INFORMATION ITEM

Delta Adapts Update

Summary

Council staff will provide an update on Delta Adapts, the Council's climate change study, and the related work that has been accomplished this year. Specifically, staff will review the adaptation scenarios, metrics evaluation, and tradeoffs between the scenarios based on these metrics. This work was presented at a Stakeholder Workgroup meeting in June 2023. The key takeaways from the feedback received at the Stakeholder Workgroup, as well as next steps in preparation of the Adaptation Plan, will be provided.

Background

The Delta Reform Act defines "restoration", as including consideration of "the future impact of climate change and sea level rise" (Water Code [Wat. Code] section 85066) and identifies the year 2100 for the restoration of large areas of interconnected habitats within the Delta and its watershed. (Wat. Code section 85302(e)(1).) The Delta Reform Act also notes that the Delta Plan may address "the effects of climate change and sea level rise on the three state highways that cross the Delta" in consultation with the Department of Transportation. (Wat. Code section 85307(c).) Executive Order B-30-15, signed by Governor Brown in April 2015, requires State agencies to incorporate climate change into planning and investment decisions. State agencies are also required to prioritize natural infrastructure and actions for climate preparedness and to protect California's most vulnerable populations. (Cal. Exec. Order No. B-30-15 (April 29, 2015).)

Climate change is already altering the physical environment of the Sacramento-San Joaquin Delta and Suisun Marsh (Delta). Moving forward, climate change in the Delta will continue to adversely affect human health and safety, lead to economic disruptions, diminish water supply, degrade water quality, shift ecosystem function and habitat qualities, and increase the challenges of providing basic services. Many of these impacts will disproportionately affect disadvantaged communities.

Delta Adapts will help the Council assess specific climate risks and vulnerabilities in the Delta and, in coordination with a diverse group of stakeholders, develop adaptation strategies to address those vulnerabilities. The study consists of two phases: 1) a **Vulnerability Assessment** to improve understanding of regional vulnerabilities due to climate change in order to protect the vital resources the Delta provides to California and beyond, with a focus on State interests and investments, followed by 2) an **Adaptation Plan** detailing strategies and actions to adapt and respond to those vulnerabilities. The Delta Adapts Vulnerability Assessment was approved by the Council on June 24, 2021, and the Adaptation Plan is currently under development.

Adaptation Process

Council staff began the adaptation phase of Delta Adapts in Fall 2021. Throughout this process, staff has engaged with a diverse array of interests to inform the adaptation planning process. This stakeholder outreach and engagement has included:

- convening a cross-sector Stakeholder Workgroup (SWG) and four technical focus groups associated with ecosystems, agriculture, water supply, and flood risk reduction;
- presenting to and interviewing farmers and landowners across the Delta and Suisun Marsh;
- meeting with the Council's Environmental Justice Expert Group for guidance on incorporating equity into adaptation; and
- conducting additional targeted outreach and meetings with State and local agencies and other Delta interests.

Through these engagements, staff have identified climate impacts that are of most concern to these groups and what they desire as an outcome of adaptation.

This engagement has also informed development of adaptation scenarios and tradeoffs among these scenarios, evaluated using a set of metrics. Scenario results will inform development of individual adaptation strategies included in the Adaptation Plan, alongside many other inputs including community feedback, best practices, best available science, and other sources. Staff are currently developing draft adaptation strategies and supporting actions. Next steps include receiving

input on draft strategies from the four technical focus groups and the SWG; releasing a draft Adaptation Plan (expected in late 2023); and finalizing the Adaptation Plan in early 2024, following a public comment period. **Figure 1** shows the adaptation planning process and timeline.

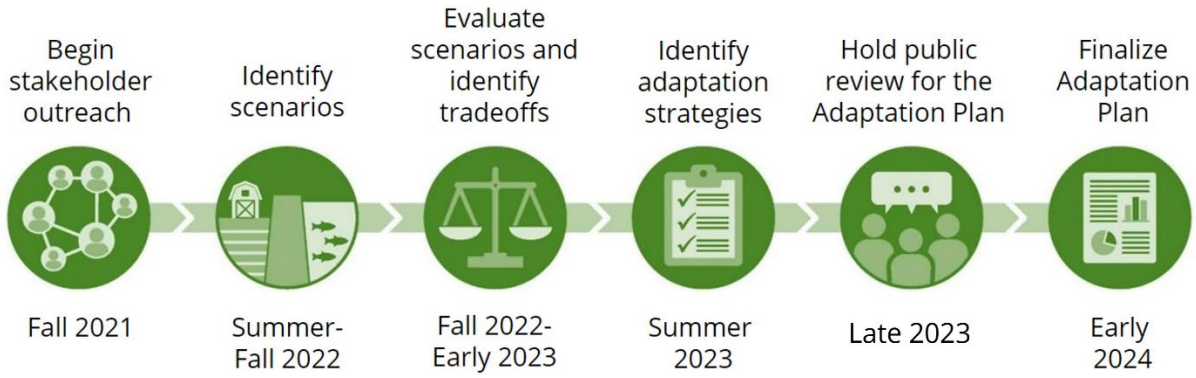


Figure 1*:* Adaptation Process and Timeline

Scenarios

Four scenarios were developed based on adaptation needs that were identified through stakeholder input from three sets of focus group meetings and the Vulnerability Assessment findings, as well as through the other outreach described above. Three scenarios assume that all levees are improved to accommodate climatic changes through 2050, while a fourth scenario assumes a lower level of levee improvement investments. Each scenario maximizes a different adaptation need and shows alternative ways to adapt to the identified climate vulnerabilities. The adaptation scenarios help visualize and promote dialogue regarding different ways for adapting the Delta's landscape. The scenarios allow comparison of tradeoffs between different goals, such as continuing agriculture at a similar level as today, undertaking more ecosystem restoration to meet established targets, and incorporating varying levels of flood protection for levees located in different areas of the Delta.

The following list describes goals and components of each of the four scenarios; see **Attachment 1: Scenarios Overview** for additional details regarding each scenario and the anticipated benefits and tradeoffs among them.

- *Baseline:* The baseline assumptions describe the starting point for the scenarios. For ecosystem uses, the metric land use baseline is "existing conditions" for the year 2017. The agricultural baseline is based on 2014-2017 uses. The baseline for flood level of protection (LOP) assumptions are largely based on the tolerable risk considered by the Council in the Delta Levees Investment Strategy (DLIS) Final Report, or State law (e.g. 200-year urban level of flood protection in the Central Valley). The baseline condition assumes that all Delta levees achieve Bulletin 192-82 standards with the 1992 Special Study hydrology. In Suisun Marsh, the baseline condition assumes that levees would achieve Suisun Resource Conservation District levee standards, except in areas where small communities, highways, or completed/planned restoration projects dictate the need for higher standards. The water quality baseline assumes existing conditions and water project operations.

- *Scenario 1 – Climate Smart Agriculture Focus*: This scenario focuses on the continuation of existing land uses, which in the Delta, is primarily agriculture. In this scenario, all land currently zoned for agriculture would continue on privately-owned land, while restoration or multi-benefit landcover mosaics (such as a mix of rice and habitat areas) would occur on suitable publicly-owned lands. This scenario assumes that climate smart adaptation strategies are used to enable agricultural uses to continue under changing climate conditions.

- *Scenario 2 – Restoration Focused:* This scenario focuses on meeting restoration targets by specific habitat type as identified in the Delta Plan, assuming that restoration occurs on suitable public lands first. The remaining restoration acreage needed to meet the targets is then assumed to occur on private lands suitable for the needed habitat types. Conversion of private lands would be voluntary.
- *Scenario 3 – Less Restoration in the Delta*: This scenario focuses on meeting overall restoration targets established in the Delta Plan while reducing conversion of prime farmland. This scenario also focuses restoration on public lands first, but would substantially reduce the amount

of restoration assumed on private lands in the Delta, and instead place more restoration in Suisun Marsh. This scenario would meet overall Delta Plan restoration acreage goals, but would not achieve those goals for each specific habitat type.

- *Scenario 4 – Levee Underinvestment:* Assuming less funding for flood risk reduction is available, Scenario 4 highlights the Delta impacts that would occur with fewer levee improvements. This scenario assumes no levee improvements are made to further protect some islands where the cost to improve levees is greater than the economic value of the assets present on the island. This scenario illustrates the consequences of not improving all Delta levees to accommodate changing climate conditions.

Evaluation Metrics

Evaluation metrics were used to quantitatively compare tradeoffs among the four scenarios. The metrics measure tradeoffs related to the four technical focus areas: ecosystems, agriculture, flood risk reduction, and water supply/quality, including metrics related to economics and equity. For example, agriculture metrics include changes in gross revenue and changes in agricultural jobs. Similarly, ecosystem metrics include connectivity of tidal wetlands, the percentage of subsided lands covered by subsidence-halting or subsidence-reversal habitat types, and the cost of implementing the restoration assumed in each scenario.

The cost of implementing the assumed levee improvements were estimated for all scenarios. Under Scenarios 1-3, all areas are protected from flood risks under a changing climate. Scenario 4 assumes that funding for all identified levee improvements is not available, and thus some areas would not receive a level of flood protection adequate to keep up with sea level rise and increased surface water flows. For Scenario 4, the population, economic activity, asset value, and critical facilities exposed to flooding were also calculated. Other metrics also include anticipated salinity changes and jobs created as a result of levee improvements and restoration actions.

Equity metrics focused on impacts to socially vulnerable communities and communities dependent on drinking water wells currently failing human right to water criteria (e.g., water quality, affordability). For example, in addition to

identifying the population across the Delta and Suisun Marsh that would be exposed to flooding in Scenario 4, the population exposed to flooding within socially vulnerable communities was also estimated. Salinity modeling under Scenarios 1 through 3 identifies the anticipated change in salinity levels at locations adjacent to Legacy Communities and SAFER (the State Water Resource Control Board's *Safe and Affordable Funding for Equity and Resilience Program*) drinking water wells identified as failing or at risk of failing human right to water criteria (e.g., water quality, affordability).

The primary objective of these metrics is to identify the relative differences among the scenarios to identify relative tradeoffs. **Table 1** shows all metrics assessed.

Table 1: Evaluation Metrics and Results

	Baseline	**Scenario 1 Climate-Smart Ag**	**Scenario 2 Restoration Focus**	**Scenario 3 Less Restoration In-Delta**	**Scenario 4 Levee Underinvestment**
Agriculture					
Change in gross revenue	$915,669,223	-5%	-14%	-12%	-14%
Change in agricultural jobs	7,107 jobs	-5% (-643 jobs)	-26% (-1,892 jobs)	-25% (-1,783 jobs)	-19% (-1,339 jobs)
Change in cropped lands	365,452 ac	-8%	-15%	-13%	-17%
Change in water used	1,018,803 acre-feet	-7%	-13%	-12%	-16%
Change in net revenue	$201,090,387	-4%	-20%	-18%	-17%
Change in Gross Domestic Product (GDP) (%)	$577,706,134	-5%	-14%	-12%	-15%
Rice acres (new conversion)	n/a	8,100	62,400	62,300	8,100
Rice conversion costs ($)	n/a	$7M	$52M	$52M	$7M
Ecosystems					
Percentage of subsided lands covered by wetted habitat types (%) (existing + new)	12%	23.5%	42.2%	42.4%	22%
GHG Emissions (MT CO2e/yr)*	1,200,000	918,700	654,100	654,800	917,000
Avoided GHG emissions (MT CO2e/yr)*	n/a	259,000	524,000	523,000	282,000
Connectivity of tidal wetlands (average distance along channel network to	3.2	3	2	3	2

nearest large connected tidal wetland) (miles)					
Total connected wetland area (acres)	30,821	54,500	58,600	60,200	49,000
Non-tidal restoration (acres)	n/a	16,000	35,000	27,000	17,000
Tidal restoration (acres)	n/a	24,000	39,000	36,000	28,000
Habitat restoration costs ($)[1]	n/a	$247M	$425M	$388M	$306M
Habitat area in socially vulnerable communities (acres)	33,462	47,432	59,404	54,925	48,624
Flood Risk Reduction					
Levee improvement costs ($)	$1.4B	$3.34B	$3.29B	$3.24B	$1.8B
Population exposed to flooding	n/a				4,140
Population exposed to flooding in socially vulnerable communities	n/a				502
Economic value of assets exposed to flooding ($)	n/a				$98M
Annual economic activity exposed to flooding ($)	n/a				$34M
Critical facilities exposed to flooding	n/a				1
Miles of highway exposed to flooding	n/a				7
Water Quality					
Salinity: Change in electrical conductivity (EC) (% change compared to baseline)	2,655	1.0	1.0	1.3	n/a
Change in X2 compared to baseline (kilometers)	81.38 km	-0.12 km	-0.13 km	-0.14 km	n/a
Economics					
Direct levee improvement jobs created	n/a	27,020	26,630	26,230	14,600
Direct habitat restoration jobs created	n/a	3,270	5,620	5,110	4,030

*Carbon emission metrics do not include figures for Suisun Marsh

Key Tradeoffs

Key tradeoffs among the scenarios are highlighted below; see **Attachment 1: Scenarios Handout** for additional details regarding scenario tradeoffs. A virtual,

[1] Costs subject to change based on input received after the June 2023 SWG.

interactive dashboard was also created to visualize scenario tradeoffs. The virtual dashboard can be viewed at rebrand.ly/deltaadapts070523.

Scenario 1: Scenario 1 would maintain agricultural jobs and revenue and maximize protection of prime farmland. Continuation of agricultural activities would allow for continued assessments on economic activity and ongoing maintenance of levees. However, this scenario would continue a relatively high level of greenhouse gas (GHG) emissions from continued agricultural operations and subsided lands, resulting in higher GHG emissions than the other scenarios. Scenario 1 would not meet Delta Plan restoration acreage or habitat type targets and would not meet restoration targets for Suisun Marsh (set in the Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Suisun Marsh Plan)). Under this scenario, subsidence on farmed land would continue, which could further threaten levee integrity.

Scenario 2: Scenario 2 would meet Delta Plan restoration goals by acreage and specific habitat type and would exceed Suisun Marsh Plan restoration goals. By halting and reversing subsidence, this scenario would support a more resilient long-term Delta landscape. Scenario 2 would generate the least GHG emissions, since it includes the most restoration. This scenario would result in fewer overall agricultural jobs based on the reduction of farmland; and a reduced agricultural economy would likely contribute to broader shifts in local economies and communities currently employed in the agricultural sector. On the other hand, this scenario would result in the second-highest number of jobs created from levee improvement and habitat restoration actions. In this scenario, more subsidence reversal projects such as rice on agricultural land would result in fewer agricultural jobs as rice is more mechanized than most current crops, but these projects would also reduce flood risk and GHG emissions. Reduced economic activity on lands converted from agriculture would lead to reduced assessments that may not be sufficient to generate the local cost share required to operate and maintain Delta levees.

Scenario 3: Scenario 3 would have similar benefits and drawbacks to Scenario 2, except that it would meet overall Delta Plan restoration goals by acreage, but not by specific habitat type, and would include slightly lower overall restoration acreages. Scenario 3 would reduce conversion of prime farmland on privately-

owned lands in the Delta by approximately 15,000 acres, and would result in lower capital costs for restoration than Scenario 2.

Scenario 4: In Scenario 4, levee improvement costs would be about half those of the other scenarios because a lower level of investment in levees is assumed. Failed islands could contribute to ecosystem degradation, by providing favorable habitat for invasive species and negative impacts to water quality. A significant number of people, economic activity, assets, and critical faciltiies would be exposed to a level of flood risk that exceeds what is tolerable according to State law or policy. Scenario 4 would result in reduced agricultural revenue and jobs, and the least number of jobs created from levee improvements and habitat restoration actions.

Stakeholder Feedback

A Stakeholder Workgroup meeting was held on June 6, 2023 at the California Natural Resources Building and virtually on Zoom to review the scenarios and metric evaluations, and to discuss the tradeoffs, major challenges to adaptation, and potential adaptation strategies. Over sixty people attended the meeting, representing a range of State and local agencies, reclamation districts, environmental non-profits, water agencies, academia, and more.

Adaptation Challenges and Tradeoffs

Though not a comprehensive summary, a few key takeaways from the discussions on adaptation tradeoffs and major challenges include:

- **The importance of flood protection and levees**: The cost of levee maintenance is often underestimated, and stakeholders think that the State should play a greater role in funding levee maintenance. Levees are essential for protecting the Delta and levee maintenance and improvements need to be adequately funded. Without adequate flood protection, the Delta cannot be restored, water supplies cannot be maintained, and other goals cannot be achieved.
- **Addressing subsidence**: Subsidence is a major problem in the Delta, making it difficult to maintain water supply reliability and levee integrity. Subsidence can be addressed by changing agricultural practices, switching to different crops, increasing subsidence halting and subsidence reversal land cover

types, and investing in levee maintenance. Some stakeholders described the potential to reuse sediment to help build levees and address subsidence.

- **Funding:** Funding mechanisms for adaptation projects must be identified and secured. This could include federal grants, state bonds, and/or private investments. Stakeholders noted the need to align incentives from federal and state objectives, and the need to provide incentives for carbon sequestration and restoration. Stakeholders also noted that the Delta needs significant funding to address the challenges it faces, and that it will be important to generate the political will to secure funding and to expedite implementation of projects.
- **Trade-offs will be required:** There are many different goals for the Delta, and not all of them can be achieved. It will be important to identify the most important goals and make trade-offs where necessary.
- **Prioritization and protection for vulnerable communities**: Vulnerable communities have been and will continue to be disproportionately impacted by climate change, and they need to be prioritized and protected.
- **Incentivize restoration on private lands**: Restoration on private lands can be expensive. Incentives are needed to support private landowners who choose to restore their land. This could be accomplished through financial incentives, such as tax breaks, or through non-financial incentives, such as education and outreach programs.

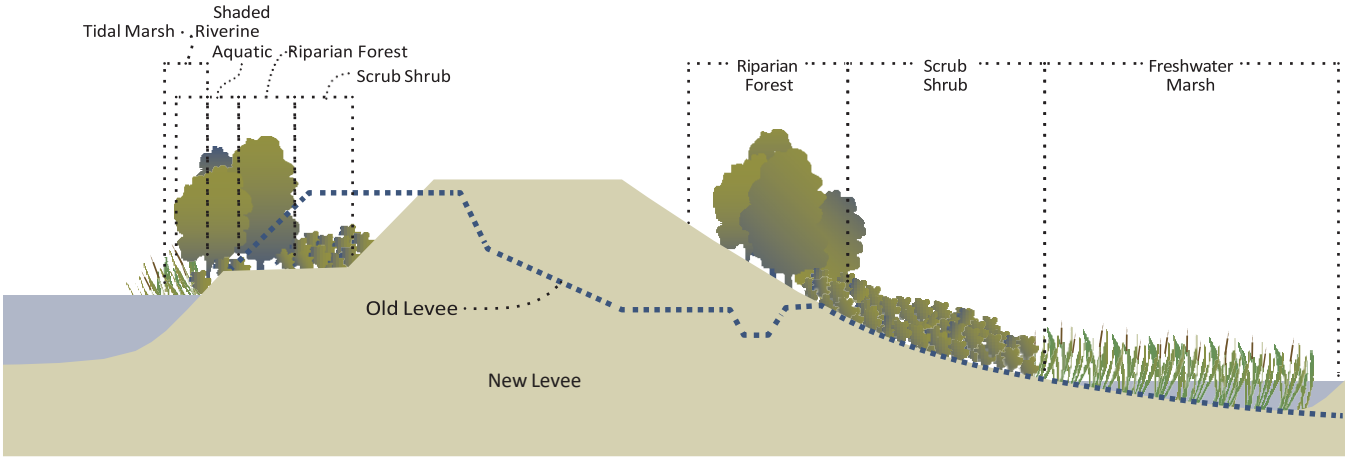
Stakeholders emphasized that the traditional approaches to managing the Delta are no longer sufficient under climate change, and that all will need to be open to new ideas and solutions. Stakeholders also stated that the Council could play a key role in developing a program for adaptation and securing funding for the program.

Adaptation Strategies

At the SWG meeting, Council staff also presented potential adaptation strategies across the four thematic areas (presented visually on posters and using a virtual interactive whiteboard). Stakeholders added comments regarding the strategies, indicated support for specific strategies, added ideas for additional strategies, and provided overall comments regarding the Adaptation Plan.

For example, for flood risk reduction, one of the strategies presented was "physical improvements." Stakeholders provided comments on many of the supporting actions presented as part of this strategy, such as:

- *Action: For tidally influenced areas, consider nature-based solutions such as waterside tidal benches that dissipate tidal energy and provide habitat*



- **Figure 1.** Cross-section of a levee and related habitats on a subsided island.

    - Comment: Existing waterside benches are being lost due to erosion. They aren't high priorities for reclamation districts because the erosion is not yet within the levee section, so the benches don't get repaired. Saving existing benches needs to be a priority.
    - Comment: This was tried during CALFED with some success, but the benches need to be maintained. In addition, remnant, or tule berms should be maintained and improved since they provide tremendous habitat and protect levees from wave action forces.
- *Action: For riverine influenced areas, set levees back, and reconnect floodplains, both within and upstream of the Delta*
    - Comment: Setting back levees in the Delta is difficult as much of the highest-value property is often adjacent to the levees.
    - Comment: Work with flood districts to move sediment they remove from channels to the needed areas in the Delta.
    - Comment: Subsided areas are not conducive to levee setbacks since they will result in deep subtidal habitat.

- *Action: Halt or reverse subsidence within 500 feet of the levee toe*
    - Comment: This is the only area where subsidence halting, or reversal may help levee stability.
- *Action: Build adaptive levees when making improvements. This can include, but is not limited to, widening existing levees to allow for future raises, purchasing flood easements, or land at the levee toe for future levee widening or setbacks*
    - Comment: Setting back levees on private land may be the right thing to do for better flood protection but it will involve taking very good agricultural land for the benefit of others. Concept is good, implementation is difficult.

For ecosystems, participants provided ideas for additional actions to consider across many of the strategies. Some of these ideas included:

- Restoration in strategic areas that will build on existing high value patches of habitat first.
- Begin working with landowners to develop trust. Look for common ground and construct restoration in areas all can accept.
- Restoration should maximize connectivity across landscapes.
- What opportunities exist in the Delta Plan to accelerate restoration projects that also support climate adaptation?
- Quantify benefits to various sectors that could be affected by restoration, including recreation and tourism, community well-being, cultural benefits, water quality, aquatic food webs, and fish populations (even if not quantified in dollars).
- Quantify the cost of no action, or of "business as usual" (current trends of land use change continue), plus climate change impacts.

Participant input on these examples and additional adaptation strategies will be considered as staff continue to develop the Adaptation Plan.

How Scenarios Inform Adaptation Plan

As discussed previously, the adaptation scenarios help visualize and explore different ways to adapt the Delta landscape, with a focus on comparing tradeoffs

between different goals. During the process to date, we have learned a number of important things. For example, we have developed information describing how much it would cost to improve levees to accommodate climate change by 2050, a range of $1.8 to $3.34 billion. In addition, we learned that it is not possible to meet Delta Plan restoration targets solely on currently publicly-owned lands -- about 28,000 acres of land that is currently under private ownership is needed to meet targets by habitat type. Meeting with the Stakeholder Working Group, we heard about tradeoffs, potential adaptation strategies, and climate burdens. This process has helped staff come to understand what different stakeholders value, and what risks they are willing to accept in order to protect what they value.

There are well-known tradeoffs in the Delta between agriculture, ecosystem restoration, water supply reliability, and flood risk, and stakeholders have diverging opinions about how the Delta should evolve as a place over time. The Delta Adapts scenarios and metrics enable quantification of the outcomes of adaptation strategies. They also provide estimates of the costs of changing the landscape, the costs of undertaking adaptive actions, and the cost of doing nothing. The next step is to determine a course for an uncertain future regarding the Delta as an evolving place, as well as equitable individual and community actions to adapt the Delta to inevitable change.

Next Steps

Council staff will incorporate stakeholder feedback, and will continue working with the technical focus groups, the Environmental Justice Expert Group, and Stakeholder Workgroup to develop proposed draft adaptation strategies over the coming months. These strategies will then be part of a public draft Adaptation Plan that staff will present to the Council.

Fiscal Information

Not applicable.

List of Attachments

Attachment 1: Scenarios Overview

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