Long-Term Operation – Final Environmental Impact Statement

Appendix X – Public Health and Safety Technical Appendix

November 2024

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Acronyms and Abbreviations

BMP	best management practice
CDPH	California Department of Public Health
MVCD	mosquito and vector control district
MVCAC	Mosquito and Vector Control Association of California
OEHHA	Office of Environmental Health Hazard Assessment
SLEV	St. Louis encephalitis virus
WEEV	western equine encephalomyelitis virus
WNV	West Nile virus

Appendix X Public Health and Safety Technical Appendix

X.1 Background Information

This appendix presents an overview of the potential threats to public health[1] and safety that may be affected by implementation of the No Action Alternative and the action alternatives.

X.1.1 Valley Fever

Coccidioidomycosis (Valley fever) is an illness that is caused by inhaling the spores of a soil-dwelling fungus, *Coccidioides* (Centers for Disease Control and Prevention 2019). This fungus lives in the top layers of some soils within two to 12 inches from the ground surface (California Division of Occupational Safety and Health 2017). *Coccidioides* forms in subsoil strata that are moist during the wet season and dry throughout the rest of the year. Generally, heavy rainfall periods followed by very dry weather conditions create optimal conditions for increased incidence of Valley fever. When the soil is disturbed by digging, vehicles, cultivation, or wind, the fungal spores are dispersed and can be inhaled by people in the area. Irrigated soils are less likely to contain the fungus than dry, previously undisturbed soils (San Joaquin Valley Air Pollution Control District 2012). It is believed that propagation of the spores and air entrainment occurs on soils that remain unirrigated during dry seasons (e.g., natural environments, undeveloped land, and grazing areas) (San Joaquin Valley Air Pollution Control District 2012).

Studies indicate that climate influences seasonal and yearly Valley fever infection patterns, and that drought and increased temperature contribute to an expanding geographic range for *Coccidioides*. Accordingly, increasing temperatures, and more intense and prolonged droughts, aridity, and dust storms of climate change may be conducive to the spread of *Coccidioides* (Bell et al. 2016; OEHHA 2022a).

Coccidioides is endemic in many areas of the southwestern United States, Mexico, Central America, and South America (Centers for Disease Control and Prevention 2019). Although Valley fever cocci grow in localized areas of the southwestern United States, the San Joaquin Valley and Central Coast are the major endemic regions in California (California Department of Public Health 2017c). Statewide, the annual incidence of reported cases of Valley fever has increased nearly fivefold from 2001 (4.3 cases per 100,000 people) to 2021 (20.6 cases per 100,000 people (OEHHA 2022a). In 2019, there were 20,003 cases of Valley fever in the United States reported to the Centers for Disease Control and Prevention. Of these cases, there were 9,004 reported cases of Valley fever in California (Centers for Disease Control and Prevention 2022). The highest Valley fever incidence in California in 2019 were reported in counties in the San Joaquin Valley and Central Coast regions, including, in descending order of incidence, Kern,

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[1] For the purposes of this analysis, *public health* refers to the health and well-being of a population of people.

Kings, San Luis Obispo, Tulare, Fresno, Ventura and Madera (California Department of Public Health 2020).

In general, the people who have the highest risk of exposure to the fungus include construction workers, archeologists, geologists, wildland fire fighters, military personnel, mining or gas/oil extraction workers, and agricultural workers in non-irrigated areas (California Department of Public Health 2019) known to contain *Coccidioides*. Other populations also may be at risk, e.g., members of the cast and crew of a television film became ill with Valley fever after working on an outdoor set in Ventura County (Centers for Disease Control and Prevention 2014).

Valley fever is difficult to diagnose. It is estimated that approximately 60% of Valley fever infections result in no symptoms or a mild clinical illness that is indistinguishable from other illnesses such as flu or pneumonia, and therefore, a large percentage of cases of Valley fever go undiagnosed. For most cases that are diagnosed, symptoms also include rash, fever, and joint pain. In about 0.5% of diagnosed cases, the fungal infection spreads from the lungs to other parts of the body including the skin, bones, joints, and brain meninges (membranes). There are no vaccines to prevent Valley fever. (San Joaquin Valley Air Pollution Control District 2012).

X.1.2 Bioaccumulation of Methylmercury in Fish

Appendix G, *Water Quality Technical Appendix*, provides a discussion of mercury and methylmercury as water quality constituents, a description of mercury and methylmercury occurrence in the study area, and identifies the water bodies in the study area that are currently impaired by mercury and methylmercury. Mercury is a statewide water quality issue and is being addressed through various state and federal water quality control efforts.

In aquatic environments, sulfate-reducing bacteria, and, to a lesser degree, iron-reducing bacteria, convert inorganic mercury to methylmercury, and this process is enhanced by multiple environmental variables in water and sediment including temperature, pH, oxygen, sulfate and/or iron, and the presence of organic matter (U.S. Geological Survey 2014; State Water Resources Control Board 2017). Conversion of inorganic mercury to methylmercury occurs primarily at the sediment-water interface, but also in anoxic waters, and drying and rewetting of soils (e.g., with reservoir water level fluctuations) and sediment stimulates mercury methylation (State Water Resources Control Board 2017). Flooding in terrestrial ecosystems significantly contributes to increased levels of water column and fish methylmercury in newly formed reservoirs (State Water Resources Control Board 2017). This phenomenon occurs due to bacterial stimulation and the subsequent methylation of mercury present in the soil. Methylmercury production is greatest in high marshes that experience wet and dry periods over the highest monthly tidal cycles, and production is lower in low marshes that are always inundated and not subject to dry periods (Alpers et al. 2008). Total mercury concentrations in sediment positively correlate with methylmercury levels in sediment and water (Central Valley Regional Water Quality Control Board 2010). Positive correlations also exist between fish tissue methylmercury concentrations and concentrations of total mercury and methylmercury in water (State Water Resources Control Board 2017). High concentrations of mercury in the form of methylmercury can bioaccumulate in fish and shellfish through food consumption and absorption from water based upon the water quality. Consumption of contaminated fish is the major pathway for human exposure to mercury (via methylmercury from fish tissue). Bioaccumulation is the process by which organisms, including humans, can, over time, accumulate certain contaminants in their tissues (from sources including water, air, and diet) more rapidly than can be eliminated through metabolism and excretion.

Fish and shellfish consumption is the most common route of human exposure to mercury. Nearly all people have at least some methylmercury in their bodies because it is so widespread in the environment; however, generally blood mercury concentrations in most people are lower than those associated with health impacts. Exposure to methylmercury at high concentrations can result in impacts on the central nervous system. Prenatal exposure to methylmercury can adversely impact the developing central nervous system (U.S. Environmental Protection Agency 2018, 2019a).

The California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA) evaluates concentrations of potentially toxic substances in edible tissues of fish and shellfish harvested in water bodies in California. Based upon the evaluation, general and specific safe eating guidelines are developed for the fish and shellfish. These fish consumption advisories are guidelines that recommend how often an individual can safely eat fish caught from waterbodies in California. For the water bodies in the study area, the primary water contaminants that have triggered the development of safe eating guidelines are mercury, dieldrin, and/or polychlorinated biphenyls. Other contaminants are present, including selenium; however, the concentrations of these contaminants do not exceed thresholds that would trigger safe-eating guidelines. The OEHHA develops two separate guidelines: (1) guidelines for children from one to 17 years old and women from 18 to 49 years old; and (2) guidelines for women over 50 years and men 18 years and older (California Office of Environmental Health Hazard Assessment 2019).

X.1.3 Harmful Algal Blooms

As described in Appendix G, cyanobacteria harmful algal blooms (CHABs) are overgrowths of cyanobacteria in surface waterbodies that generally occur from spring to fall (May to October) when water temperatures are warmer and are therefore conducive to bloom formation (Central Valley Regional Water Quality Control Board 2019). Cyanobacteria are microscopic, photosynthetic organisms that occur naturally in fresh, marine, and brackish waters (ITRC 2021). Under certain conditions, cyanobacteria can multiply and become very abundant, discoloring the water throughout a water body, accumulating at the surface, and/or attached to surfaces in a water body (e.g., rocks, submerged vegetation). The overgrowth of cyanobacteria in surface waters is referred to as a bloom. Generally, CHABs are dependent on warmer water temperatures; water clarity and irradiance; a calm, stratified water column coupled with long water residence times; and sufficient availability of dissolved nitrogen and phosphorus (U.S. Environmental Protection Agency 2019b; Lehman et al. 2013; Berg and Sutula 2015). CHABs have been reported in the Delta and multiple lakes and reservoirs throughout the Central Valley, including Oroville Reservoir, San Luis Reservoir, and O'Neill Forebay (Central Valley Regional Water Quality Control Board 2019).

Some species of cyanobacteria produce toxins, referred to as *cyanotoxins*, which can have adverse health impacts on humans, domestic animals, fish and other aquatic biota, and other wildlife. Cyanotoxins typically remain within cyanobacteria until the cells die or rupture, at which point the toxins are released; however, cyanotoxins can be actively released from living cyanobacteria as well (Graham et al. 2008). Humans may be exposed to cyanotoxins from

CHABs in multiple ways, including drinking contaminated water, dermal contact, inhalation, consumption of contaminated food, consumption of algal dietary supplements, and hemodialysis (Massey et al. 2018). Exposure to cyanotoxins has the potential to occur during water-based recreational activities through direct contact, by inhaling aerosolized toxins near a contaminated waterbody, aspirating water containing cyanobacteria and cyanotoxins, or through accidental ingestion of (or oral exposure to) contaminated water (U.S. Environmental Protection Agency 2023a). Exposure to cyanotoxins during recreational activities such as swimming can result in irritation of the skin, eyes, nose, throat, and lungs; ingestion of cyanotoxins can result in stomach pain, headache, neurological symptoms (e.g., dizziness), vomiting, diarrhea, kidney, and liver damage (Centers for Disease Control and Prevention 2022b; U.S. Environmental Protection Agency 2023b). The concentration of cyanotoxins present in water or biomass, along with the duration of exposure, affects the nature and severity of potential health consequences (ITRC n.d.). The long-term health consequences of cyanotoxin exposure in humans is unclear (Centers for Disease Control and Prevention 2022b).

There are no federal or state regulatory standards for cyanotoxins in drinking water or recreational waters. Participating state agencies, including the State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Water Boards), have developed voluntary guidance for responding to CHABs in recreational waters (California Water Quality Monitoring Council 2021). In addition, OEHHA has developed notification-level recommendations for four cyanotoxins in drinking water: anatoxin-a, saxitoxins, microcystins, and cylindrospermopsin (California Office of Environmental Health Hazard Assessment 2022b). The U.S. Environmental Protection Agency has published recommendations and guidelines for public water systems on developing a cyanotoxin management plan and treatment strategies and has developed non-regulatory drinking water health advisories for microcystin and cylindrospermopsin, as well as recommended recreational ambient water quality criteria or swimming advisories (U.S. Environmental Protection Agency 2015, 2019b, 2023c).

The State Water Board and Regional Water Boards collaborate with other water managers to carry out monitoring and tracking of CHABs and share CHAB concerns with various state agencies (e.g., OEHHA) and the public. This includes issuing relevant water quality alerts, conducting thorough surveillance, and implementing appropriate response measures to handle and mitigate HAB occurrences. This effort is bolstered by the enactment of Assembly Bill 834 in 2019, which established a CHABs program within the water boards, outlining specific goals such as event response, statewide assessment and monitoring, risk evaluation, research initiatives, community outreach and education, as well as comprehensive reporting. The State Water Board established the California Harmful Algal Bloom Portal to provide centralized information and resources related to CHABs in California, including interactive maps which provide data on voluntarily report CHABs in the state.

X.2 Evaluation of Alternatives

This section describes the evaluation of environmental consequences associated with the action alternatives and the No Action Alternative.

X.2.1 Methods and Tools

The No Action Alternative and action alternatives may exacerbate public health hazards in the study area through the following mechanisms.

- A reduction in surface water supplies could result in an increase in agricultural land fallowing and a consequent increase in dust, which could increase the potential for exposure to Valley fever fungal spores.
- Central Valley Project and State Water Project operations could affect water and fish tissue methylmercury concentrations.
- Increase the potential for public exposure to cyanotoxins due to an increase in CHABs.

The qualitative assessment of potential impacts on public health related to methylmercury and cyanotoxins from CHABs resulting from implementation of the No Action Alternative and the action alternatives is based on review of conclusions from Appendix G, *Water Quality Technical Appendix*, regarding potential changes in concentrations of methylmercury in fish tissue in the Delta and Suisun Marsh and potential increases in CHABs in the study area. The qualitative assessment of impacts on public health due to potential increases in *Coccidioides* exposure resulting from potential increases in fallowing of agricultural land impacts is based on review of Appendix R, *Land Use and Agricultural Resources Technical Appendix*, regarding changes in irrigated agricultural acreage.

The study area for the Valley fever analysis includes the Sacramento River and San Joaquin River regions. For the purposes of the public health analyses concerning cyanotoxins and fish tissue accumulation of methylmercury, the study area is the Bay-Delta region.

X.2.2 No Action Alternative

Under the No Action Alternative, Reclamation would continue with current operation of the CVP, as described in the 2020 Record of Decision and subject to the 2019 Biological Opinions. The 2020 Record of Decision for the CVP and the 2020 Incidental Take Permit for the SWP represent current management direction or intensity pursuant to 43 CFR § 46.30.

The No Action Alternative is based on 2040 conditions. Changes that would occur over that time frame without implementation of the action alternatives are not analyzed in this technical appendix. However, the changes to public health and safety that are assumed to occur by 2040 under the No Action Alternative are summarized in this section.

Conditions in 2040 would be different than existing conditions because of the following factors:

- Climate change and sea-level rise
- General plan development throughout California, including increased water demands in portions of the Sacramento Valley

By the end of September, the surface water elevations at CVP reservoirs generally decline. It is anticipated that climate change would result in more short-duration high-rainfall events and less snowpack in the winter and early spring months. The reservoirs would be full more frequently by the end of April or May by 2040 than in recent historical conditions. To the extent that CVP reservoirs would experience greater reservoir water level fluctuations under the No Action Alternative relative to existing conditions, there could be increased mercury methylation in these reservoirs, in reservoir releases and ultimately increased concentrations of methylmercury in fish. In addition, climate change and associated large flow events could result in higher sediment loading to the Delta, which could affect mercury loading. However, it is reasonable to assume that OEHHA standards for the consumption of fish in the study area would continue to be implemented and, thus, would serve to protect people against the overconsumption of fish with increased body burdens of mercury.

CHABs may occur with similar or greater frequency in the Delta relative to existing conditions. To the extent that future climate change will result in reduced inflows to the Delta during June through November, there would be increased water residence times in some parts of the Delta. Further, in the future, inflow water temperatures are expected to be warmer due to a reduction in water from the upper watersheds, which will result from a reduction in snowpack and precipitation increasingly falling as rain. Higher water temperatures and potential increases in residence time in the Delta due to climate change may be conducive to CHABs and could increase the bloom magnitude and duration, which could result in increased public exposure to cyanotoxins.

Under the No Action Alternative, current flows and reservoir level trends would continue and municipal and industrial (M&I) and agricultural water deliveries would continue to vary according to available water supply. As described in Section X.1.2, *Valley Fever*, *Coccidioides* typically does not grow in tilled, irrigated farmland. Rather, spores are more likely to occur on agricultural land that is idle because of agricultural practices or reduced water supply availability. The increasing frequency and severity of drought, aridity, and dust storms in California due to climate change may impact *Coccidioides* growth and spore spread, potentially leading to an increase in Valley fever infections. However, CVP and SWP operations under the No Action Alternative are not expected to result in an increase in nonirrigated agricultural land relative to existing conditions and, thus, there would be no increased potential for growth of *Coccidioides* in the study area related to CVP and SWP operations.

The No Action Alternative would also rely upon increased use of Livingston-Stone National Fish Hatchery during droughts to increase production of winter-run Chinook salmon. However, this component would have no adverse public health impact because it would not create environmental conditions that would be conducive to *Coccidioides* propagation in soil, mercury methylation and bioaccumulation in fish, or CHABs formation in surface waters.

X.2.3 Alternative 1

X.2.3.1 Potential changes in the potential for Valley fever related to changes in irrigated agricultural land

As discussed in Appendix R, *Land Use and Agricultural Resources Technical Appendix,* SWAP modeling results indicate that there would be an increase in irrigated agricultural acreages in the study area (i.e., the Sacramento River and San Joaquin River regions) in the average and dry water year conditions under Alternative 1 relative to the No Action Alternative. As described in Section X.1.1, generally, *Coccidioides* propagation and air entrainment occurs on soils that remain unirrigated during dry seasons, and the San Joaquin Valley and Central Coast are the major endemic regions in California. Because there would be no reduction of irrigated agricultural land in the study area under Alternative 1 relative to the No Action Alternative, there would not be an increase in the potential for Valley fever due to CVP and SWP operations under this alternative, and the increase in irrigated agricultural acreages could decrease the potential.

X.2.3.2 Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption

As described in Appendix G, modeled changes in water column concentrations of total methylmercury at 12 Delta assessment locations under Alternative 1 would have little to no measurable impact on Delta fish tissue concentrations relative to the No Action Alternative (Appendix G, Table G-27). Similarly, water operations under Alternative 1 would not contribute to additional water quality degradation with respect to water column methylmercury concentrations or increased methylmercury bioaccumulation in biota in Suisun Bay and San Francisco Bay because Delta outflow rates in all months except June would be lower than the No Action Alternative. Therefore, Alternative 1 would not result in increased health risks to humans consuming fish from the Delta, Suisun Marsh, Suisun Bay, or San Francisco Bay, relative to the No Action Alternative.

X.2.3.3 Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs

As described in Appendix G, *Water Quality*, Alternative 1 is expected to have minor, if any, impact on the environmental variables (i.e., irradiance, nutrients, water column turbulence/mixing, temperature and residence time) in the study area such that there would be an increase in the frequency or magnitude of CHABs, relative to the No Action Alternative. As such, Alternative 1 would not increase the potential for public exposure to cyanotoxins in the study area impacts.

X.2.4 Alternative 2

X.2.4.1 Potential changes in the potential for Valley fever related to changes in irrigated agricultural land

SWAP modeling results indicate that there would be a decrease in irrigated agricultural acreages in the study area in the average and dry water year conditions under Alternative 2 relative to the No Action Alternative. As discussed in Appendix R, *Land Use and Agricultural Resources Technical Appendix*, for the phases of Alternative 2[2] without Temporary Urgency Change Petitions (TUCPs) there would be decreases in irrigated acreage in the average water year condition, with reductions ranging from 4,758 acres to 6,401 acres in the Sacramento River region, and ranging from 3,806 acres to 37,982 acres in the San Joaquin River region (see Appendix R, Table R-37 for details). In the dry water year condition, across all Alternative 2

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[2] Implementation of Alternative 2 may include the Alternative 2 Without Temporary Urgency Change Petition (TUCP) Delta Voluntary Agreements (VA) phase, Alternative 2 Without TUCP and Without VA phase, Alternative 2 Without TUCP Systemwide VA phase, or Alternative 2 With TUCP Without VA phase. The Alternative 2 With TUCP Without VA phase would only be implemented as a backstop during drought.

phases there would be decreases in irrigated acreage relative to the No Action Alternative, with decreases ranging from 6,026 acres to 11,917 acres for the Sacramento River region and ranging from 20,097 acres to 53,681 in the San Joaquin River Region for phases without VAs. Decreases range in the Sacramento River region from 5,013 to 5,885 acres and in the San Joaquin River Region from 39,212 to 40,017 acres for phases with VAs (see Appendix R, Table R-39 for details). Although there would be a reduction in irrigated agricultural land in the study area under Alternative 2 relative to the No Action Alternative, conversion of this land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides*. Further, implementation of Mitigation Measure AG-1, *Diversify Water Portfolios,* described in Appendix R, would help reduce the magnitude of irrigated agricultural land conversion by encouraging water users to develop alternative sources of water.

X.2.4.2 Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption

There would be no adverse impacts on public health due to methylmercury exposure related to consumption of fish because modeled changes in water column concentrations of methylmercury show no measurable impact on fish tissue concentrations in the Delta, Suisun Marsh, Suisun Bay or San Francisco Bay under Alternative 2 relative to the No Action Alternative (Appendix G, Table G.4-1).

X.2.4.3 Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs

For the same reasons described for Alternative 1 (minor, if any, impact on the relevant environmental variables), there would be no adverse public health impacts related to an increase potential for public exposure to cyanotoxins in the study area under Alternative 2 relative to the No Action Alternative.

X.2.5 Alternative 3

X.2.5.1 Potential changes in the potential for Valley fever related to changes in irrigated agricultural land

SWAP modeling results indicate that there would be a decrease in irrigated agricultural acreages in the study area in the average and dry water year conditions under Alternative 3 relative to the No Action Alternative. There would be approximately 22,818 fewer acres of irrigated farmland in the Sacramento River region and approximately 303,764 fewer acres in the San Joaquin River region under Alternative 3 in the average water year condition (see Appendix R, Table R-44). In the dry water year condition, the Sacramento River region would have approximately 21,123 fewer irrigated acres and the San Joaquin River region would have 210,633 fewer irrigated acres relative to the No Action Alternative (see Appendix R, Table R-46). Although there would be a reduction in irrigated agricultural land in the study area, conversion of this land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether—one that is not conducive to the growth of *Coccidioides*. Further, implementation of Mitigation Measure AG-1, *Diversify Water Portfolios,* described in Appendix R, would help reduce the magnitude of irrigated agricultural land conversion by encouraging water users to develop alternative sources of water.

X.2.5.2 Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption

As described in Appendix G, Alternative 3 would not result in increased water column methylmercury concentrations or substantially increased methylmercury bioaccumulation in biota in Suisun Marsh relative to the No Action Alternative. Modeled long-term average water column concentrations of methylmercury in the Delta under Alternative 3 would not differ from those under the No Action Alternative at the modeled Delta assessment locations except for increases of 0.01 ng/L at Victoria Canal, Contra Costa Water District Pumping Plant #1, Banks Pumping Plant, and Jones Pumping Plant (Table G-54, Appendix G, Attachment 4, Table G4-16). Modeled changes in water column concentrations of total methylmercury show that Alternative 3 could have a measurable impact on Delta fish tissue concentrations relative to the No Action Alternative. All modeled fish tissue concentrations exceed the water quality objective of 0.24 milligrams per kilogram (mg/kg) wet weight (ww [350 mm largemouth bass fillets])[3] under both the No Action Alternative and Alternative 3. Average modeled fish tissue concentrations for all years increased at all modeled Delta locations by 0.01 to 0.08 mg/kg ww relative to the No Action Alternative (Appendix G, Table G-55), which indicates a substantial increase in the potential for methylmercury bioaccumulation in fish tissue. Because Alternative 3 would result in higher Delta outflow in all months except June, relative to the No Action Alternative, methylmercury loads to Suisun Bay and San Francisco Bay could potentially increase, which could result in increased methylmercury bioaccumulation in fish in these areas. OEHHA standards for the consumption of fish in the study area would continue to be implemented and, thus, would serve to protect people against the overconsumption of fish with increased body burdens of mercury.

X.2.5.3 Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs

As discussed in Appendix G, relative to the No Action Alternative, Alternative 3 would result in substantial reductions in Sacramento River flows at Freeport and San Joaquin River flows at Vernalis entering the Delta during the months June through September, when CHABs are most likely to occur. The substantial flow reductions that would occur under this alternative, relative to the No Action Alternative, in June and July in all but critical water years types; June through August for wet, above normal, and below normal years; and in June and July of dry years would be expected to increase residence time throughout many locations within the study area. Reduced Sacramento River and San Joaquin River inflows to the Delta and increased water residence times within the Delta could cause increased water temperatures at some Delta locations in some months of the June through September period. The substantial reductions in Delta inflows from these rivers may also result in reduced turbulence and mixing of water in the Delta, relative to that for the No Action Alternative. This reduction in turbulence would create a calmer water column favored by cyanobacteria. Alternative 3 would have similar impacts on nutrients and water clarity as Alternative 1, which would be minimal changes from the No Action Alternative.

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[3] The methylmercury objectives protective of human health and wildlife include a goal of not exceeding 0.24 mg/kg wet weight in muscle tissue of trophic level 4 fish (200–500 mm total length) normalized to 350 mm total length.

Based on these findings, Alternative 3 could increase the potential for public exposure to cyanotoxins in waterbodies in the study area (i.e., the Bay-Delta region).

Because Alternative 3 is expected to make CHABs worse in the Delta, greater volumes of cyanobacteria cells would be expected to flow from the Delta into Suisun Marsh, relative to the No Action Alternative. Also, salinity is typically sufficiently low within the eastern portion of the marsh to allow CHABs to form. Accordingly, Alternative 3 could adversely impact CHABs in Suisun Marsh. However, because of higher salinity levels in Suisun Bay and San Francisco Bay that typically prevent *Microcystis* and other cyanobacteria common to the Delta from producing problematic blooms in these water bodies, Alternative 3 is not expected to adversely impact CHABs in Suisun Bay or San Francisco Bay.

X.2.6 Alternative 4

X.2.6.1 Potential changes in the potential for Valley fever related to changes in irrigated agricultural land

SWAP modeling results indicate that there would be an increase in irrigated agricultural acreages in the study area in the average water year condition under Alternative 4 relative to the No Action Alternative. In the dry water year condition, the Sacramento River region would have approximately 1,889 more irrigated acres and the San Joaquin River region would have 1,907 fewer irrigated acres relative to the No Action Alternative (see Appendix R, Table R-53). Although there would be a reduction in irrigated agricultural land in the San Joaquin River region under Alternative 4 relative to the No Action Alternative, conversion of this land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides*. Further, implementation of Mitigation Measure AG-1, *Diversify Water Portfolios,* described in Appendix R, would help reduce the magnitude of irrigated agricultural land conversion by encouraging water users to develop alternative sources of water. Accordingly, a substantial increase in the potential for Valley fever due to CVP and SWP operations under Alternative 4 is not expected.

X.2.6.2 Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption

There would be no adverse impacts on public health due to methylmercury exposure related to consumption of fish because modeled changes in water column concentrations of methylmercury show little to no measurable impact on fish tissue concentrations in the Delta, Suisun Marsh, Suisun Bay or San Francisco Bay under Alternative 4 relative to the No Action Alternative, as described in Appendix G (Table G-70).

X.2.6.3 Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs

For the same reasons described for Alternative 1 (minor, if any, impact on the relevant environmental variables), there would be no adverse public health impacts related to an increase potential for public exposure to cyanotoxins in the study area under Alternative 4 relative to the No Action Alternative.

X.2.7 Mitigation Measures

The mitigation measure below relies on entities other than Reclamation to implement the measures. Because Reclamation does not have authority to implement this measure, Reclamation cannot ensure that it will be implemented. If it is implemented, it will reduce impacts on agricultural land, specifically the reduction of irrigated agricultural land acreages.

X.2.7.1 Mitigation Measure AG-1: Diversify Water Portfolios

Water agencies should diversify their water portfolios. Diversification could include the sustainable conjunctive use of groundwater and surface water, water transfers, water conservation and efficiency upgrades, and increased use of recycled water or water produced through desalination where available. Diversification would include consideration of water conservation plans and technologies for water use efficiency.

X.2.8 Summary of Impacts

Table X-1, Impact Summary, includes a summary of impacts, the magnitude and direction of those impacts, and potential mitigation measures for consideration.

Table X-1. Impact Summary

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
Potential changes in the potential for Valley fever related to changes in irrigated agricultural land	No Action	Under the No Action Alternative, flows and reservoir levels would remain as under current conditions and M&I and agricultural water deliveries would continue to vary according to available water supply, therefore the No Action Alternative is not expected to result in an increase in nonirrigated agricultural land and, thus, there would be no increased potential for growth of *Coccidioides* in the study area.	–
	Alternative 1	In both the average and dry water year conditions irrigated agricultural acreages would increase in the Sacramento River and San Joaquin River regions relative to the No Action Alternative. Therefore, there would be no increased potential for growth of *Coccidioides* in the study area	–
	Alternative 2	In both the average and dry water year conditions, irrigated agricultural acreage would decrease across the four phases in the Sacramento River and San Joaquin River regions relative to the No Action	MM AG-1

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
		Alternative. However, conversion of irrigated agricultural land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides.* To the extent that land is fallowed or idled in the long term, this would be considered a moderate adverse impact. Implementation of Mitigation Measure AG-1 would help reduce the magnitude of agricultural land conversion by encouraging water users to develop alternative sources of water.	
	Alternative 3	In both the average and dry water year conditions, irrigated agricultural acreage would decrease substantially in the Sacramento River and San Joaquin River regions relative to the No Action Alternative. Reductions would be greatest in the San Joaquin River region where *Coccidioides* is endemic. However, conversion of irrigated agricultural land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides.* To the extent that land is fallowed or idled in the long term, this would be a potential adverse impact. Implementation of Mitigation Measure AG-1 would help reduce the magnitude of agricultural land conversion by encouraging water users to develop alternative sources of water.	MM AG-1
	Alternative 4	In the average water year condition there would be an increase in irrigated agricultural acreages in the Sacramento River and San Joaquin River regions relative to the No Action Alternative. In the dry water year condition, there would be	MM AG-1

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
		relatively minor reductions in irrigated agricultural acreages in the San Joaquin River region compared to the No Action Alternative. However, conversion of irrigated agricultural land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides*. To the extent that land is fallowed or idled in the long term, this would be a minor adverse impact. Implementation of Mitigation Measure AG-1 would help reduce the magnitude of agricultural land conversion by encouraging water users to develop alternative sources of water.	
Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption	No Action	Under the No Action Alternative, it is anticipated CVP reservoirs would experience greater water level fluctuations due to climate change conditions, which could lead to increase mercury methylation and, thus, increased methylmercury concentrations in fish. However it is reasonable to assume that OEHHA standards for the consumption of fish in the study area would continue to be implemented and, thus, would serve to protect people against the overconsumption of fish with increased body burdens of mercury.	–
	Alternative 1	Water column methylmercury concentrations and methylmercury bioaccumulation in fish the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay would not be substantially affected relative to the No Action Alternative. Therefore, there would be no adverse impacts on public health due to increased methylmercury exposure.	–
	Alternative 2	Water column methylmercury concentrations and methylmercury	–

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
		bioaccumulation in fish the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay would not be substantially affected relative to the No Action Alternative. Therefore, there would be no adverse impacts on public health due to increased methylmercury exposure.	
	Alternative 3	Water column methylmercury concentrations and methylmercury bioaccumulation in biota Suisun Marsh would not be substantially affected and existing impairments would not be made worse, relative to the No Action Alternative. Water column methylmercury concentrations and methylmercury bioaccumulation in fish in the Delta, Suisun Bay, and San Francisco Bay may be affected. However, OEHHA standards for the consumption of fish in the study area would continue to be implemented and, thus, would serve to protect people against the overconsumption of fish with increased body burdens of mercury. As such, there would be no adverse impact.	–
	Alternative 4	Water column methylmercury concentrations and methylmercury bioaccumulation in fish the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay would not be substantially affected relative to the No Action Alternative. Therefore, there would be no adverse impacts on public health due to increased methylmercury exposure.	–
Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs	No Action	Under the No Action Alternative, it is anticipated reduced inflows to the Delta, warmer temperatures, and increased water residence times would occur as a result of climate change conditions. These conditions may be conducive to CHABs and could increase the bloom magnitude and duration, which could result in increased public exposure to cyanotoxins.	–

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
	Alternative 1	There would be no substantial increased risk of increased CHABs in the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay relative to the No Action Alternative. Therefore, there would be no increase in the potential for public exposure to cyanotoxins and no adverse impact.	–
	Alternative 2	There would be no substantial increased risk of increased CHABs in the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay relative to the No Action Alternative. Therefore, there would be no increase in the potential for public exposure to cyanotoxins and no adverse impact.	–
	Alternative 3	There would be a potential increased risk of CHABs in the Delta and Suisun Marsh, which could increase the potential for public exposure to cyanotoxins in and near these waterbodies. There would be no increased risk of CHABs in Suisun Bay and San Francisco Bay relative to the No Action Alternative and, therefore no increased potential for public exposure to cyanotoxins in these areas.	–
	Alternative 4	There would be no substantial increased risk of increased CHABs in the Delta, Suisun Marsh, Suisun Bay, and San Francisco Bay relative to the No Action Alternative. Therefore, there would be no increase in the potential for public exposure to cyanotoxins and no adverse impact.	–

X.2.9 Cumulative Impacts

Past, present, and reasonably foreseeable projects, described in Appendix Y, *Cumulative Impacts Technical Appendix*, may have cumulative impacts on public health and safety, to the extent that these projects could affect Valley fever occurrences resulting from changes in irrigated agricultural land, methylmercury production and resultant changes in bioaccumulation in fish for human consumption, and public exposure to cyanotoxins due to an increase in CHABs.

Past and present actions contribute to the existing condition of the affected environment in the project area while reasonably foreseeable actions are those that are likely to occur in the future that are not speculative. Past, present, and reasonably foreseeable projects include actions to develop water storage capacity, water conveyance infrastructure, water recycling capacity, the reoperation of existing water supply infrastructure, including surface water reservoirs and conveyance infrastructure, and habitat restoration actions. The projects identified in Appendix Y that have the most potential to contribute to cumulative impact on public health and safety are water supply (e.g., Sites Reservoir Project, Delta Conveyance Project, B.F. Sisk Dam Raise and Reservoir Expansion Project, Bay-Delta Water Quality Control Plan Update) and tidal habitat restoration (e.g., Prospect Island Tidal Habitat Restoration Project and Bradmoor Island Habitat Restoration Project).

The No Action Alternative would continue with the current operation of the CVP and may result in changes to public health and safety with respect to Valley fever and bioaccumulation of methylmercury in fish for human consumption. These changes may potentially contribute to cumulative impacts and were described and considered in the 2020 Record of Decision.

Higher water temperatures and potential increases in residence time in the Delta due to future climate change under the No Action Alternative may be conducive to CHABs and could increase the bloom magnitude and duration, which could result in increased public exposure to cyanotoxins. Because CVP operations would remain the same as existing conditions, operations would not make environmental conditions more conducive to CHABs. Therefore, the future climate change under the No Action Alternative may contribute to potential cumulative impacts to public health and safety by increasing the potential for public exposure to cyanotoxins.

X.2.9.1 Potential changes in the potential for Valley fever related to changes in irrigated agricultural land

Past, present, and reasonably foreseeable projects that have or would potentially result in the reduction or limitation of the availability of water for agricultural irrigation in the study area (e.g., the Bay-Delta Water Quality Control Plan Update) may create conditions suitable for *Coccidioides* growth and dispersal. In addition, the increasing frequency and severity of drought, aridity, and dust storms in California due to climate change may impact *Coccidioides* growth and spore spread, potentially leading to an increase in Valley fever infections.

There would be an increase in irrigated agricultural acreages in the study area under Alternative 1. As such, an increase in the potential for Valley fever due to CVP and SWP operations under this alternative would not be expected, and the increase in irrigated agricultural acreages could decrease the potential. There would be a reduction in irrigated agricultural land in the study area under Alternatives 2 (all phases except with the TUCP and no VA in the San Joaquin River Region) and Alternative 3 and in the San Joaquin River region under Alternative 4, potentially contributing further to adverse conditions cumulatively for Valley fever. The magnitude of this reduction would be greatest under Alternative 3. Under Alternative 3 in the average and dry water year conditions, there would be an overall reduction in irrigated agricultural land in the Sacramento River region and a substantially greater reduction in the San Joaquin River region, where *Coccidioides* is endemic. However, conversion of agricultural land to non-agricultural use would not necessarily mean that the land would be fallowed or idled; land taken out of production could be converted to a different land use altogether that is not conducive to the growth of *Coccidioides*. Further, Mitigation Measure AG-1 could reduce impacts by encouraging water agencies to diversify their water portfolios, thus, increasing the likelihood that water users would have adequate water for agricultural irrigation.

X.2.9.2 Potential changes in methylmercury production and resultant changes in bioaccumulation in fish for human consumption

Under existing conditions, mercury is present in the Delta, Delta tributaries, Suisun Marsh, and San Francisco Bay due to historical and ongoing deposition from upstream tributaries and discharge of methylmercury from wetlands adjacent to these waterbodies. A key challenge surrounds the pool of mercury deposited in Delta sediments, which cannot be readily or rapidly reduced, despite efforts to reduce future loads in Delta tributaries, and serves as a source for continued methylation and Delta biota methylmercury bioaccumulation.

Based on the modeling performed for the analysis in Appendix G, methylmercury concentrations in fish tissue are not expected to be substantially affected by Alternatives 1, 2 and 4; Alternative 3, through higher Delta outflow in all months except June, relative to the No Action Alternative, may make existing methylmercury water quality impairments in the Bay-Delta region worse and increased methylmercury bioaccumulation in fish under Alternative 3 could contribute to the cumulative water quality impacts for methylmercury in the Bay-Delta region. However, OEHHA standards for the consumption of fish in the study area would continue to be implemented and, thus, would serve to protect people against the overconsumption of fish with increased body burdens of mercury.

X.2.9.3 Potential changes in the potential for public exposure to cyanotoxins due to an increase in CHABs

Past, present and reasonably foreseeable future projects that may reduce Delta inflows during the spring to fall period, such as the Bay-Delta Water Quality Control Plan Update, could result in an incremental increase in the production of CHABs in the Delta and contribute, along with future climate change, to the adverse cumulative condition for CHABs and public exposure to cyanotoxins in the Delta. Alternatives 1, 2, and 4 would not substantially alter Delta water temperatures or residence times relative to the No Action Alternative. However, Alternative 3 may make water temperature and/or residence time conditions worse because it would result in substantial reductions in Sacramento River flows entering the Delta at Freeport and San Joaquin River flows entering the Delta at Vernalis and this could contribute to cumulative impacts for CHABs and public exposure to cyanotoxins.

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