APPENDIX 1-C

Salton Sea Elevation and Salinity Modeling and SSMP Projects Water Demand Modeling Memo

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Revised 5/5/2023

The projects that comprise the different alternatives in the EA require water for their functioning. This additional water consumption is expected to impact the remaining inflows and the elevation of the Salton Sea in future years. Furthermore, the projects require an evaluation of their individual water budgets to compare against available inflows to the Sea. This document has been developed to support these quantitate evaluations at the scale of the entire Sea and for individual projects across the alternatives. Here, we describe modeling of Salton Sea elevation and salinity under the SSMP “Proposed Project” scenario, five alternative scenarios, and one “No Action” scenario, as well as the water demands from the Salton Sea and river water associated with individual projects associated with the SSMP. For the Salton Sea, the general modeling approach is to perform a salt and water balance over time, and compute the changing water volume, and thus the salinity and elevation. For individual projects that constitute the different alternative scenarios, typically ponds, wetlands and enhanced vegetation areas, a water demand is computed for each area, accounting for evaporation, seepage, and/or overflow. Pond areas are assumed to contain an overflow to allow salinity to remain within a target range, typically 20-40 parts per thousand.

Three modeling frameworks are used, the first two are for modeling the salinity and elevation of the residual Sea and the third for modeling the water budget of individual projects for a target salinity. The first model is the SALSA2 model developed by the Imperial Irrigation District (IID). The second is the Salton Sea Accounting Model (SSAM), developed by the US Bureau of Reclamation in 2000 and updated with more recent flow, elevation and salinity data by Tetra Tech. The third model is a simple water budget for individual ponds, that computes salinity and volume over time for different residence times and outflows. The SALSA2 model is limited to two predefined hydrologic scenarios whereas the SSAM can be used with any hydrologic scenario. As part of ongoing work on the Long-Range Plan for the SSMP (CNRA et al. 2022), three new hydrologic inflow scenarios were developed, which were used for the SSAM runs: a high probability inflow scenario, a low probability inflow scenario, and a very low probability inflow scenario. Collectively these model runs with SALSA2 and SSAM provide a reasonable range of future water levels and salinities that may be expected in the Salton Sea with the implementation of the different project alternatives.

SALSA2 Modeling

SALSA2 is a Salton Sea hydrology modeled developed by CH2M Hill for IID. It is implemented in the GoldSim modeling platform, and accounts for water and salt balance under projected inflow and conservation scenarios, some parts of which can be defined by the user of the model. The model operates under a Monte Carlo framework, allowing uncertainty about model inputs to be propagated throughout all the model calculations. A detailed technical report about the development of the SALSA2 model is available on IID’s website (CH2MHill, 2018a).

Future No Action Hydrology

The primary driver of SALSA2 model behavior is the projected future hydrology applied to the Salton Sea. The model comes with a hydrology scenario termed "Future No Action", which "is intended to reflect recent conditions and trends plus changes which are reasonably expected to occur in the foreseeable future, based on current plans and reasonable estimates of future water uses." This hydrology encompasses "inflows from Mexico, Imperial Valley, Coachella Valley to the Salton Sea and uncertainty in Salton Sea evaporation due to climate change" (CH2MHill, 2018b). The programs/projects used to inform the Future No Action hydrology and projected changes to these inflows were as follows:

- IID Water Conservation and Transfer Project (and associated required mitigation measures)
- Coachella Canal Lining Project
- All-American Canal Lining Project
- Colorado River Basin Salinity Control Program
- Coachella Valley Water District Water Management Plan
- Mexicali Wastewater Improvements
- Mexicali Power Production
- Total Maximum Daily Loads Implementation.

This hydrology scenario was also designed while considering the following factors (CH2MHill, 2018b):

- Level of desalination to be implemented in Coachella Valley Water District (CVWD) WMP (Water Management Plan)
- Future reductions in Mexico flows in the New River
- Future reductions of drain water flows in IID or reuse of drain water within IID
- Increased consumption in the Imperial Valley associated with nutrient and/or selenium treatment
- Climate change effects on Salton Sea evaporation.

Section 4 of CH2MHill (2018b) provides more detail about the specific factors considered for each of these conditions in the development of the Future No Action Hydrology. In the SALSA2 model, there are two variations of the Future No Action available for selection in the model interface. There is a "moderate uncertainty" inflow scenario that matches the graphics featured in CH2MHill (2018b) (with some minor differences likely attributable to changes to the model since the hydrology report was published in 2018) and a "low uncertainty" scenario with less variability in the probability distributions (resulting in higher flows on average). These are used to model the response of the Sea in a Monte Carlo framework (implemented in a third-party tool called Goldsim). The mean value of the inflow variables through water year 2046 from the moderate uncertainty scenario have been copied from the model into Table C-1.

SSMP Scenario Implementation in SALSA2

SALSA2 does not allow for adding arbitrary increases, reductions, or diversions of inflowing water into the Sea for use in restoration projects. However, it does allow for a user-specified annual construction schedule of shallow water habitat area that uses water at a rate of 6 acre feet per year (af/yr) per acre of habitat constructed. Therefore, it is possible to emulate the use of water usage of other project alternatives by having the model simulate an amount of habitat area that would use an equivalent amount of water. The estimated water consumption for project alternatives was converted into an equivalent habitat area based on the following annual water consumption per acre:

- Desert Shores Channel Restoration (6 af/acre)
- Future Dust Suppression and Vegetation Enhancement (1 af/acre)
- Alamo River Project (6 af/acre)
- North Lake Project (6 af/acre)
- North Lake Demonstration (6 af/acre)
- New River Expansion Project (6 af/acre)
- Bombay Beach Wetland (5 af/acre)
- Alternative 1 ponds (6 af/acre)
- Alternative 2 wetlands (5 af/acre)
- Alternative 3 ponds (6 af/acre)
- Alternative 4 enhancing wetlands (5 af/acre).

Future dust suppression and vegetation enhancement is assigned a conservative and high value of 1 af/acre. The water consumption above is a loss from the system and essentially reduces the inflow to the Sea. The acreages of these project alternatives are shown in Table C-2. Construction of all project alternatives is gradual, with 10% of the acreage coming online in 2023, an additional 20% in each year from 2024-2027, and the final 10% in 2028. After 2028, the water consumption (and equivalent habitat area) associated with project alternatives is constant.

SSAM Spreadsheet Modeling

The Salton Sea Accounting Model (SSAM) is a spreadsheet model of Salton Sea hydrology first developed at the U.S. Bureau of Reclamation in the early 2000s. It accounts for mass balance of water and salt content for the Salton Sea's freshwater inflows, evaporation, precipitation, and conservation project water usage. The original spreadsheet model has been updated with new features related to increased modeling flexibility and implementation of the types of conservation projects being considered under the SSMP and with a new calibration using the most recently available observed data in 2022.

SSAM Model Hydrology

We used three inflow scenarios developed for the Long-Range Plan (LRP) modeling: a high probability inflow, a low probability inflow, and a very low probability inflow (CNRA et al., 2022). Each hydrologic scenario has one specific inflow trace, unlike the Monte Carlo approach taken by SALSA2.

The full derivation of the three flow scenarios can be found in the LRP Appendix B (Hydrology and Climate Change).[1] Figure C-1 shows the annual inflows to the Salton Sea for the three inflow scenarios over the period of 2010 to 2060. Key assumptions used to derive the inflow scenarios are summarized as follows:

- Water deliveries to IID are based on Colorado River Simulation System (CRSS) model and resampling hydrology from 2000-2018 (information from Wheeler et al. 2022). The assumption that the current dry conditions in the 21st century will continue over the following four decades is a relatively stressful scenario from the hydrologic perspective. The three scenarios use the 50th percentile exceedance flow (high probability inflow scenario, 2.535 MAF), 90th percentile exceedance flow (low probability inflow scenario, 2.33 MAF), and 95th percentile exceedance flow (very low probability inflow scenario, 2.09 MAF).
- Mexico inflows to the Salton Sea (via the New River) are assumed to decline from current levels to zero by 2035, and those flows are assumed to be recycled south of the border.
- Water used for lithium production is assumed to reduce inflows to the Sea by 50,000 acre-feet per year (AFY) by 2035 and remain constant thereafter. This is a new and growing water use in the basin.
- Climate change is estimated to increase evapotranspiration (ET) by 5% in the Imperial Valley from current conditions, based on average temperatures projected over the 30-year window from 2035-2064. ET is assumed to reach this increased value by 2035 and remain at this level for the rest of the simulation period.
- The current drought-related water conservation results in a decrease of 250,000 AF of water allocation to IID from 2023 to 2026 (4 years), based on published reports. In the high probability flow scenario, this is assumed to be met by land fallowing, so the net decrease of flow to the Salton Sea is 89,000 AF. For the low probability inflow and very low probability inflow assumptions, the reduction continues, and fallowing is replaced by efficiencies which are implemented over 5 years.

With the above assumptions, by mid-21st century, the high probability inflow scenario stabilizes at 889,000 AFY, the low probability inflow scenario stabilizes at 684,000 AFY, and the very low probability inflow scenario stabilizes at 444,000 AFY, with a transition from current conditions as shown in Figure C-1.

[1] https://saltonsea.ca.gov/wp-content/uploads/2022/12/Salton-Sea-Long-Range-Plan-Public-Draft-Dec-2022-Appendices.pdf

SSMP Scenario Implementation in SSAM Spreadsheet Model

Unlike in SALSA2, there is no need to express individual projects in terms of equivalent habitat area. The total areas in Table C-2 and the construction schedule and per-acre water consumption described above in the section about SALSA2 Scenario implementation were implemented directly in the SSAM spreadsheet model.

Individual Project Water Demand Estimation

Besides the Salton Sea as a whole, Sea water and river water demands associated with individual projects that constitute different SSMP alternatives are also estimated. These water demands address evaporative loss, seepage loss and outflows from individual projects. Most aquatic habitat projects, with the exception of wetlands formed at river mouths, assume the use of river water and higher salinity Salton Sea water use to achieve mid-salinity conditions within habitats, i.e., a salinity of 30 parts per thousand, reflecting a mid-point of the 20-40 parts per thousand range.

The concept of “residence time” is important for the water quality of managed habitat areas. Insufficient water exchange, i.e., water with too long a residence time, can lead to poor water quality. Neither the SALSA model nor the SSAM model imposes residence time restrictions in its modeling of aquatic habitat; therefore, an independent modeling exercise was undertaken to estimate water demand in three types of habitat projects: (1) aquatic habitat pond areas, (2) the New River Expansion project, which will receive the outflow from Species Conservation Habitat (SCH) areas, and (3) wetland areas formed near existing creek and drain outflows to the Sea.

The water demand was estimated using mass balance for water volumes and dissolved salt under applied time series of monthly precipitation, evaporation, and seepage from 2018-2028. In certain types of projects, additional constraints in the form of target salinities and maximum residence times affect the estimated water demands.

The following modeling assumptions were used:

> Habitat ponds have an average depth 4 feet

> The New River Expansion Project and wetland areas have an average depth of 3 feet

> Annually, there is 6 feet of evaporation, 2 feet of seepage, and 3 inches of rain

> Seepage is applied uniformly over the year, evaporation is divided according to the monthly pattern in the Department of Water Resources (DWR) supply memo (Wang 2017), and precipitation is divided according to historical averages from the Westmoreland station from CIMIS, as was done in the DWR supply memo

> River water salinity is a constant value of 3 parts per thousand; sea water salinity varies annually taken from the above SALSA modeling of the proposed project scenario using low uncertainty inflows, ranging from ~64 ppt in 2018 to ~122 ppt in 2028

> Evaporation and precipitation change water volumes without affecting salt mass; seepage withdraws water according to the current timestep’s salinity

All three types of projects need to meet losses due to evaporation and seepage, but the handling of maximum residence time and target salinity varies slightly by project type:

1. Habitat ponds have a target salinity of 30 parts per thousand, and the balance of river and Sea water required to meet that target at the end of the timestep is calculated at each timestep. Five percent of total the project area is reserved to accommodate the necessary mixing ponds to achieve this; mixing ponds are subject to precipitation, evaporation, and seepage. Habitat ponds' residence time is their total storage volume divided by the inflow rate; if this quantity would be above 90 days, additional water demand is added, and outflow is released to maintain a fixed volume. For some habitat projects groundwater or agricultural drainwater may serve as a partial source of water instead of river water.
2. The New River Expansion Project always receives the above outflow from SCH areas as a fixed input. It also has the same 90-day maximum residence time requirement which can trigger additional demands, but it has no fixed target salinity and always takes river water for its demands.
3. Wetland areas have neither residence time nor target salinity requirements and simply take river water or agricultural drainwater equal to the net losses from evaporation and seepage. This is assumed to be 5 af per acre.

In addition to the above types of projects, water may also be needed for dust suppression and vegetation enhancement projects. For these projects, the water supply may originate from stormwater spreading from the minor washes and creeks flowing into the Salton Sea, from groundwater, or from other external trucked sources.

Groundwater, fresh or brackish, may also be used as a partial source of water for some habitat pond projects, where it is a sustainable source in proximity to the project area.

Results

Figure C-2 shows the total Sea inflow under the low- and moderate-uncertainty variants of the Future No Action hydrology for SALSA2 as well as the high probability inflow, low probability inflow, and very low probability inflow scenarios from the LRP SSAM model. Note that the reduced uncertainty in future flows results in higher modeled flows on average. Figure C-3 to Figure C-5 show the SSAM model's estimated sea elevations under the water use of the SSMP scenarios as implemented per the above description for the high probability inflow, low probability inflow, and very low probability inflow scenarios, respectively. Figure C-6 to Figure C-8 show the corresponding modeled sea salinities for the high probability inflow, low probability inflow, and very low probability inflow scenarios, respectively.

Table C-3 shows the water demand per unit area (in acre feet of water per acre of project area) for river water in 2028 according to the estimates from the water use modeling. It only depends on common assumptions used in the modeling (average depth, boundary conditions, etc.) but not the aerial footprint. Similarly, Table C-4 shows the Salton Sea water demand in 2028 per unit area. Table C-5 shows the outflow per unit area (e.g., arising from flow-through water to meet residence time requirements). Table C-6, Table C-7, and Table C-8 show the corresponding total volumes (in acre-feet), and these do vary with the size of the proposed project areas.

Table C-9 compares the water requirements for the different projects with the pertinent inflows for the three different flow scenarios. Table C-10 shows the river/drain water use as a percent of total inflows for three flow scenarios and for three points in time (2023, 2028, and 2047)

References

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Wheeler, K.G., Udall, B., Wang, J., Kuhn, E., Salehabadi, H. and Schmidt, J.C., 2022. What will it take to stabilize the Colorado River? Science, 377(6604), pp.373-375. https://doi.org/10.1126/science.abo4452

Table C-1. SALSA2 v3.27 "Future No Action" inflows, moderate uncertainty, mean value in acre feet.

Year	Inflows_NewR_ Mexico:	Inflows_AlamoR_ Mexico:	Inflows_DirectDrains_West:	Inflows_NewR_ IID:	Inflows_DirFlows_bet_Alamo_New:	Inflows_AlamoR_ IID:	Inflows_DirectDrains_East:	Inflows_GW_IID:	Inflows_Whitewater_ CVWD:	Inflows_DirectDrains_ CVWD:	Inflows_Localw_SaltCreek:	Inflows_Localw_ EAST:	Inflows_Localw_Westside_ GW:	Inflows_Localw_ WEST:	Inflows_Localw_SanFelipe:	Inflows_NewR:	Inflows_AlamoR:	Inflows_DirectDrains:	Inflows_SSRREI:	Inflows_SSWIFT:	Inflows_Mexico:	Inflows_ IID:	Inflows_ CVWD:	Inflows_Localwatershed:	Inflows_ Total:
2018	89778	2000	21168	215392	37359	450837	17974	1000	31150	21238	1359	503.5	10000	1996	5352	305170	452837	97739	886896	343030	91778	743730	52387	19211	907107
2019	84006	2000	20161	205151	35583	429403	17120	1000	31595	21542	1254	431.8	10000	1883	5047	289157	431403	94406	846560	327053	86006	708418	53137	18616	866176
2020	77950	2000	19113	194485	33733	407077	16229	1000	32135	21910	1287	454	10000	1890	5068	272435	409077	90986	804633	310925	79950	671638	54045	18699	824332
2021	69893	2000	18580	189058	32792	395718	15777	1000	32760	22336	1278	447.9	10000	1922	5154	258951	397718	89484	778913	298143	71893	652923	55096	18802	798715
2022	63683	2000	18464	187878	32587	393249	15678	1000	33504	22843	1272	443.7	10000	1866	5004	251561	395249	89572	769885	291340	65683	648856	56347	18586	789471
2023	57293	2000	18383	187053	32444	391521	15609	1000	34409	23460	1295	460	10000	1936	5190	244346	393521	89896	762172	285240	59293	646010	57870	18881	782053
2024	50423	2000	18224	185439	32164	388142	15475	1000	35559	24245	1280	449.6	10000	1905	5107	235862	390142	90107	751671	277809	52423	640444	59804	18742	771413
2025	43858	2000	18061	183778	31876	384666	15336	1000	36833	25113	1305	466.4	10000	1947	5219	227636	386666	90386	741520	270993	45858	634716	61946	18937	761457
2026	37397	2000	17855	181684	31513	380283	15161	1000	38309	26119	1312	471	10000	1946	5218	219081	382283	90648	730321	263919	39397	627497	64428	18947	750268
2027	36613	2000	17469	177758	30832	372066	14834	1000	39657	27039	1338	489.1	10000	1936	5190	214371	374066	90173	718268	260557	38613	613959	66696	18953	738221
2028	37189	2000	17089	173887	30160	363963	14511	1000	40744	27780	1320	477.1	10000	1953	5237	211076	365963	89539	707323	258377	39189	600610	68524	18987	727311
2029	37777	2000	16738	170315	29541	356487	14212	1000	41537	28320	1291	456.8	10000	1919	5145	208092	358487	88811	696927	256065	39777	588293	69858	18812	716739
2030	36920	2000	16379	166668	28908	348854	13908	1000	42075	28687	1350	497.4	10000	1986	5325	203589	350854	87883	684401	252340	38920	575719	70762	19160	704561
2031	35831	2000	16074	163564	28370	342357	13649	1000	42385	28898	1330	483.3	10000	2000	5361	199395	344357	86992	673128	248470	37831	565014	71283	19173	693301
2032	37072	2000	15692	159671	27695	334207	13324	1000	42519	28989	1392	525.8	10000	2261	6062	196743	336207	85700	661169	246716	39072	551588	71508	20241	682410
2033	36607	2000	15340	156094	27074	326721	13026	1000	42498	28975	1469	578.5	10000	2528	6776	192701	328721	84415	648335	243444	38607	539256	71473	21351	670686
2034	36720	2000	14956	152180	26395	318528	12699	1000	42416	28920	1439	558	10000	2460	6594	188900	320528	82970	634814	239349	38720	525758	71336	21051	656865
2035	35353	2000	14619	148753	25801	311356	12413	1000	42290	28834	1534	623.2	10000	2657	7124	184107	313356	81667	621419	235055	37353	513942	71124	21939	644358
2036	33360	2000	14599	148553	25766	310937	12397	1000	43359	29562	1475	582.7	10000	2517	6747	181913	312937	82324	620533	233493	35360	513252	72921	21321	642854
2037	33059	2000	14650	149070	25856	312020	12440	1000	44248	30169	1537	625.5	10000	2667	7150	182130	314020	83114	623512	235065	35059	515036	74417	21980	646491
2038	34635	2000	14679	149369	25908	312644	12465	1000	45028	30700	1485	589.5	10000	2556	6853	184003	314644	83752	627427	237369	36635	516065	75728	21484	649911
2039	35455	2000	14614	148708	25793	311260	12409	1000	45812	31235	1495	596.7	10000	2530	6782	184163	313260	84052	627287	238252	37455	513785	77047	21404	649690
2040	34850	2000	14616	148719	25795	311285	12410	1000	46611	31780	1529	619.4	10000	2654	7115	183570	313285	84601	628067	238825	36850	513825	78391	21917	650984
2041	36290	2000	14620	148768	25804	311387	12414	1000	47465	32362	1476	583.4	10000	2554	6848	185058	313387	85200	631111	240847	38290	513993	79827	21462	653572
2042	36443	2000	14664	149208	25880	312308	12451	1000	48240	32890	1521	614.4	10000	2641	7081	185651	314308	85885	634084	242493	38443	515511	81130	21858	656942
2043	36653	2000	14687	149447	25921	312809	12471	1000	48939	33367	1459	571.9	10000	2545	6822	186100	314809	86446	636295	243320	38653	516336	82306	21398	658692
2044	37556	2000	14732	149906	26001	313769	12509	1000	49564	33793	1518	611.9	10000	2606	6986	187463	315769	87035	639831	245530	39556	517918	83357	21722	662552
2045	37541	2000	14733	149915	26003	313788	12510	1000	50139	34185	1466	576.9	10000	2485	6661	187456	315788	87430	640812	245722	39541	517949	84323	21189	663002
2046	37535	2000	14770	150296	26069	314584	12542	1000	50668	34546	1504	602.5	10000	2575	6903	187830	316584	87927	643010	246905	39535	519261	85214	21584	665593

Table C-2. Estimated size of SSMP project alternatives (in acres). All alternatives (including ‘No Action’) also model completion of the SCH Project in 2023 (estimated at 4,110 acres)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration	pond	30	0	0	0	0	30	0
Dust Suppression	dust control	14,900	0	0	0	14,900	23,973	0
Alamo River Project	pond	7,257	3,558	4,500	5,855	0	10,216	0
North Lake Project	pond	3,862	3,862	5,363	3,862	0	3,862	0
North Lake Demonstration	pond	160	160	160	160	0	160	0
New River Expansion Project	pond	6,850	5,384	4,548	9,411	0	9,563	0
Bombay Beach Wetland	wetland	903	903	993	0	0	903	0
Alternative 1	pond	0	11,823	0	0	0	0	0
Alternative 2	wetland	0	0	10,126	0	0	0	0
Alternative 3	pond	0	0	0	6,402	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	10,790	0	0
TOTAL		33,962	25,690	25,690	25,690	25,690	48,707	0

Table C-3. Estimated per-area river water or other fresh or brackish water use for SSMP project alternatives (in feet., i.e., annual rate of water demand in acre-feet per acre of project area). Other fresh or brackish water sources include groundwater and drainwater. All alternatives (including 'No Action') also model completion of the SCH Project in 2023 (which uses 13.67 feet of water per acre, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration*	pond	6	0	0	0	0	6	0
Dust Suppression*	dust control and vegetation enhancement	1	0	0	0	1	1	0
Alamo River Project	pond	13.67	13.67	13.67	13.67	0	13.67	0
North Lake Project	pond	13.67	13.67	13.67	13.67	0	13.67	0
North Lake Demonstration	pond	13.67	13.67	13.67	13.67	0	13.67	0
New River Expansion Project	pond	12.17	12.17	12.17	12.17	0	12.17	0
Bombay Beach Wetland	wetland	5.00	5.00	5.00	0	0	5.00	0
Alternative 1	pond	0	13.67	0	0	0	0	0
Alternative 2	wetland	0	0	5.00	0	0	0	0
Alternative 3	pond	0	0	0	13.67	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	5.00	0	0

*Assumes use of groundwater or water sources besides Salton Sea or its inflowing rivers

Table C-4. Estimated per-area Salton Sea water use of SSMP project alternatives (in feet, i.e., volume of water demand in acre-feet per acre of project area). All alternatives (including 'No Action') also model completion of the SCH Project in 2023 (2.14 feet, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration*	pond	0	0	0	0	0	0	0
Dust Suppression*	dust control and vegetation enhancement	0	0	0	0	0	0	0
Alamo River Project	pond	2.14	2.14	2.14	2.14	0	2.14	0
North Lake Project	pond	2.14	2.14	2.14	2.14	0	2.14	0
North Lake Demonstration	pond	2.14	2.14	2.14	2.14	0	2.14	0
New River Expansion Project	pond	0	0	0	0	0	0	0
Bombay Beach Wetland	wetland	0	0	0	0	0	0	0
Alternative 1	pond	0	2.14	0	0	0	0	0
Alternative 2	wetland	0	0	0.00	0	0	0	0
Alternative 3	pond	0	0	0	2.14	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	0.00	0	0

*Assumes use of groundwater or water sources besides Salton Sea or its inflowing rivers

Table C-5. Estimated per-area water outflow from SSMP project alternatives (in feet, i.e., volume of water outflow in acre-feet per acre of project area). All alternatives (including 'No Action') also model completion of the SCH Project in 2023 (8.07 feet, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration*	pond							
Dust Suppression*	dust control and vegetation enhancement							
Alamo River Project	pond	8.07	8.07	8.07	8.07	0	8.07	0
North Lake Project	pond	8.07	8.07	8.07	8.07	0	8.07	0
North Lake Demonstration	pond	8.07	8.07	8.07	8.07	0	8.07	0
New River Expansion Project	pond	9.26	10.6	11.7	7.94	0	7.88	0
Bombay Beach Wetland	wetland	0	0	0	0	0	0	0
Alternative 1	pond	0	8.07	0	0	0	0	0
Alternative 2	wetland	0	0	0	0	0	0	0
Alternative 3	pond	0	0	0	8.07	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	0	0	0

*Assumes use of groundwater or water sources besides Salton Sea or its inflowing rivers

Table C-6. Estimated river water or other fresh or brackish water use for SSMP project alternatives (in acre-feet). Other fresh or brackish water sources include groundwater and drainwater. All alternatives (including 'No Action') also model completion of the SCH Project in 2023 (56,200 acre-feet, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration*	pond	195	0	0	0	0	195	0
Dust Suppression*	dust control and vegetation enhancement	14,900	0	0	0	14,900	23,973	0
Alamo River Project	pond	99,232	48,652	61,533	80,061	0	139,693	0
North Lake Project	pond	52,809	52,809	73,333	52,809	0	52,809	0
North Lake Demonstration	pond	2,188	2,188	2,188	2,188	0	2,188	0
New River Expansion Project	pond	83,342	65,505	55,334	114,500	0	116,350	0
Bombay Beach Wetland	wetland	4,515	4,515	4,965	0	0	4,515	0
Alternative 1	pond	0	161,667	0	0	0	0	0
Alternative 2	wetland	0	0	50,630	0	0	0	0
Alternative 3	pond	0	0	0	87,541	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	53,950	0	0

*Assumes use of groundwater or water sources besides Salton Sea or its inflowing rivers

Table C-7. Estimated annual Salton Sea water use of SSMP project alternatives (in acre-feet). All alternatives (including ‘No Action’) also model completion of the SCH Project in 2023 (8,815 acre-feet, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration	pond	0	0	0	0	0	0	0
Dust Suppression	dust control and vegetation enhancement	0	0	0	0	0	0	0
Alamo River Project	pond	15,565	7,631	9,652	12,558	0	21,912	0
North Lake Project	pond	8,283	8,283	11,503	8,283	0	8,283	0
North Lake Demonstration	pond	343	343	343	343	0	343	0
New River Expansion Project	pond	0	0	0	0	0	0	0
Bombay Beach Wetland	wetland	0	0	0	0	0	0	0
Alternative 1	pond	0	25,358	0	0	0	0	0
Alternative 2	wetland	0	0	0	0	0	0	0
Alternative 3	pond	0	0	0	13,731	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	0	0	0

Table C-8. Estimated annual water outflow from SSMP project alternatives (in acre-feet). All alternatives (including 'No Action') also model completion of the SCH Project in 2023 (33,163 acre-feet, annually)

SSMP Project Areas	Type	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action
Desert Shores Channel Restoration	pond							
Dust Suppression	dust control and vegetation enhancement							
Alamo River Project	pond	58,555	28,709	36,310	47,243	0	82,431	0
North Lake Project	pond	31,162	31,162	43,273	31,162	0	31,162	0
North Lake Demonstration	pond	1,291	1,291	1,291	1,291	0	1,291	0
New River Expansion Project	pond	63,417	56,942	53,250	74,728	0	75,399	0
Bombay Beach Wetland	wetland	0	0	0	0	0	0	0
Alternative 1	pond	0	95,397	0	0	0	0	0
Alternative 2	wetland	0	0	0	0	0	0	0
Alternative 3	pond	0	0	0	51,656	0	0	0
Alternative 4	enhancing wetlands	0	0	0	0	0	0	0

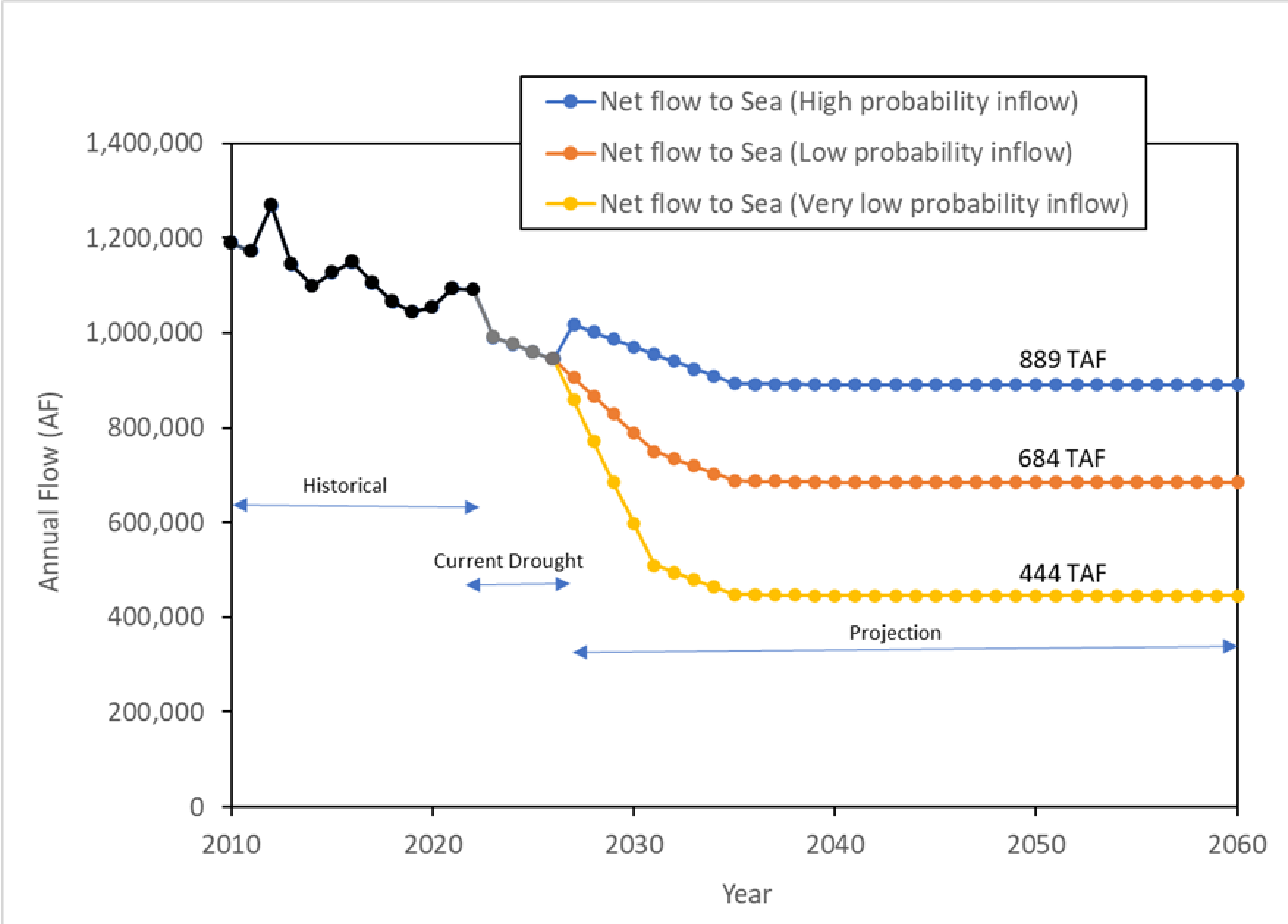

Figure C-1. Inflow scenarios developed as part of the Long Range Plan (CNRA et al., 2022).

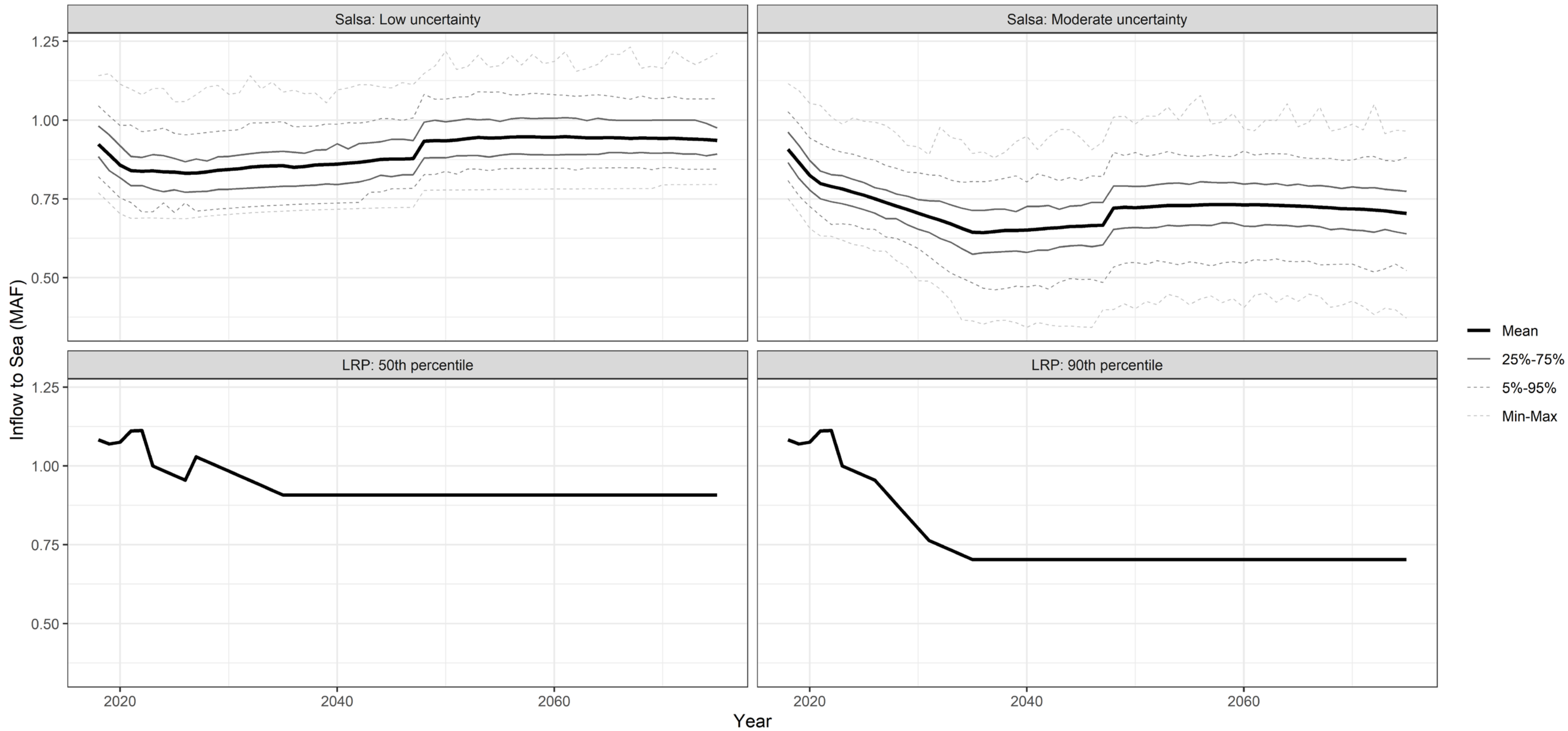

Figure C-2. Total sea inflows under the low uncertainty and moderate uncertainty variants of the "Future No Action" hydrology of the SALSA2 model (top row) and the 50th and 90th delivery exceedance percentile of the LRP model (bottom row).

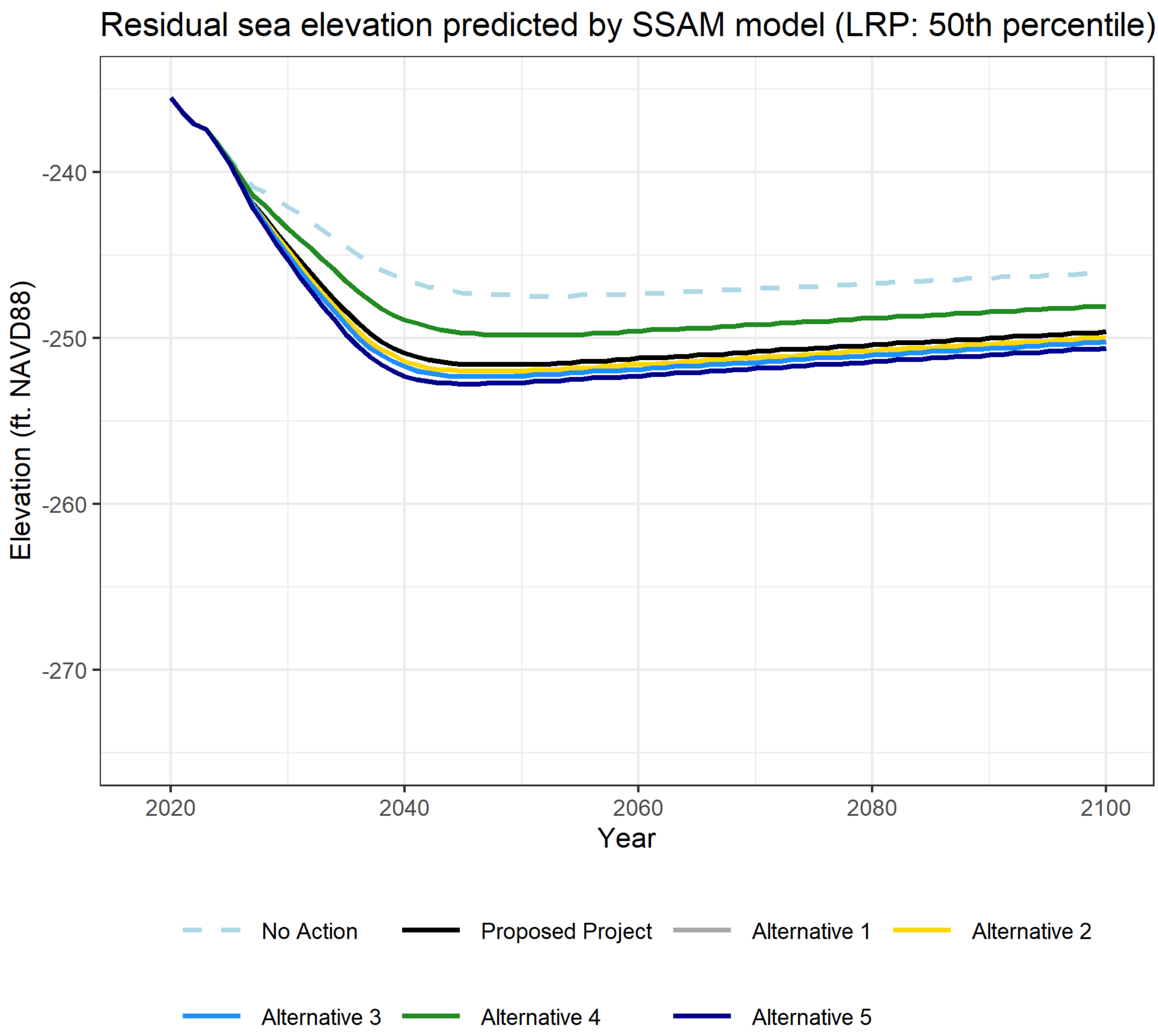

Figure C-3. Modeled sea elevations under SSMP project alternatives using the LRP model (high probability inflow scenario).

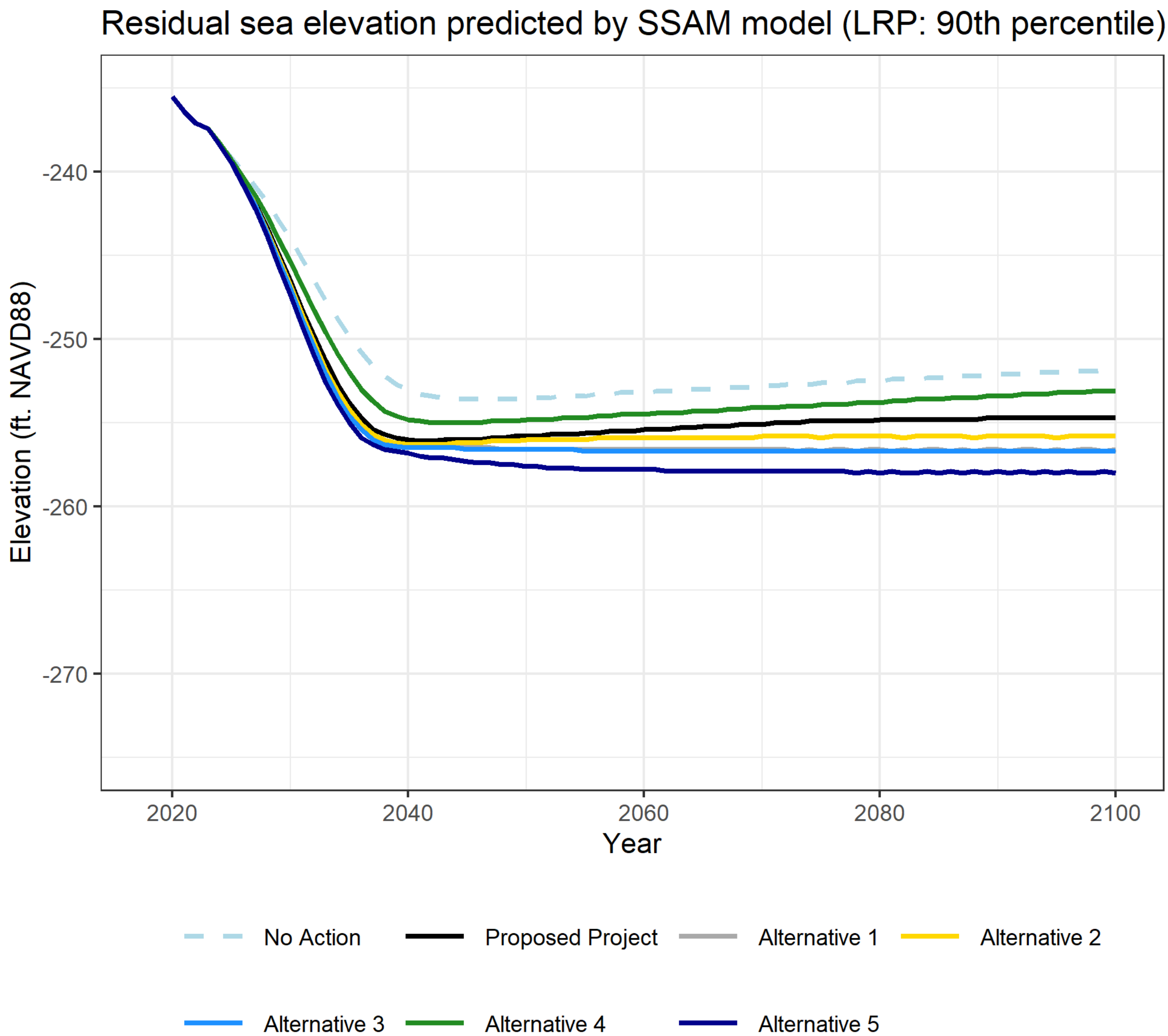

Figure C-4. Modeled sea elevations under SSMP project alternatives using the LRP model (low probability inflow scenario).

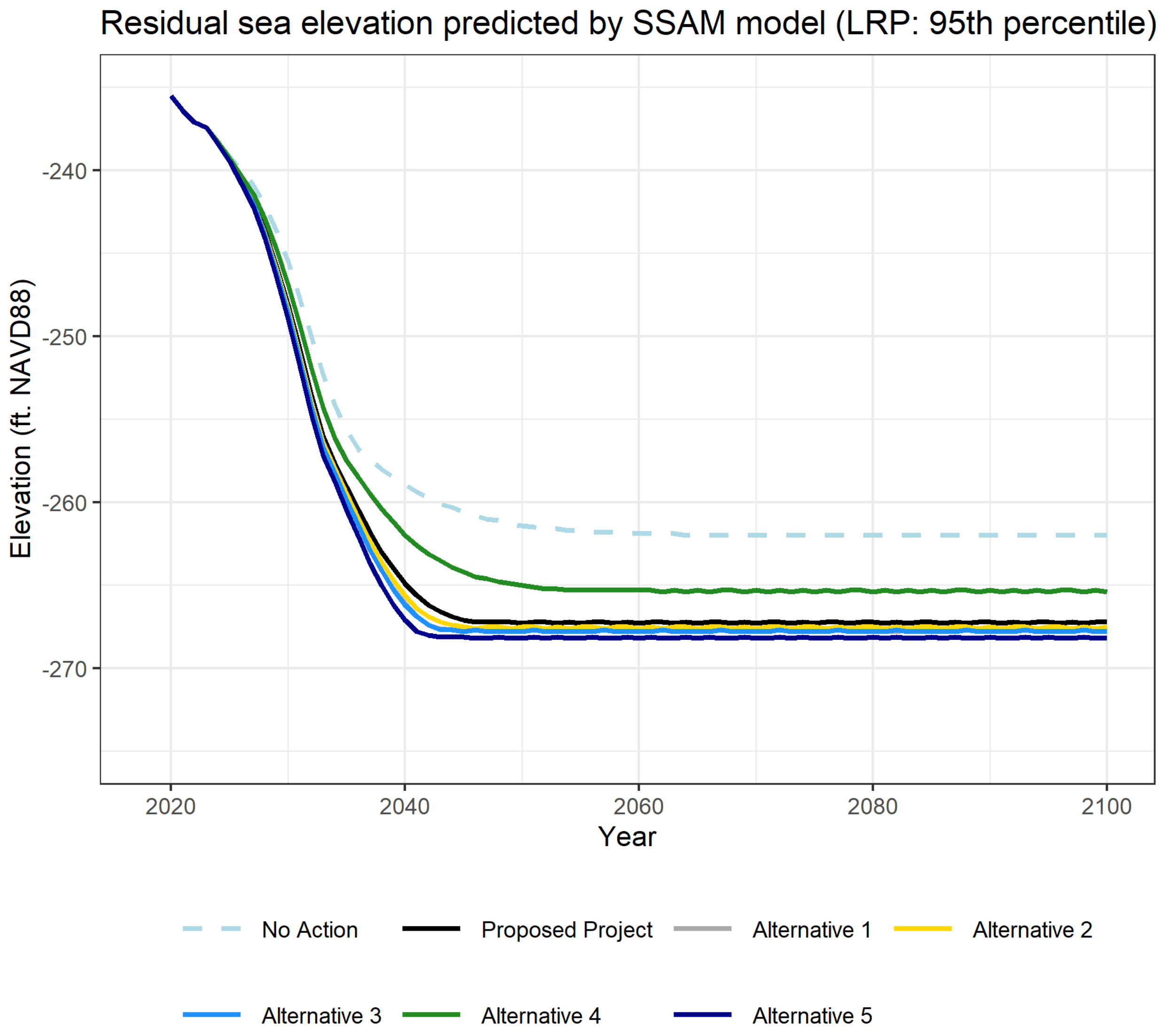

Figure C-5. Modeled sea elevations under SSMP project alternatives using the LRP model (very low probability inflow scenario).

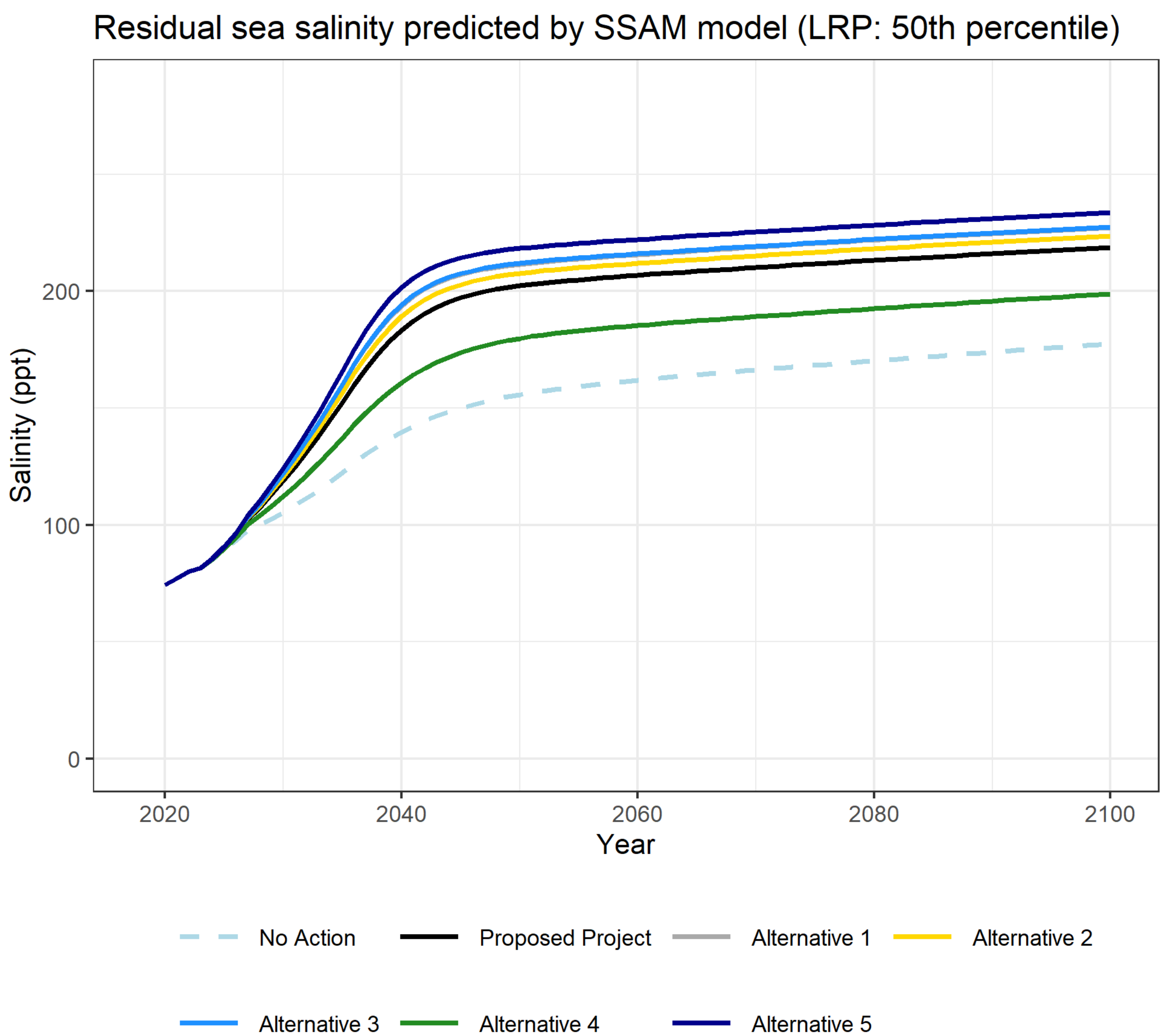

Figure C-6. Modeled sea salinity under SSMP project alternatives using the LRP model (high probability inflow scenario).

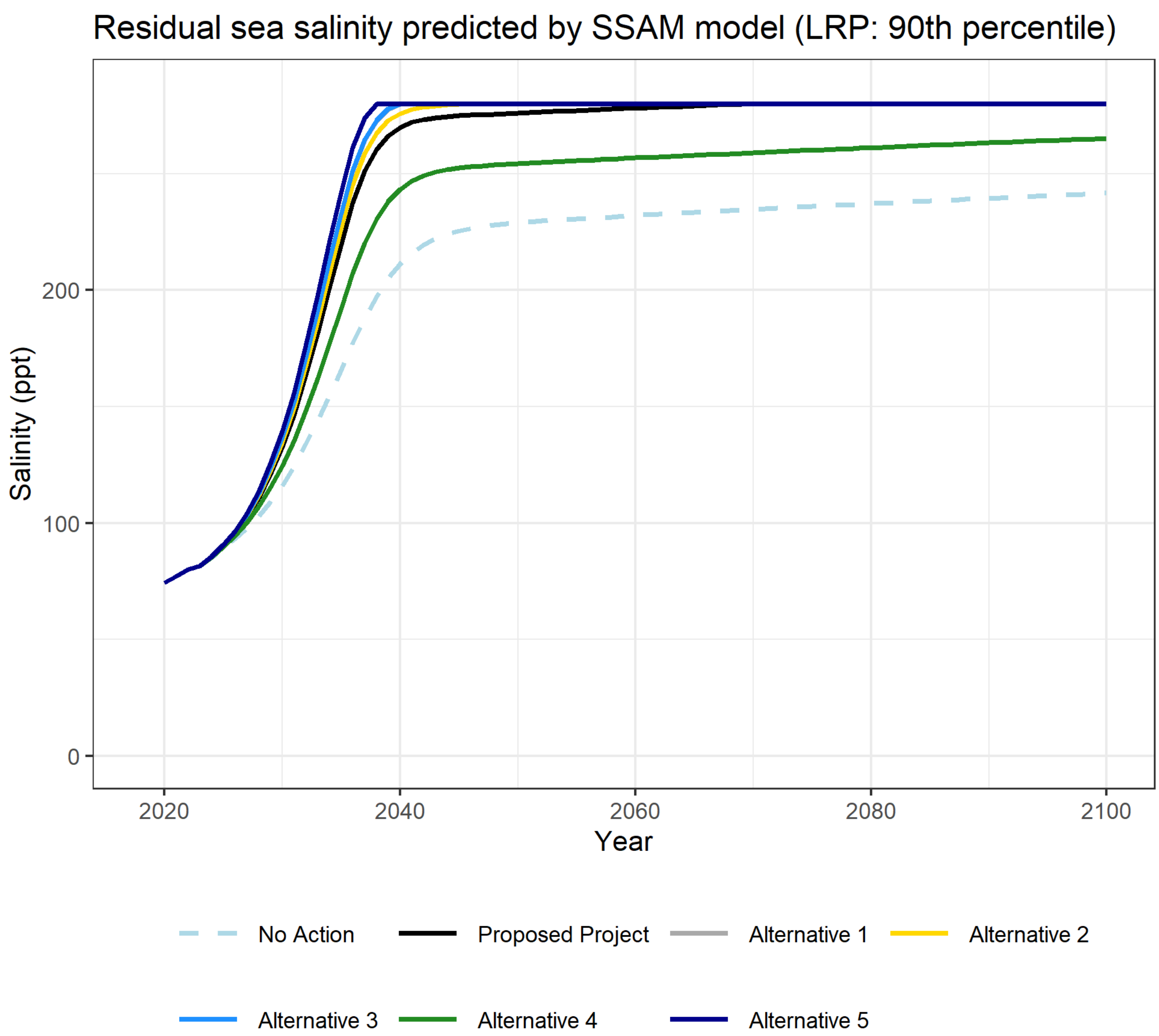

Figure C-7. Modeled sea salinity under SSMP project alternatives using the LRP model (low probability inflow scenario).

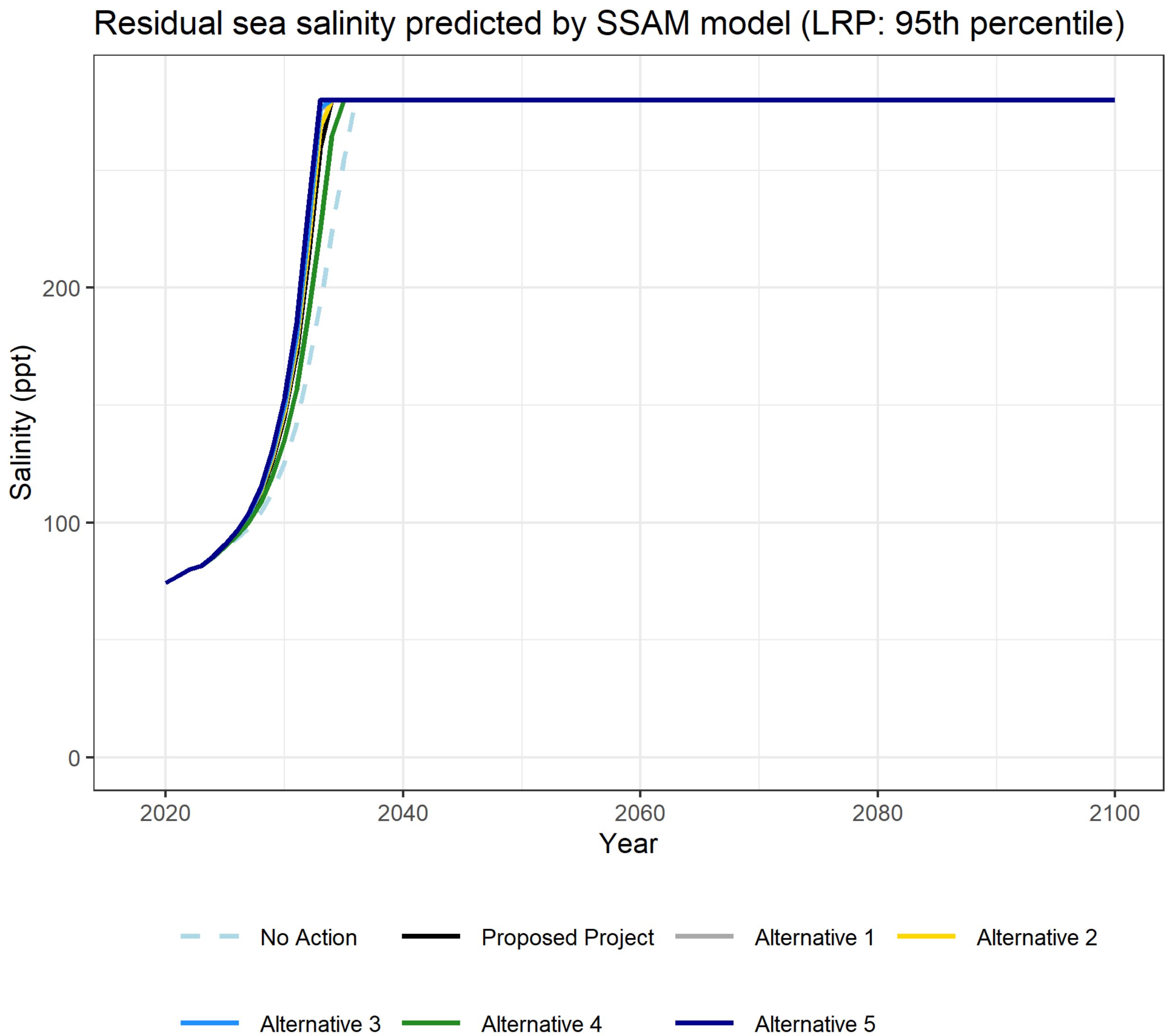

Figure C-8. Modeled sea salinity under SSMP project alternatives using the LRP model (very low probability inflow scenario).

Table C-9. Estimated annual water use (in acre feet per year) and source of water for each project and alternative

Estimated annual water use (in acre feet per year) and source of water for each project and alternative.											High Probability Inflow			Low Probability Inflow			Very Low Probability Inflow		
SSMP Project Components	**Project Area Acreage (acres)**	**Project Type**	**Water Source**	**Proposed Project**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**	**No Action (SCH Project)**	**Sufficient Surface Flow 2023?**	**Sufficient Surface Flow 2028?**	**Sufficient Surface Flow 2047?**	**Sufficient Surface Flow 2023?**	**Sufficient Surface Flow 2028?**	**Sufficient Surface Flow 2047?**	**Sufficient Surface Flow 2023?**	**Sufficient Surface Flow 2028?**	**Sufficient Surface Flow 2047?**
Water-Based Dust Suppression	14,900 - 23,973	Dust Suppression [1]	Return Flows	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			Groundwater Well Water, Local Creeks and Washes, and Trucked Water	14,900	0	0	0	14,900	23,973	0									
Desert Shores Channel Restoration	30 [2]	Revegetation/ Islands Aquatic Habitat/Pond [2] Aquatic Habitat Pond [2] Vegetative Dust Suppression	Well Water (fresh water and/or brackish water) (West Salton Sea Basin)	195	0	0	0	0	195	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Sea	0	0	0	0	0	0	0									
			River Water/Inflows	0	0	0	0	0	0	0									
Alamo River Project	3,558 - 10,216 [2]	Aquatic Habitat/Ponds [2]	Alamo River/Inflows	99,232	48,652	61,533	80,061	0	139,693	0	541,654 (Alamo) 2,753 (Alamo Mexico)	579,228 (Alamo) 3,166 (Alamo Mexico)	550,878 (Alamo) 3,480 (Alamo Mexico)	541,654 (Alamo) 2,753 (Alamo Mexico)	491,600 (Alamo) 2,687 (Alamo Mexico)	418,464 (Alamo) 2,644 (Alamo Mexico)	541,654 (Alamo) 2,753 (Alamo Mexico)	429,539 (Alamo) 2,347 (Alamo Mexico)	263,444 (Alamo) 1,664 (Alamo Mexico)
			Sea Water	15,565	7,631	9,652	12,558	0	21,912	0									
North Lake Project	3,862 - 5,363 [2]	Aquatic Habitat/Ponds (>3) [2] Aquatic Habitat/Ponds (>3) [2]	CVSC (canal) Water	--	--	--	--	--	--	--	47,325 (Whitewater /CVSC) 32,266 (CVWD Drains) 79,591 (Total CVWD Inflows)	45,647 (Whitewater /CVSC) 31,123 (CVWD Drains) 76,770 (Total CVWD Inflows)	41,622 (Whitewater /CVSC) 28,378 (CVWD Drains) 70,000 (Total CVWD Inflows)	47,325 (Whitewater/ CVSC) 32,266 (CVWD Drains) 79,591 (Total CVWD Inflows)	45,647 (Whitewater/ CVSC) 31,123 (CVWD Drains) 76,770 (Total CVWD Inflows)	41,622 (Whitewater/ CVSC) 28,378 (CVWD Drains) 70,000 (Total CVWD Inflows)	47,325 (Whitewater/ CVSC) 32,266 (CVWD Drains) 79,591 (Total CVWD Inflows)	45,647 (Whitewater/ CVSC) 31,123 (CVWD Drains) 76,770 (Total CVWD Inflows)	41,622 (Whitewater/ CVSC) 28,378 (CVWD Drains) 70,000 (Total CVWD Inflows)
			Flood Flows	--	--	--	--	--	--	--									
			Sea Water	8,283	8,283	11,503	8,283	0	8,283	0									
			CVWD Inflows	52,809	52,809	73,333	52,809	0	52,809	0									
North Lake Demonstration	160 [2]	Aquatic Habitat/Pond [2]	CVDC (canal) Water [5]	0	0	0	0	0	0	0	47,325 (Whitewater /CVSC) 32,266 (CVWD Drains) 79,591 (Inflows CVWD)	45,647 (Whitewater /CVSC) 31,123 (CVWD Drains) 76,770 (Inflows CVWD)	41,622 (Whitewater /CVSC) 28,378 (CVWD Drains) 70,000 (Inflows CVWD)	47,325 (Whitewater/ CVSC) 32,266 (CVWD Drains) 79,591 (Inflows CVWD)	45,647 (Whitewater/ CVSC) 31,123 (CVWD Drains) 76,770 (Inflows CVWD)	41,622 (Whitewater/ CVSC) 28,378 (CVWD Drains) 70,000 (Inflows CVWD)	47,325 (Whitewater/ CVSC) 32,266 (CVWD Drains) 79,591 (Inflows CVWD)	45,647 (Whitewater/ CVSC) 31,123 (CVWD Drains) 76,770 (Inflows CVWD)	41,622 (Whitewater/ CVSC) 28,378 (CVWD Drains) 70,000 (Inflows CVWD)
			Sea Water	0	0	0	0	0	0	0									
			Agricultural Drainage	1622	1622	1622	1622	0	1622	0									
			Groundwater Well Water	1622	1622	1622	1622	0	1622	0									
New River Expansion Project	4,548 - 9,563 [2]	Aquatic Habitat/Pond [2]	SCH Pond Outflows	33,163	33,163	33,163	33,163	0	33,163	0	293,142 (New - IID Inflows) 61,105 (New - Mexico Inflows)	313,597 (New - IID Inflows) 35,592 (New - Mexico Inflows)	298,500 (New - IID Inflows) 0 (New - Mexico Inflows)	293,142 (New - IID Inflows) 61,105 (New - Mexico Inflows)	266,154 (New - IID Inflows) 35,592 (New - Mexico Inflows)	226,750 (New - IID Inflows) 0 (New - Mexico Inflows)	293,142 (New - IID Inflows) 61,105 (New - Mexico Inflows)	232,554 (New - IID Inflows) 35,592 (New - Mexico Inflows)	142,750 (New - IID Inflows) 0 (New - Mexico Inflows)
			New River/Inflows	83,342	65,505	55,334	114,500	0	116,350	0									
			Sea Water	0	0	0	0	0	0	0									
Audubon California Bombay Beach Wetland [4]	903-993	Aquatic Habitat/ Wetland [4] Vegetative Dust Suppression	River Water	0	0	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Sea Water	0	0	0	0	0	0	0									
			Local Drainage	4,515	4,515	4,965	0	0	4,515	0									
			Stormwater	--	--	--	--	--	--	--									

Estimated annual water use (in acre feet per year) and source of water for each project and alternative.												High Probability Inflow			Low Probability Inflow			Very Low Probability Inflow		
SSMP Project Components		Project Area Acreage (acres)	Project Type	Water Source	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action (SCH Project)	Sufficient Surface Flow 2023?	Sufficient Surface Flow 2028?	Sufficient Surface Flow 2047?	Sufficient Surface Flow 2023?	Sufficient Surface Flow 2028?	Sufficient Surface Flow 2047?	Sufficient Surface Flow 2023?	Sufficient Surface Flow 2028?	Sufficient Surface Flow 2047?
Other undefined projects associated with:	Proposed Project	14,900	Water-based Dust Suppression [1]	River Water/Inflows	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				Agricultural Drainage	0	--	--	--	--	--	--									
				Groundwater Well Water, Local Creeks and Washes, and Trucked Water	14,900	--	--	--	--	--	--									
	Alternative 1	11,823	Veg enhancement Aquatic Habitat/Pond [2]	Stormwater Runoff	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				Whitewater, Alamo, New Rivers/Inflows	--	161,667	--	--	--	--	--									
				Sea Water	--	25,358	--	--	--	--	--									
				Agricultural Drainage	--	--	--	--	--	--	--									
	Alternative 2	9,272 (10,126)	Aquatic Habitat/Wetland [3] Aquatic Habitat/Pond [2]	River Water/Inflows	--	--	50,630	--	--	--	--	--	--	--	--	--	--	--	--	--
				Sea Water	--	--	0	--	--	--	--									
	Alternative 3	6,402	Aquatic Habitat/Pond [2]	River Water/Inflows	--	--	--	87,541	--	--	--	--	--	--	--	--	--	--	--	--
				Sea Water	--	--	--	13,731	--	--	--									
	Alternative 4	14,900	Water-based Dust Suppression [1]	River Water/Inflows	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--
				Well Water	--	--	--	--	14,900	--	--									
		10,790	Aquatic Habitat/ Enhancing Wetlands	River Water/Inflows	--	--	--	--	53,950	--	--									
				Sea Water	--	--	--	--	0	--	--									
--				Total AFY	282,085	175,739	204,664	256,555	0	356,074	0	990,889	1,001,856	889,438	990,889	866,306	684,438	990,889	770,306	444,438
				Total AFY (Salton Sea)	23,848	41,273	21,155	34,573	0	30,195	0	Total Modeled Inflows, Long-Range Plan, High probability inflow, 50th percentile			Total Modeled Inflows, Long-Range Plan, Low probability inflow, 90th percentile			Total Modeled Inflows, Long-Range Plan, Low probability inflow, 95th percentile		
				Total AFY (River/Drain Flows)	237,005	330,255	242,452	336,532	53,950	310,474	0	--								
				Total AFY (Other Sources)	16,717	1,622	1,622	1,622	14,900	25,790	0									

[1] 1 acre-foot/acre
[2] 6 acre-feet/acre
[3] 5 acre-feet/acre
[4] Audubon California Bombay Beach Wetland uses local flows for water needs
[5] Or temporary use of canal water

Table C-10. Estimated annual water use of river and drain water compared to total inflows (expressed as a percent). The percentages are shown for three points in time (2023, 2028, and 2047) and for three inflow scenarios (high probability, low probability, and very low probability)

Flow Scenario	Time Period	Proposed Project	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	No Action (SCH Project)
Percent of High Probability Flow	% Annual River/Drain Inflow (2023)	24	33	24	34	5	31	0
	% Annual River/Drain Inflow (2028)	24	33	24	34	5	31	0
	% Annual River/Drain Inflow (2047)	27	37	27	38	6	35	0
Percent of Low Probability Flow	% Annual River/Drain Inflow (2023)	24	33	24	34	5	31	0
	% Annual River/Drain Inflow (2028)	27	38	28	39	6	36	0
	% Annual River/Drain Inflow (2047)	35	48	35	49	8	45	0
Percent of Very Low Probability Flow	% Annual River/Drain Inflow (2023)	24	33	24	34	5	31	0
	% Annual River/Drain Inflow (2028)	31	43	31	44	7	40	0
	% Annual River/Drain Inflow (2047)	53	74	55	76	12	70	0