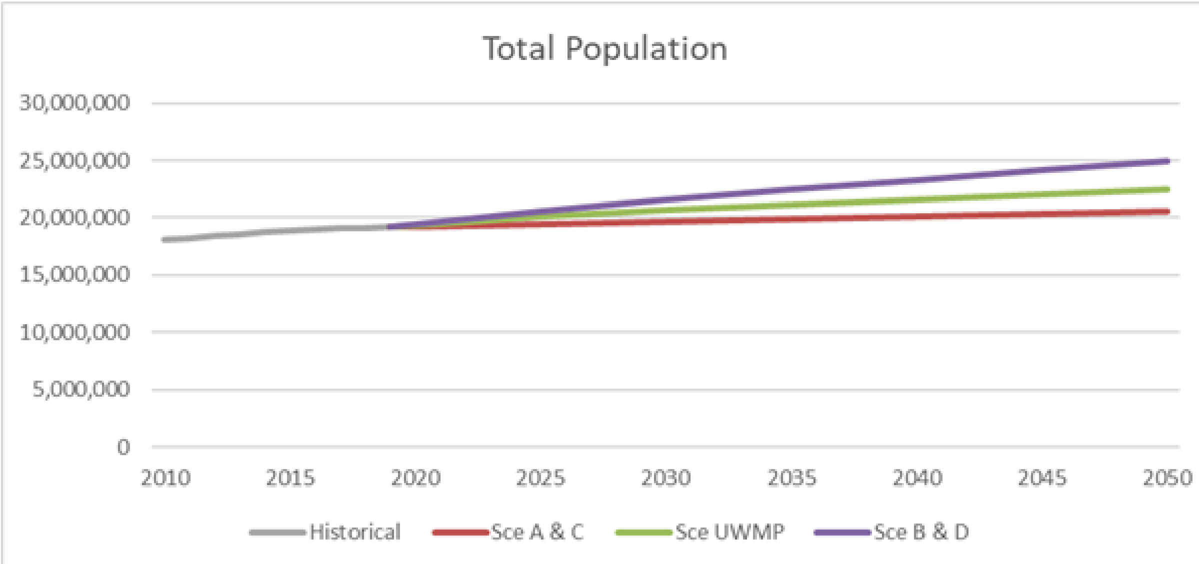
Households, Total	6.2 M	7.6 M	7.0 M	8.3 M
Households, SF	3.7 M	4.1 M	3.8 M	4.4 M
Households, MF	2.6 M	3.4 M	3.3 M	3.9 M
Persons per Household	3.03	2.85	2.85	2.85
Urban Employment, Total	9.2 M	10.3 M	8.5 M	11.3 M

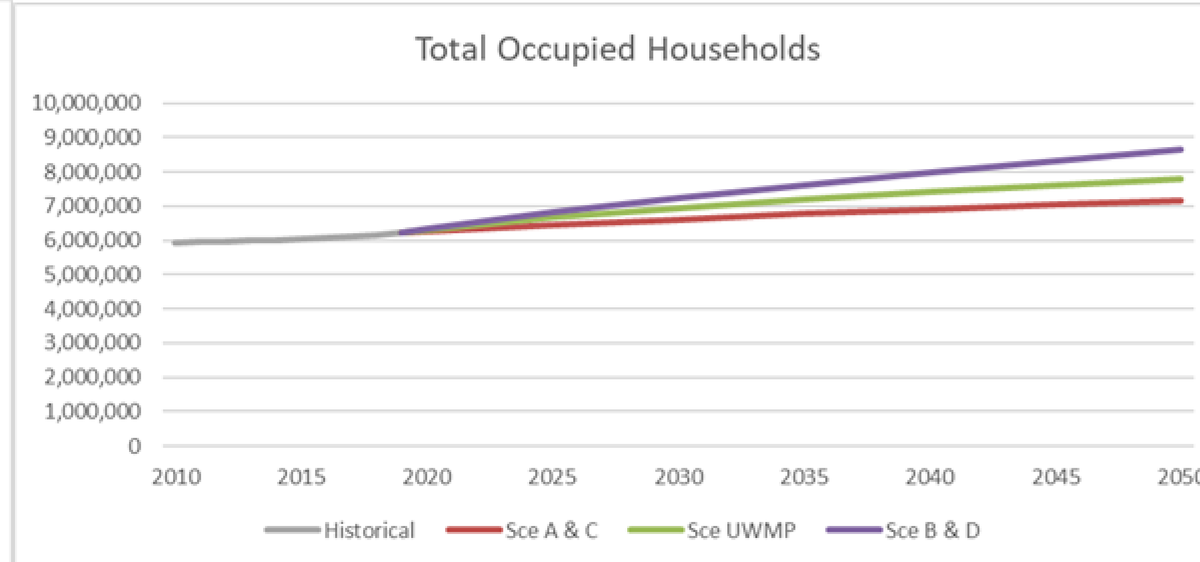
M&I Consumptive Retail Demand Model Output Comparisons (millions of acre-feet)

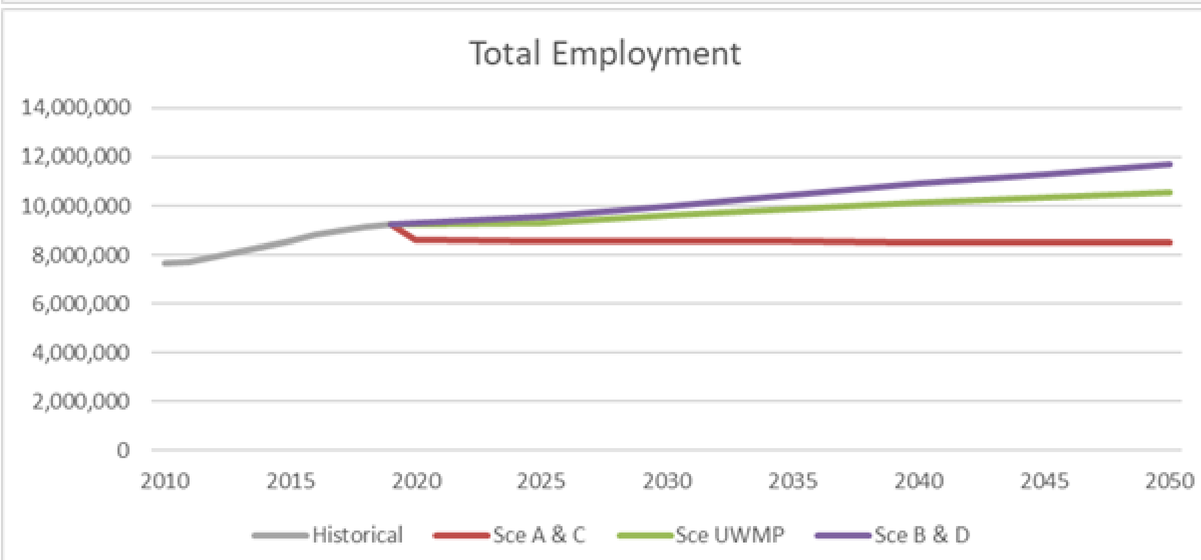
Scenario	2019 actual	2025	2030	2035	2040	2045	Δ% 2019-2045
Scenario A	2.92	2.88	2.89	2.90	2.89	2.90	- 1%
SCAG-SANDAG (UWMP)	2.92	3.02	3.08	3.15	3.19	3.23	+ 11%
Scenario D w/Rebound	2.92	3.43	3.93	4.05	4.15	4.24	+ 45%

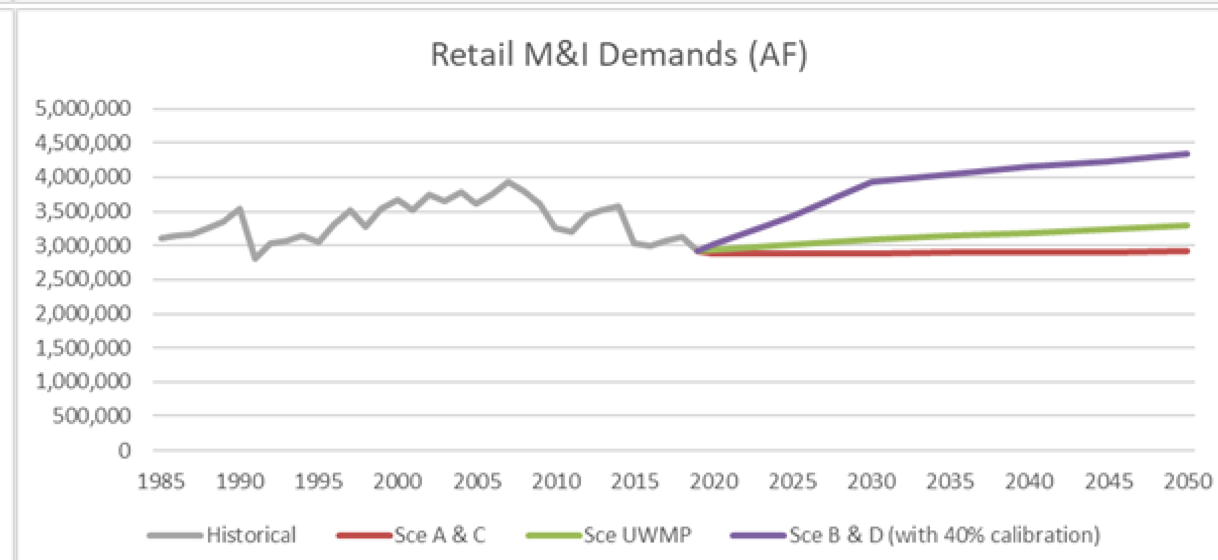
Coastal-Mid-Inland Subregion Designations by Member Agency

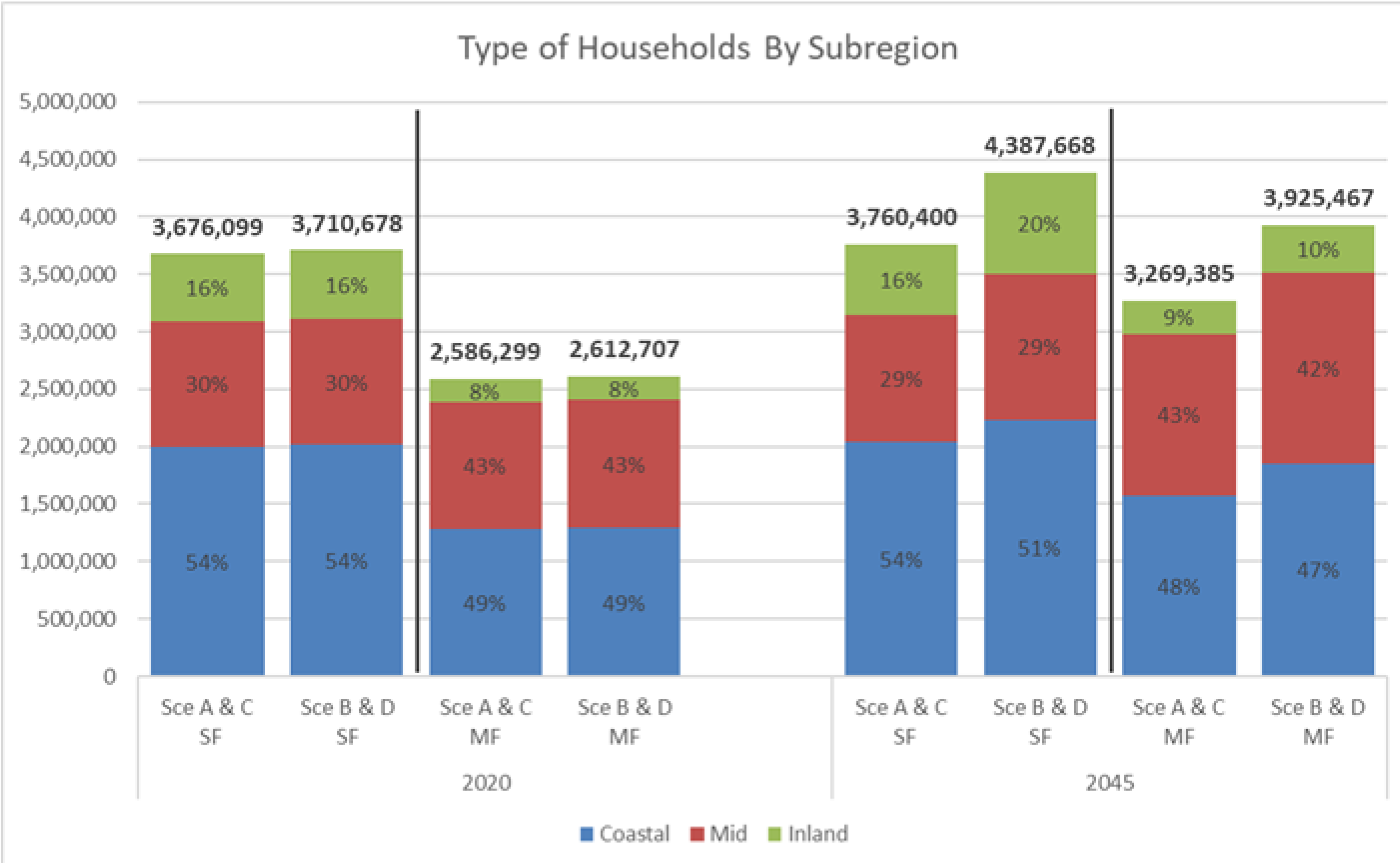
Subregion	Member Agency	Scenario A & C Housing Assumptions	Scenario B & D Housing Assumptions
Coastal	Beverly Hills Calleguas Central Basin Compton Las Virgenes Long Beach MWDOC San Diego Santa Ana Santa Monica Torrance West Basin	SF reduced (peak at 2025) MF reduced, MF rising share	SF and MF increased, MF rising share
Mid	Anaheim Burbank Foothill Fullerton Glendale Los Angeles Pasadena San Marino Three Valleys Upper San Gabriel	SF reduced (peak at 2025) MF reduced, MF rising share	SF and MF increased
Inland	Eastern Inland Empire San Fernando Western	SF reduced; MF reduced SF rising share	SF and MF increased, SF rising share


Total Population
30,000,000
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
2010 2015 2020 2025 2030 2035 2040 2045 2050
Historical
Sce A & C
Sce UWMP
Sce B & D


Total Occupied Households
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
2010 2015 2020 2025 2030 2035 2040 2045 2050
Historical
Sce A & C
Sce UWMP
Sce B & D


Total Employment
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
2010 2015 2020 2025 2030 2035 2040 2045 2050
Historical
Sce A & C
Sce UWMP
Sce B & D


Retail M&I Demands (AF)
5,000,000
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050
Historical
Sce A & C
Sce UWMP
Sce B & D (with 40% calibration)



[i] [i] As a basis for quantifying how climate change might provoke mass migration, a *New York Times Magazine* article dated September 15, 2020, "How Climate Migration Will Reshape America" was used for its quoted reference, "one in 12 Americans in the Southern half of the country will move toward California, the Mountain West, or the Northwest over the next 45 years because of climate change alone." This quotation was attributed to an influential 2018 study published in the *Journal of the Association of Environmental and Resource Economists* Fan, Qin, Fisher-Vanden, Karen, and Allen Klaiber, H., *Journal of the Association of Environmental and Resource Economists*. May 2018. Vo.. 5, No. 3., "Climate Change, Migration, and Regional Economic Impacts in the United States."

[ii] [ii] As a basis for quantifying how climate change might provoke mass migration, a *New York Times Magazine* article dated September 15, 2020, "How Climate Migration Will Reshape America" was used for its quoted reference, "one in 12 Americans in the Southern half of the country will move toward California, the Mountain West, or the Northwest over the next 45 years because of climate change alone." This quotation was attributed to an influential 2018 study published in the *Journal of the Association of Environmental and Resource Economists* Fan, Qin, Fisher-Vanden, Karen, and Allen Klaiber, H., *Journal of the Association of Environmental and Resource Economists*. May 2018. Vo.. 5, No. 3., "Climate Change, Migration, and Regional Economic Impacts in the United States."