Matt Koller, Summary of Statewide Groundwater Resource Depletion, 2000 - 2050

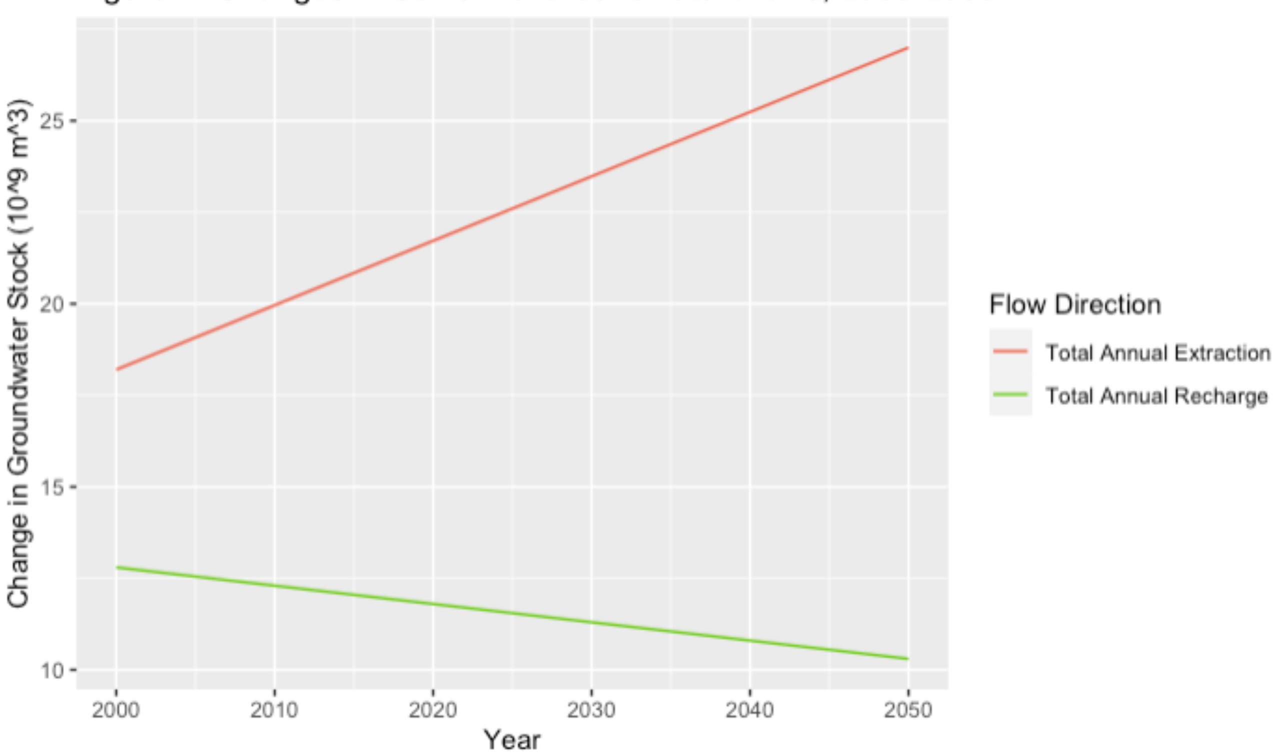
I. Overview. Ensuring that California has sufficient water to meet its consumption needs over the next fifty years is a high-priority policy goal. California water is sourced from surface water and groundwater. While surface water can be closely measured to ensure water consumption does not exceed recharge, there are currently no reliable methods of precisely measuring California's groundwater. To assist with the implementation of SGMA, this brief will analyze statewide groundwater resources and their rate of depletion from 2000 through 2050, assuming a business-as-usual scenario.

II. Current Estimates of Groundwater Resources. According to data recently published by Curmi et al.[1], we assume groundwater resources in 2000 to be normally distributed around an expected value of $350X10^9$ m^3. The lower limit of this estimate is $190x10^9$ m^3, and the upper limit is $550x10^9$ m^3 (Table 1).

Table 1. Estimated California Groundwater Resources, Year 2000	
Approximate Range	**Stock**
Upper Limit of Projected Groundwater Resources	550×10^9 m^3
Projected Groundwater Resources	350×10^9 m^3
Lower Limit of Projected Groundwater Resources	190×10^9 m^3

III. Projected Estimate of CA Groundwater Flows. Additionally, Curmi et al. provide the estimated inflow and outflow for the year 2000 and the year 2050 (based on a business-as-usual scenario). Plotting these values on a graph and applying a linear regression line allows us to estimate the approximate inflows and outflows of groundwater for each year, from 2000 to 2050 (Figure 1).

Figure 1. Changes in California Groundwater Flows, 2000-2050

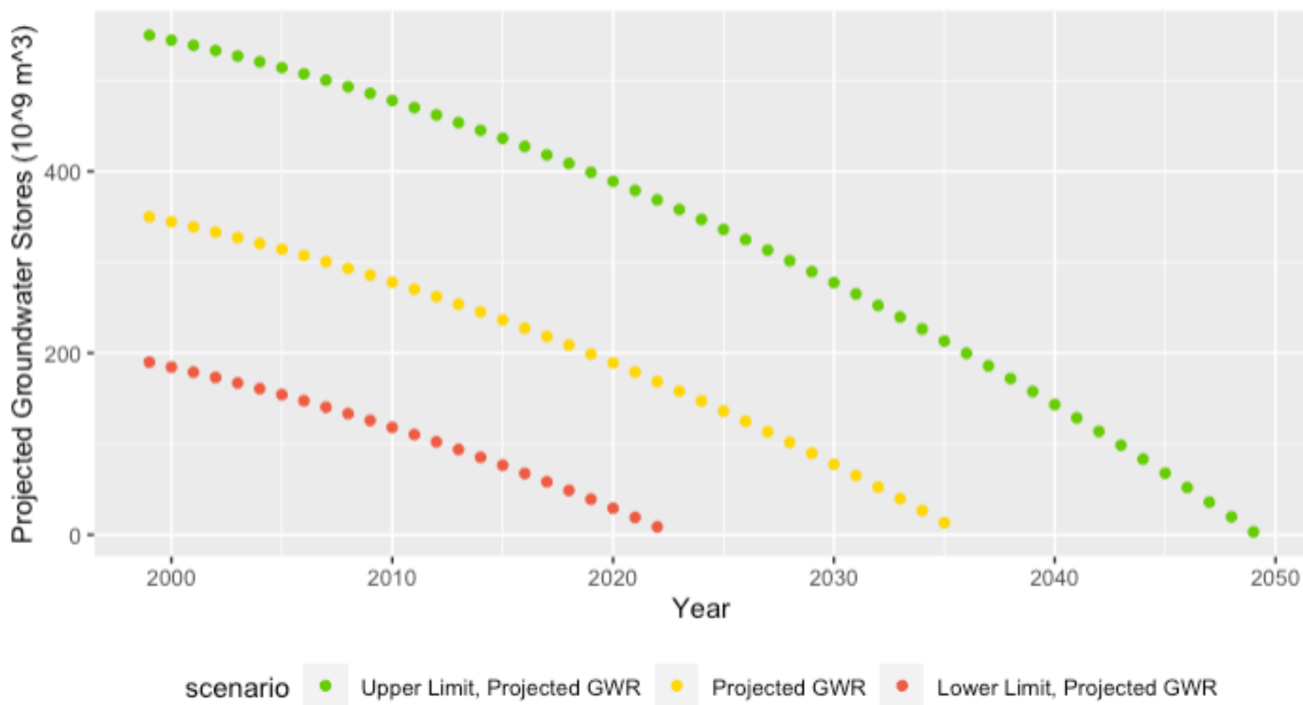


Based on these inflows and outflows, we can identify the projected change in groundwater resources each year (Supplementary Material 1), and plot these values (Figure 2).

IV. Estimate of Change in CA Groundwater Resources Over Time. These projections demonstrate that California is extracting groundwater at a faster rate than it is being recharged. *As such, groundwater resources will eventually be fully depleted*, endangering the future of California's groundwater supply and making it critically important to assess its total volume.

Applying the projected annual change in groundwater resources to the three scenarios outlined in Table 1 gives us an annual mass balance model of California groundwater stock and assess how different groundwater estimates affect the time to depletion (Figure 2).

Figure 2.
Annual California Groundwater Resources (GWR), 2000-2050



V. Key Findings and Recommendations. Assuming California continues a business-as-usual scenario, it will extract groundwater at a higher rate than it is recharged and deplete its groundwater resources. While the exact amount of California's groundwater is unknown, there is a 90% chance that these resources are between a low limit of 190 x 10^9 m^3 and an upper limit of 550 x 10^9 m^3.

If groundwater resources are at the high limit of these estimates, reserves will be depleted in the year 2050; if they are at the middle limit of these estimates, reserves will be depleted in the year 2036; *if they are at the lower limit of these estimates,* ***reserves will be depleted in the year 2022***.

Decision-makers must act now to avoid depleting California's groundwater resources in the immediate future. It is imperative that we reduce the rate at which groundwater is currently extracted. A policy mandating that annual extraction cannot exceed recharge levels of the previous year should immediately be implemented to avoid jeopardizing one of primary California's water sources.

Citations

1. Curmi, E., Fenner, R., Richards, K. et al. Water Resour Manage (2013) 27: 3035. https://doi.org/10.1007/s11269-013-0331-2

Supplementary Material 1										
Year		**Groundwater**			**Inflow**		**Year**	**Low**	**Mid**	**High**
Year	**Year #**	**Inflow**	**Outflow**	**Change**	Y		1999	190	350	550
2000	0	12.8	18.2	-5.4	M (slope)	-0.05	2000	184.6	344.6	544.6
2001	1	12.75	18.376	-5.626	X		2001	178.974	338.974	538.974
2002	2	12.7	18.552	-5.852	B (y-int)	12.8	2002	173.122	333.122	533.122
2003	3	12.65	18.728	-6.078			2003	167.044	327.044	527.044
2004	4	12.6	18.904	-6.304	**Outflow**		2004	160.74	320.74	520.74
2005	5	12.55	19.08	-6.53	Y		2005	154.21	314.21	514.21
2006	6	12.5	19.256	-6.756	M (slope)	0.176	2006	147.454	307.454	507.454
2007	7	12.45	19.432	-6.982	X		2007	140.472	300.472	500.472
2008	8	12.4	19.608	-7.208	B (y-int)	18.2	2008	133.264	293.264	493.264
2009	9	12.35	19.784	-7.434			2009	125.83	285.83	485.83
2010	10	12.3	19.96	-7.66			2010	118.17	278.17	478.17
2011	11	12.25	20.136	-7.886			2011	110.284	270.284	470.284
2012	12	12.2	20.312	-8.112			2012	102.172	262.172	462.172
2013	13	12.15	20.488	-8.338			2013	93.834	253.834	453.834
2014	14	12.1	20.664	-8.564			2014	85.27	245.27	445.27
2015	15	12.05	20.84	-8.79			2015	76.48	236.48	436.48
2016	16	12	21.016	-9.016			2016	67.464	227.464	427.464
2017	17	11.95	21.192	-9.242			2017	58.222	218.222	418.222
2018	18	11.9	21.368	-9.468			2018	48.754	208.754	408.754
2019	19	11.85	21.544	-9.694			2019	39.06	199.06	399.06
2020	20	11.8	21.72	-9.92			2020	29.14	189.14	389.14
2021	21	11.75	21.896	-10.146			2021	18.994	178.994	378.994
2022	22	11.7	22.072	-10.372			2022	8.622	168.622	368.622
2023	23	11.65	22.248	-10.598			2023	-1.976	158.024	358.024
2024	24	11.6	22.424	-10.824			2024	-12.8	147.2	347.2
2025	25	11.55	22.6	-11.05			2025	-23.85	136.15	336.15
2026	26	11.5	22.776	-11.276			2026	-35.126	124.874	324.874
2027	27	11.45	22.952	-11.502			2027	-46.628	113.372	313.372
2028	28	11.4	23.128	-11.728			2028	-58.356	101.644	301.644
2029	29	11.35	23.304	-11.954			2029	-70.31	89.69	289.69
2030	30	11.3	23.48	-12.18			2030	-82.49	77.51	277.51
2031	31	11.25	23.656	-12.406			2031	-94.896	65.104	265.104
2032	32	11.2	23.832	-12.632			2032	-107.528	52.472	252.472
2033	33	11.15	24.008	-12.858			2033	-120.386	39.614	239.614
2034	34	11.1	24.184	-13.084			2034	-133.47	26.53	226.53
2035	35	11.05	24.36	-13.31			2035	-146.78	13.22	213.22
2036	36	11	24.536	-13.536			2036	-160.316	-0.316	199.684
2037	37	10.95	24.712	-13.762			2037	-174.078	-14.078	185.922
2038	38	10.9	24.888	-13.988			2038	-188.066	-28.066	171.934
2039	39	10.85	25.064	-14.214			2039	-202.28	-42.28	157.72
2040	40	10.8	25.24	-14.44			2040	-216.72	-56.72	143.28
2041	41	10.75	25.416	-14.666			2041	-231.386	-71.386	128.614
2042	42	10.7	25.592	-14.892			2042	-246.278	-86.278	113.722
2043	43	10.65	25.768	-15.118			2043	-261.396	-101.396	98.604
2044	44	10.6	25.944	-15.344			2044	-276.74	-116.74	83.26
2045	45	10.55	26.12	-15.57			2045	-292.31	-132.31	67.69
2046	46	10.5	26.296	-15.796			2046	-308.106	-148.106	51.894
2047	47	10.45	26.472	-16.022			2047	-324.128	-164.128	35.872
2048	48	10.4	26.648	-16.248			2048	-340.376	-180.376	19.624
2049	49	10.35	26.824	-16.474			2049	-356.85	-196.85	3.15
2050	50	10.3	27	-16.7			2050	-373.55	-213.55	-13.55