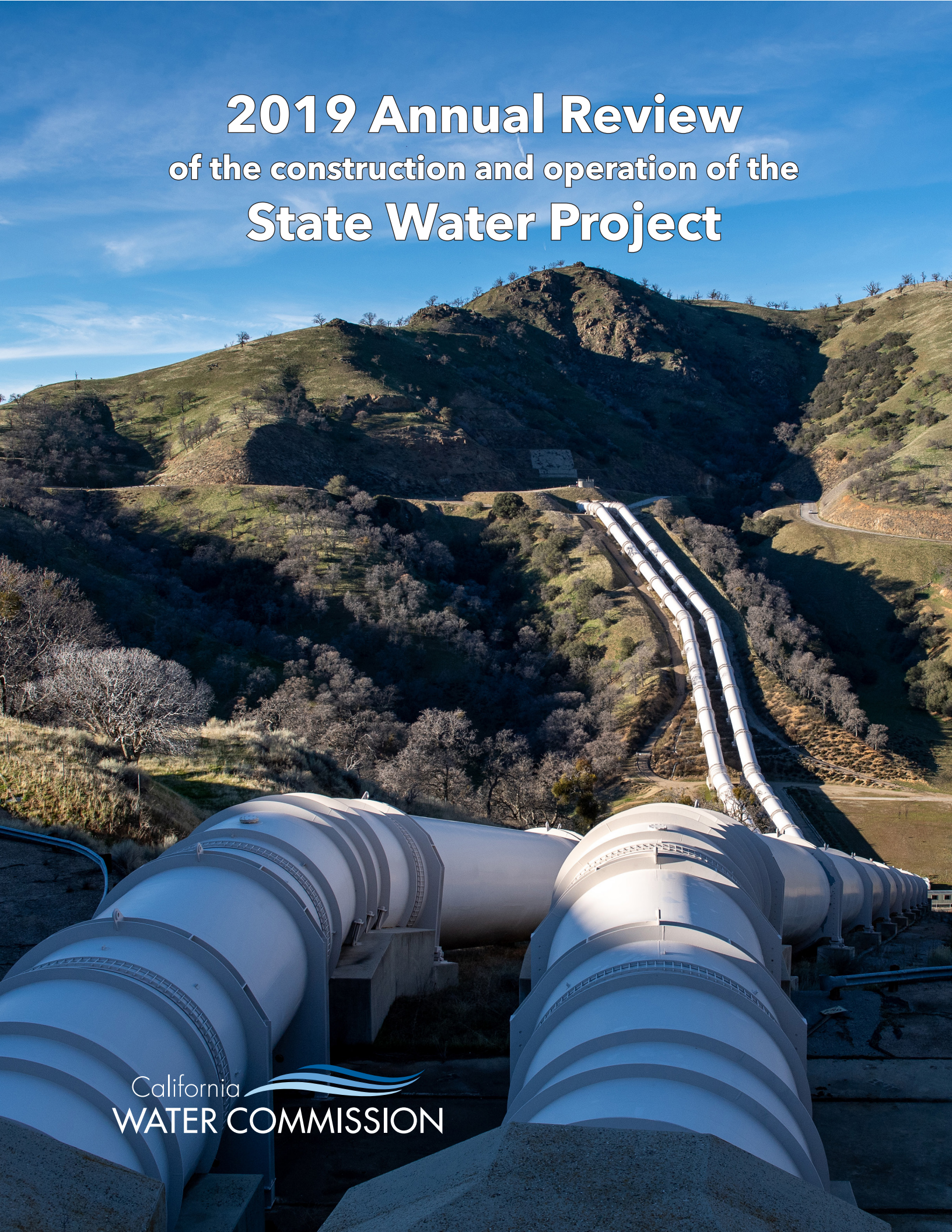
2019 Annual Review
of the construction and operation of the
State Water Project



California
WATER COMMISSION

2019 CALIFORNIA WATER COMMISSION

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Introduction

Water Code section 165 requires the California Water Commission (Commission) to conduct an annual review of the progress of the construction and operation of the State Water Project (SWP or the system). The Commission reports its findings and recommendations to the Department of Water Resources (DWR) and the Legislature. Water Code section 161 gives the Commission the responsibility to confer with, advise, and make recommendations to the Director of DWR. The Commission accomplishes this obligation by providing a forum to help the public stay informed of DWR's efforts and providing recommendations to the Department based on the information received through these interactions.

This report highlights the planning and operations in 2019. It includes findings and specific recommendations for DWR to keep the Commission apprised of operations and construction activities in 2020.

The California State Water Project, consisting of 36 water storage facilities and 700 miles of rivers, pipelines and canals, supplies water to 27 million people and irrigates 750,000 acres of farmland. The system includes 21 pumping plants, powered by a system of power-generation and power-recovery plants. DWR also purchases energy needed to operate the pumps, including the world's tallest water lift – the Edmonston Pumping Plant – which pumps water more than 1,900 feet up and over the Tehachapi Mountains into Southern California.

In 2019, the Department of Water Resources made eight presentations to the Commission on various SWP topics, including dam safety, the Feather River Fish Hatchery, the Vulnerability Assessment, DWR's Strategic Plan, the Oroville recovery program, power generation and renewable energy sources, an update on SWP construction projects, and an overview of the revised Coordinated Operations Agreement with the Bureau of Reclamation and the proposed Incidental Take Permit under the California Endangered Species Act. Commission staff worked closely with SWP staff to obtain additional information for this review.

2019 HIGHLIGHTS

Climate Change: SWP Vulnerability Assessment

DWR has a three-phase Climate Action Plan[1] to guide how DWR is addressing climate change for its programs, projects, and activities. In 2019, DWR completed the Climate Action Plan, Phase III: Climate Change Vulnerability Assessment, which is a comprehensive evaluation of DWR's vulnerabilities to projected hazards of climate change, including increased wildfire, extreme heat, and sea level rise, as well as long-term changes in hydrology. Using an approach known as "decision scaling," the SWP was modeled under a wide range of potential future climate conditions linked to temperature and precipitation. The resulting climate response function allowed quantification of the likelihood of SWP system performance declines given the large envelope of uncertainty in projected magnitudes of warming and average precipitation. Results of the Vulnerability Assessment may be found online. The expected changes to four key SWP performance measures are as follows:

- Oroville End-of-April Storage represents the amount of water the SWP has in storage at the end of the main runoff season and provides information about water supply and summer regulatory conditions. The analysis shows median storage performance at 2050 to be significantly reduced from current conditions with a loss of about 130,000 acre-feet (3.9 percent).

- Oroville Carryover Storage, which represents the amount of water the SWP has in storage at the end of the irrigation season but before winter rains begin, provides information about the drought resilience of the system. The analysis shows that this metric is highly sensitive to changes in temperature, sea level, and precipitation. Median Oroville carryover storage performance is projected to fall from a current level of 1.88 million acre-feet to 1.53 million acre-feet in 2050.

- Net Delta Outflow (NDO) describes Delta conditions and regulatory constraints that affect SWP operations necessary to maintain ecosystem conditions and water quality in the Delta. The analysis shows that changes in NDO are likely to be relatively small on an annual level. Slight shifts are seen in all seasons, with winter, spring, and fall NDO all increasing slightly. The relatively small shifts in summer

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[1] Phase I, the Greenhouse Gas Emissions Reduction Plan (GGERP), covers how DWR will help mitigate the future impacts of climate change by reducing the GHG emissions from its activities. Phase I was completed in June 2012; DWR has reduced annual GHG emissions by about 1.9 million metric tons since 1990 (approximately a 70% reduction). As reported in the Commission's 2018 Review of the State Water Project, DWR achieved its 2020 emissions reduction target five years ahead of schedule.

Phase II is DWR's framework and guidance for consistent incorporation and alignment of analysis for climate change impacts in its project and program planning activities. In 2018, DWR released its Climate Change Analysis Guidance to guide DWR managers as they incorporate climate change analyses into their decision making and planning, including strategic planning, investment decisions, risk assessments, and infrastructure development. Climate change analysis can be extremely complex, including accounting for large uncertainties about the future climate and other important future conditions. This phase ensures that all DWR planning activities meet standards for quality, scientific rigor, and consistency.

Phase III is DWR's Climate Change Vulnerability Assessment and Adaptation Plan (VA/AP), described in this Annual Review.

NDO suggest that DWR will be able to meet Delta regulatory requirements, but there will be fewer years in which summer NDO will exceed required conditions.

- SWP Deliveries describe water supply estimates for the SWP's 29 water contractors. The analysis shows that SWP deliveries are sensitive to changes in temperature, precipitation, and sea-level rise. The analysis indicates that SWP deliveries would diminish faster as precipitation decreases than they would improve as precipitation increases. SWP deliveries are found to be generally less reliable in the future, with median performance levels falling by more than 300,000 acre-feet (10 percent). The largest reductions are seen to occur in the driest years, which would place additional stress on SWP water contractors.

Other key findings of the Vulnerability Assessment include:

- All DWR field divisions and offices will experience significant increases in extreme heat (defined as the percentage increase in the number of days above 95 and 105 degrees Fahrenheit) by mid-century.

- Sea level rise will affect the Suisun Marsh by increasing inundation of mud flats and low-lying areas and causing greater variation in environmental conditions.

- Rising sea levels coupled with storm surges and storm-driven stream flows into the Delta could result in substantial increases in flood stage elevations in the Delta.

Climate change will exacerbate stresses on listed species and habitat types. According to the Vulnerability Assessment, "Warming temperatures could cause some species to migrate northward in latitude and upward in elevation, rendering mitigation parcels purchased to protect these species unsuitable in the future. Cold water fisheries, such as those on the Feather River, may be affected by warmer water in streams, leading to more species being listed as endangered and additional constraints on SWP operations. Consequently, DWR may need to take additional measures to manage or restore lands for mitigation or provide habitat for sensitive species." (Source: Vulnerability Assessment, page 16).

The decision scaling approach allowed DWR to quantify the risks and costs associated with the status quo. There is a high level of uncertainty associated with future climate conditions and the degree to which SWP facilities and operations can be adapted to ameliorate projected reductions in performance. Therefore, DWR's adaptation planning must accommodate a range of possible climate outcomes. The Phase III Adaptation Plan (AP), expected for release in 2020, will evaluate and prioritize DWR resiliency efforts such as infrastructure improvements (e.g., Delta conveyance), non-structural improvements (e.g., meadow restoration in the Upper Feather River Watershed), and operational improvements (e.g. forecast-based reservoir operations).

Executive Order N-10-19 and Delta Conveyance

On April 29, 2019, Governor Newsom issued Executive Order N-10-19, directing his administration to develop a water resilience portfolio to protect the future health of communities and the environment. The Order directed the California Natural Resources Agency, the California Environmental Protection Agency, and the

California Department of Food and Agriculture to "reassess priorities contained within the 2016 California Water Action Plan, update projected climate change impacts to our water systems, identify key priorities for the administration's water portfolio moving forward, and identify how to improve integration across state agencies to implement these priorities."

The Order instructed the three agencies to prepare a water resilience portfolio that meets California's needs through the 21st Century. Many state agencies, including the Commission, held "listening sessions" to inform the portfolio. A draft portfolio was released in January 2020—after a public comment period, the Administration released a final portfolio on July 28, 2020. The portfolio includes more than 100 separate actions, to be implemented by various state agencies, to achieve the following broad goals:

1. Maintain and diversity water supplies
2. Protect and enhance natural systems
3. Build connections
4. Be prepared

In addition, the Order called for an assessment of "current planning to modernize conveyance through the Bay Delta with a new single tunnel project." In May 2019, DWR formally withdrew its applications for all approvals associated with a twin-tunnel California WaterFix project, and announced that it would begin environmental permitting, engineering and stakeholder engagement to pursue a single tunnel solution to modernize Delta conveyance. DWR will oversee the planning effort and will be directly responsible for implementing the environmental compliance activities. The Delta Conveyance Design and Construction Authority (DCA), a joint power authority created by the public water agencies that have committed to participate in design and construction of a new conveyance, will conduct the engineering and design activities.

At the September Commission meeting, DWR Director Karla Nemeth expressed her commitment to an open and transparent planning process for a single-tunnel Delta conveyance, including opportunities to engage with stakeholders on their concerns regarding potential impacts to the Delta. Shortly thereafter, the DCA announced the establishment of a Delta Stakeholder Engagement Committee, which will represent various Delta stakeholder groups (e.g., agricultural, recreation, business, and environmental interests), and would serve as a formal advisory body to the DCA Board.

In January 2020, DWR released a Notice of Preparation (NOP) of an Environmental Impact Report (EIR) for the proposed Delta conveyance project. This action marked the first step of environmental review of the project under the California Environmental Quality Act (CEQA). The NOP also solicited comments from agencies, organizations, and members of the public regarding the scope and content of the environmental analysis in the EIR. The scoping period concluded on April 17, 2020. DWR has published a Scoping Summary Report that describes the scoping process and summarizes the comments, with the full comment letters and

A view of the Lake Oroville main spillway as rehabilitation work continues on the hillsides including grading and erosion control measures, and gravel-lined drainage at the Butte County site.
Source: Department of Water Resources

public meeting transcripts attached. The United States Army Corps of Engineers has issued a Notice of Intent to publish an Environmental Impact Statement, which started a scoping process as part of compliance with the National Environmental Policy Act. Scoping comments are due on October 20, 2020.

Oroville Spillways Update

Starting in May 2017, DWR and its construction contractors began repairing and rebuilding Oroville's main and emergency spillways. The main spillway was sufficiently repaired by November 1, 2017, to function as a flood control outlet if needed that winter. In 2018, the main spillway was fully reconstructed to final design and the emergency spillway was completed. A concrete buttress to further bolster the emergency spillway weir and an underground secant pile wall and splashpad on the hillside were constructed to prevent uphill erosion if the emergency spillway is ever used again.

On April 2, 2019, the Oroville main spillway was used for the first time since its reconstruction. DWR experts and federal and state regulators agreed that the spillway performed as designed. Its use provided room for flood storage within the reservoir.

Recreation facilities at Oroville helped shelter approximately 500 residents displaced by the November 2018 Camp Fire, which destroyed most of the Town of Paradise and portions of several adjacent small communities in the foothills of Butte County. This forced the immediate evacuation of approximately 52,000 residents; as of February 5, 2020, 44 homes have been rebuilt in the Town of Paradise. The Federal Emergency Management Agency (FEMA) requested use of 69 campsites at Bidwell Canyon Campground and Butte County requested use of 43 campsites at Lime Saddle Campground to temporarily house displaced residents.

Evacuees moved into the campgrounds beginning in December 2018; those staying at Lime Saddle had moved out by September 2019. Those staying at Bidwell were transitioned out by March 2020.

In 2019, DWR reopened public access and recreation facilities at Oroville that had been closed since reconstruction of the Oroville spillways began in 2017. In June, DWR reopened public access to Dam Crest Road and parking area, a popular attraction along the top of Oroville Dam. In August, the Spillway Boat Ramp reopened after two years of closure. New security measures for public and facility safety were also implemented at Oroville Dam, including security cameras, fencing, pop-up gates, and two security kiosks.

FINDINGS AND RECOMMENDATIONS

The Commission adopted a revised Strategic Plan in January 2020. The Plan includes a goal of carrying out its statutory authority to monitor and report on the construction and operation of the State Water Project, with three objectives that support the Commission's findings and recommendations within this annual review:

- Coordinate with the Department to remain apprised of the operations and construction activities of the State Water Project, focusing on how the SWP adapts and responds to hydrological extremes expected with climate change, restores critical ecosystems, and addresses aging infrastructure;
- Coordinate with the Department to enhance public engagement for the new Delta Conveyance Project; and
- Monitor the Department's efforts to address aging infrastructure through implementation of the asset management program, utilizing gray and green infrastructure.

Looking back on 2019, the Commission finds that:

- DWR has kept the Commission apprised on its progress in implementing its strategic plan, particularly those activities associated with modernizing SWP infrastructure, and using an asset management approach to support risk-based decision making.
- DWR Director Nemeth committed to reinvigorating the relationship with the Commission to increase interaction with the public on the activities of the SWP, and to keeping the Commission and the public informed as it plans for a single-tunnel Delta conveyance.
- DWR made good progress with inspecting its dams and spillways, developing inundation maps and emergency action plans, and integrating the SWP dam safety program with the SWP Operations & Maintenance Asset Management program.
- DWR completed reconstruction of the main and emergency spillways at Oroville and reopened important public access and recreation facilities at the reservoir.

- Some sections of the California Aqueduct south of the San Luis Reservoir have lost approximately 20 percent of conveyance capacity due to subsidence.
- Forecast Informed Reservoir Operations (FIRO) is a proposed management strategy that uses data from watershed monitoring and improved weather forecasting to enable more effective management of reservoirs. DWR, along with outside stakeholders, is exploring the use of this new strategy.
- DWR received a 10-year incidental take permit (ITP) for state-listed endangered species under the California Endangered Species Act (CESA) to allow the long-term operation of the SWP.
- DWR continues to take significant steps to address climate change and to reduce greenhouse gas emissions.

These findings set the stage for continued briefings in 2020 and beyond. The following recommendations reflect the Commission's long-term interests and ongoing issues associated with SWP operations, not all of which will be addressed in 2020. The Commission recommends that:

- DWR keep the Commission apprised of the potential role of the SWP in support of increasing groundwater recharge efforts in the State;
- DWR update the Commission on the status of emergency planning in communities within the inundation areas of SWP dams;
- DWR keep the Commission apprised on how it plans to adapt the operation of the SWP over the long term to the expected effects of climate change, including anticipated changes to deliveries, a new Delta conveyance, and ecosystem restoration efforts;
- DWR update the Commission on subsidence as it relates to the California Aqueduct and studies or plans for resolving reduced operating flexibility and capacity;
- DWR keep the Commission apprised of the information obtained through the Feather-Yuba FIRO project, and brief the Commission on the potential to apply FIRO to other reservoirs in the SWP system;
- DWR begin exploring watershed planning in the Upper Feather River watershed and the possibility for green infrastructure projects to enhance SWP operations, and brief the Commission as this work evolves;
- DWR and CDFW brief the Commission on how the ITP will affect SWP operations, as well as the condition of the four listed fish species;
- DWR continues to keep the Commission apprised on progress in achieving greenhouse gas reduction goals and the SB 100 requirement that state agencies use 100 percent emissions-free electricity by 2045; and
- DWR should keep the Commission apprised on the public engagement efforts and planning for a single-tunnel Delta conveyance project.

The Ira J. Chrisman Wind Gap Pumping Plant, located just west of Interstate Highway 5 in Kern County. The pumping plant with four discharge lines provides the third in a series of lifts culminating at the A.D. Edmonston Pumping Plant to move the water across the Tehachapi Mountains. Source: Department of Water Resources

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State Water Project Facilities
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA
Shasta Lake
Sacramento River
Antelope Lake
Lake Davis
Frenchman Lake
Grizzly Valley Pipeline
Thermalito Diversion Dam Powerplant
Thermalito Forebay
Thermalito Pumping-Generating Plant
Thermalito Afterbay
Lake Oroville
Hyatt Powerplant
Feather R.
Barker Slough Pumping Plant
North Bay Aqueduct
Cordelia Pumping Plant
Clifton Court Forebay
Skinner Fish Facility
Banks Pumping Plant
South Bay Pumping Plant
Del Valle Pumping Plant
South Bay Aqueduct
Lake Del Valle
Gianelli Pumping-Generating Plant
O'Neill Forebay
Dos Amigos Pumping Plant
San Luis Reservoir
Los Banos Reservoir
Little Panoche Reservoir
San Joaquin River
California Aqueduct
Badger Hill Pumping Plant
Devil's Den Pumping Plant
Bluestone Pumping Plant
Polonio Pass Pumping Plant
Las Perillas Pumping Plant
Coastal Branch Aqueduct
Teerink Pumping Plant
Chrisman Pumping Plant
Edmonston Pumping Plant
Tehachapi East Afterbay
Alamo Powerplant
Buena Vista Pumping Plant
Oso Pumping Plant
West Branch
East Branch
Pearblossom Pumping Plant
Quail Lake
Mojave Siphon Powerplant
Devil Canyon Powerplant
Warne Powerplant
Castaic Lake
Pyramid Lake
Castaic Powerplant (LADWP)
Silverwood Lake
East Branch Extension
Greenspot Pumping Station
Crafton Hills Pumping Station
Lake Perris
Crafton Hills Reservoir
Cherry Valley Pumping Station
Citrus Reservoir
Citrus Pumping Station
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Miles 0 25 50 100 200
Public Affairs Office 11/7/2018

OVERVIEW OF THE STATE WATER PROJECT (SWP)

Rain and melted snow collect in SWP storage facilities located within the Feather River watershed. The water flows into the Sacramento-San Joaquin Delta, where the SWP pumps deliver it to the SWP water contractors. In addition to its primary purpose of supplying water, the SWP system also provides flood protection, generates hydroelectric power, and offers recreational opportunities such as boating and hiking. Other SWP facilities, such as fish hatcheries, fish screens and passages, as well as restricted pumping schedules and cool water releases, help to preserve and protect endangered and threatened fish species.

In the 1960s, public agencies and local water districts signed long-term water supply contracts with DWR while the SWP was under construction. Today, the 29 public agencies and local water districts are collectively known as the SWP water contractors. The water supply contracts (which expire in 2035) specify the maximum amount of SWP water a contractor may request annually. However, the amount of SWP water available for delivery varies, based on rainfall, snowpack, runoff, water in reservoirs, pumping capacity in the Delta, and operating constraints that protect fish, wildlife, and Delta water quality.

California's water sustainability depends on the water quality and environmental health of the Sacramento-San Joaquin Delta. The SWP operates to limit salinity intrusion into the Delta and Suisun Marsh by allowing fresh water to flow through the Delta to the ocean. During certain times of the year, water exports are limited to protect sensitive species. As the operator of the SWP, DWR maintains the delicate balance between fulfilling the state's need for fresh water and protecting the environment.

SWP DELIVERIES AND POWER

The SWP delivered 3,049,485 acre-feet in 2019. The State Water Project contractors received an initial allocation of 10 percent which eventually increased to 75 percent by June 19, 2019.[1] During 2019, the SWP facilities (Oroville, Gianelli, Alamo, Mojave Siphon, Devil Canyon, Warne, and Castaic) generated 4,842 gigawatt hours (GWh) of energy. During the same period, the SWP used 7,662 GWh of energy. About 73 percent of this power was used by the Valley String Pumping Plants which are pumping plants in the San Joaquin Valley ranging from Dos Amigos to Edmonston Pumping Plants. The Valley String Pumping Plants work to lift the water more than 3,000 feet from the floor of the southern San Joaquin Valley, over the Tehachapi Mountains, and into Southern California.

Table 1 displays recent years' water deliveries and energy generation and usage. In general, SWP power usage increases with SWP water deliveries. Figure 1 shows that 2019 water deliveries were the fourth highest since 2006 at just over 3 million acre-feet; deliveries peaked in 2017 at 3.7 million acre-feet.

[1] The contractors' allocations were based on their maximum Table A amount, which equals 4,172,786 acre-feet for all 29 contractors combined.

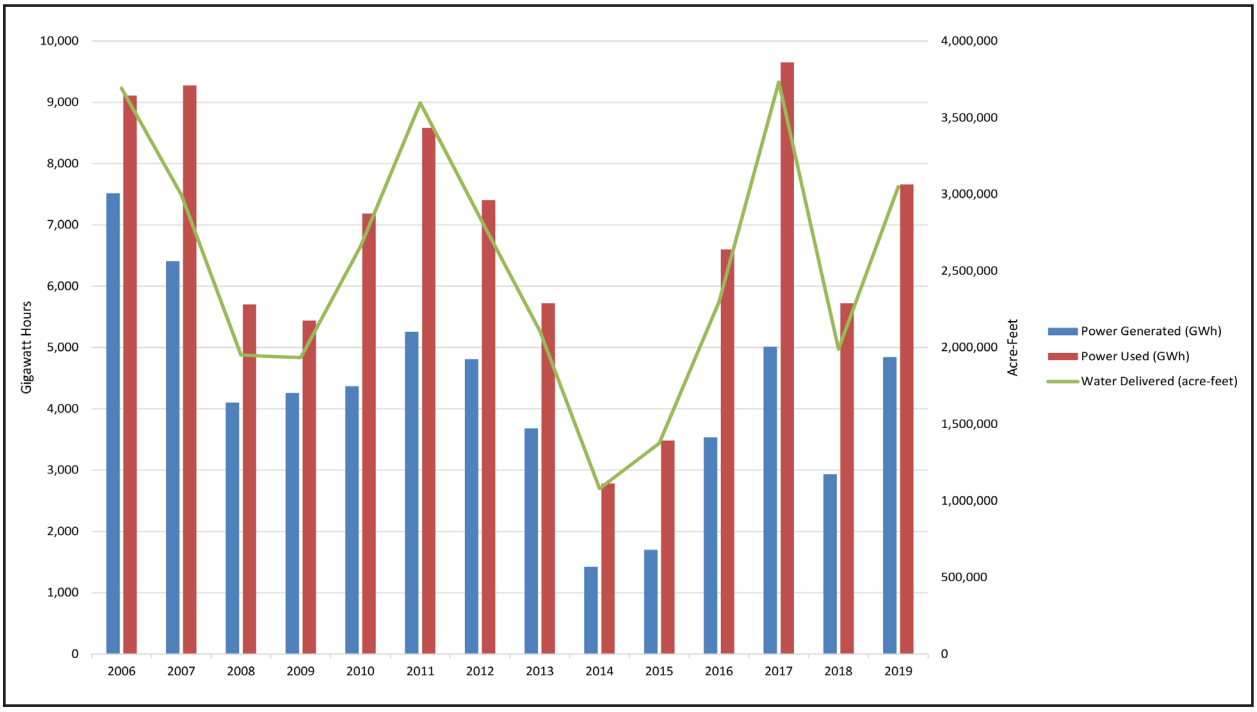
Table 1: SWP Water and Power Statistics [1]

Year	Water Delivered (acre-feet)	Power Generated (GWh/year)	Power Used (GWh/year)
2000	3,584,667	6,832	8,518
2001	2,042,118	4,588	6,358
2002	2,850,215	5,631	8,191
2003	3,167,604	6,117	8,862
2004	3,119,578	6,887	9,661
2005	3,627,004	5,661	8,282
2006	3,691,568	7,515	9,109
2007	2,996,629	6,410	9,276
2008	1,950,968	4,100	5,701
2009	1,933,735	4,255	5,438
2010	2,660,960	4,368	7,184
2011	3,596,749	5,258	8,583
2012	2,848,082	4,810	7,404
2013	2,107,572	3,679	5,721
2014	1,079,839	1,426	2,780
2015	1,375,536	1,699	3,483
2016	2,299,679	3,535	6,598
2017	3,732,527	5,011	9,652
2018	1,984,723	2,933	5,723
2019 [2]	3,049,485	4,842	7,662

[1] Source: Department of Water Resources' State Water Project Analysis Office. (In addition to Table A, reported deliveries include Carryover, Article 21, other SWP deliveries such as Settlement, Permit and Flexible Storage, and other non-SWP deliveries such as Dry Purchase, Temporary Transfer and Water Bank Recoveries.)

[2] As of January 27, 2020

Figure 1: SWP Water Deliveries and Power



ASSET MANAGEMENT

"Asset management" describes the coordinated activities of an organization to realize value from its assets. Since much of the SWP's infrastructure exceeds 50 years of age, the maintenance needs of the system have increased to require more frequent refurbishment, renewal, and replacement. DWR has adopted asset management as an approach to decision making, using all available information to make the best infrastructure investment decisions for the SWP. This includes creating a framework for lifecycle management of infrastructure by incorporating risk assessment into investment planning as well as potential threats from climate change.

The SWP Division of Operations and Maintenance (O&M) completed the O&M Asset Management Program Development Strategy in May 2017. This document describes the vision, principles, and approach to manage the SWP storage and conveyance infrastructure. The strategy includes more than two dozen asset management initiatives designed to align, develop, and/or update new tools and business processes to advance O&M's asset management practices.

Key activities in 2019 included the roll-out of new or revised business processes established in O&M's 2018 Risk Management Framework, including O&M enterprise risk and project prioritization. The program led the development of a new O&M Data and Information Management Strategy which defines the guiding principles for securely managing and sharing asset data and information between O&M business areas and partners. The program also started work on two new initiatives: Asset Register and Long-Term Investment Plan Phase 1. The Asset Register project is an effort to enhance the structure and quality of asset data

As part of the Castaic Dam Modernization Program, DWR and its contractors take core samples from the Castaic Dam's stream release chute. Castaic Lake State Recreation Area is located in Los Angeles County. Source: Department of Water Resources

stored in O&M's computerized maintenance management system to better support a wide array of asset management, maintenance, compliance, and reporting activities. Phase 1 of the Long-Term Investment Plan is developing an initial 20-year forecast of capital costs for refurbishment and replacement of the SWP's major water storage, conveyance, and support facilities. These two initiatives are planned for completion in late 2020. O&M also developed a comprehensive plan for implementing shared and related asset management, maintenance management, and dam safety initiatives.

DAM SAFETY

The Oroville Spillway incident in 2017 increased the focus on dam safety for the SWP and throughout the entire dam safety industry. In 2018, DWR updated its SWP dam safety policy, and continued making enhancements to the SWP Dam Safety Program, which includes surveillance and dam safety assessments.

In January 2019, DWR briefed the Commission on some of the changes that it is making to strengthen the dam safety program. DWR updated the Commission on the progress with the SWP dam and spillway inspections and explained how dam safety is addressed within the broader risk-informed decision making and prioritization processes of asset management.

Efforts in 2019 included further spillway inspections, emergency action plans (EAPs), and inundation map updates, Oroville facilities analysis and risk assessment workshops, and a continued alignment of the SWP Dam Safety Program with the Operations and Maintenance Asset Management Program Initiatives. DWR completed inundation maps for 15 SWP dams and submitted nine EAPs to the California Office of Emergency Services (Cal OES) for approval in 2019.

The following table shows the SWP dams, classified by hazard level, and the status of inundation maps:

Table 2: Status of SWP Dam Emergency Action Plans		
Dam	DSOD Hazard Classification	DSOD Inundation Map Approval
Castaic Dam	Extremely High	7-Feb-2019
Pyramid Dam	Extremely High	7-Feb-2019
Cedar Springs Dam	Extremely High	19-Aug-2019
Perris Dam	Extremely High	6-Nov-2019
Del Valle Dam	Extremely High	22-Oct-2019
Thermalito Afterbay Dam	Extremely High	in progress
Crafton Hills Dam	High	22-Oct-2019
Patterson Dam	High	13-Nov-2019
Bethany Dams	High	5-Nov-2019
Dyer Dam	High	4-Oct-2019
Antelope Valley Dam	High	13-Nov-2019
Frenchman Dam	High	13-Nov-2019
Grizzly Valley Dam	High	12-Nov-2019
Thermalito Diversion Dam	High	5-Nov-2019
Thermalito Forebay	High	6-Nov-2019

The hazard classification is based solely on potential downstream impacts to life and property should the dam fail when operating with a full reservoir. This hazard is not related to the condition of the dam or its appurtenant structures.

DWR staff assess the gated and emergency spillway for the Pyramid Dam Modernization project in Los Angeles County. Source: Department of Water Resources

In 2019, DWR began programs to reduce seismic and hydrologic risk at four dams:

Pyramid Dam Modernization Program (Los Angeles County) In September 2019, DWR began assessments of the condition of the facility and possible improvements to the emergency and gated spillways. The gated spillway is used approximately once per year and the emergency spillway has never been used. DWR wants to continue safe operations of the gated spillway and emergency spillway if used. Field investigations will be completed in early 2020 and evaluations are planned for completion in 2022.

Castaic Dam Modernization Program (Los Angeles County) In October 2019, DWR began an assessment of the integrity of a 60-foot-wide rectangular concrete chute used to pass natural flows from Castaic Lake into Castaic Lagoon. DWR will conduct additional assessments of the dam, spillway, intake towers, and other associated structures to ensure that the dam continues to operate safely and reliably. The modernization efforts of the dam facility are expected to take about 10 years.

Perris Dam Remediation Program (Riverside County) DWR began retrofit work in October 2019 on the outlet tower bridge, which is a part of the Perris Dam complex. The bridge work, which is the second of three Perris Dam seismic retrofit projects, includes modifications to the bridge support and seat. The tower bridge retrofit is expected to be completed by fall of 2020.

Sisk Dam (Merced County) DWR and the U.S. Bureau of Reclamation completed final environmental impact statement/report and initiated geotechnical explorations for seismic retrofit of Sisk Dam in 2019.

COORDINATED OPERATIONS WITH THE CENTRAL VALLEY PROJECT (CVP)

In 2019, the Commission received a briefing on the agreement between DWR and the Bureau of Reclamation, reached in late 2018, that updated how the SWP and CVP will be operated to meet environmental regulations. The Coordinated Operations Agreement (COA), essentially a water rights settlement between the SWP and the CVP, was reached in 1986. The COA Addendum is the first formal adjustment to that agreement. It defines how the state and federal water projects share water quality and environmental flow obligations imposed by regulatory agencies. The Addendum addresses how the project will meet the State Water Resources Control Board's Decision 1641, the water quality control plan for the Bay-Delta, specifying the relative contributions for both projects to meet in-basin needs. The other most notable adjustment in the COA addendum was establishing proportional shares to meet when there are export constraints on the south Delta. It also called for more frequent and streamlined regulatory reviews when there are changes to the Bay-Delta system.

INCIDENTAL TAKE PERMIT UNDER THE CALIFORNIA ENDANGERED SPECIES ACT (CESA)

DWR pursued a 10-year incidental take permit (ITP) for state-listed endangered species under CESA to allow the long-term operation of the SWP. There are four listed species: spring-run Chinook, winter-run Chinook, Delta smelt and long-fin smelt. All except the long-fin smelt are also listed under the federal Endangered Species Act. Previously, incidental take of the three federal species was permitted under federal biological opinions issued by federal fishery agencies. The SWP received its incidental take coverage under CESA through a "consistency determination" with the federal ESA. Under DWR's new approach, the SWP will have a state permit for all four species; CESA coverage will be independent of any changes in the federal law.

The SWP released a draft Environmental Impact Report (DEIR) in November 2019 in support of the ITP application. According to the DEIR:

The Proposed Project – Long-Term Operation of the SWP—continues DWR's state water quality control plan objectives under the State Water Resources Control Board's Decision 1641. The Proposed Project continues fall habitat operations, includes a different approach to achieving salinity standards, and includes an adaptive management approach to evaluate the efficacy of the long-term operations. Under CESA, the SWP must minimize or fully mitigate incidental take of listed species.

DWR received the ITP and final Notice of Decision in March 2020. Implementation is underway.

FORECAST INFORMED RESERVOIR OPERATIONS

The Yuba-Feather Rivers system has a long history of catastrophic floods. The Oroville Dam and the New Bullards Bar Dam are operated in a coordinated fashion to help manage the down-stream flood risk on these rivers. DWR is working with the Yuba Water Agency, owner and operator of New Bullards Bar Dam and Reservoir, U.C. San Diego, Scripps Institution of Oceanography, Center for Western Weather and Water Extremes (CW3E), the National Oceanic and Atmospheric Administration, the US Army Corps of Engineers, and the National Weather Service to assess the potential of Forecast-Informed Reservoir Operations (FIRO) to better anticipate and to better manage large storm events while also improving their ability to supply water.

> *"Over the last decade, scientific knowledge about the Delta ecosystem and its relationship to water operations has grown, largely due to new science that has been developed through collaborative processes since the issuance of the existing ESA and CESA authorizations for current SWP operations. The Long-Term Operation of the Central Valley Project and State Water Project (Proposed Project) ... incorporates this new science, as well as information about the current status of listed species, to develop updates to the long-term SWP operations. The operational updates are designed to minimize adverse environmental effects, particularly with respect to listed species and water quality, on accounting for operational restrictions based on species as well as on environmental conditions such as salinity and turbidity. For example, the Proposed Project would provide for pumping restrictions for the protection of listed species to be triggered in most water year types, which would be more often than under current project operations." (DEIR, pp. 1-2)*

FIRO includes investments in atmospheric river research, including ocean reconnaissance and land-based monitoring of atmospheric conditions and snow levels. A preliminary study indicated FIRO could significantly reduce flood risks in Yuba and Sutter Counties. The FIRO program may inform a future update of the water control manuals for both rivers, which date back to the early 1970s. The FIRO results will also inform decisions made on projects identified through the Oroville Dam Safety Comprehensive Needs Assessment. It may also determine the need for other structural changes at New Bullards Bar Reservoir.

AQUEDUCT SUBSIDENCE

Over-pumping of groundwater in the San Joaquin Valley has caused significant land subsidence. In 2017, DWR produced the California Aqueduct Subsidence Study (CASS) to analyze the effects of this subsidence on SWP aqueducts and flood control structures. The study found that the continual subsidence along the western edge of the San Joaquin Valley, both north and south of Kettleman City, has altered the hydraulic profile of sections of the California Aqueduct.

A section of the California Aqueduct that conveys water between the Buena Vista and John R. Teerink Pumping Plants within Kern County. Source: Department of Water Resources

In 2019, DWR completed a supplemental report to the CASS, with new data, analysis, and modeling of the effects of land subsidence within a 10-mile-wide study corridor centered the California Aqueduct in the San Luis and San Joaquin Field Divisions, south of San Luis Reservoir. The supplemental report predicted future subsidence rates and refined the analysis of the impacts of subsidence based on updated hydraulic modeling. The main findings are as follows:

- Subsidence bowls have reduced local conveyance capacity by 20 percent in some areas. This creates bottlenecks, impeding the ability to provide water during periods of peak demand (e.g. summer months for agriculture). Currently, the aqueduct can convey the same total capacity, although at a slower rate and with less flexibility, leading to increased energy and operational costs.

- Evidence to date indicates that subsidence due to hydrocarbon production in the Lost Hills Oil Field does not extend east to the aqueduct.

- Recent trends in agricultural land use (shift toward permanent crop plantings) have hardened demand for groundwater, potentially exacerbating subsidence rates along the aqueduct.

The supplemental report also predicted future rates of subsidence, taking into consideration past patterns of agricultural land use and Central Valley Project (CVP) water deliveries, as well as variations in rainfall. The CASS found that for the San Luis Field Division, the most rapidly subsiding parts of the subsidence bowls will lose, on average, an additional two feet of freeboard within the next several decades. A variation of the model, using shorter term higher rate withdrawals, predicts that some low points in the San Luis Field Division pools could lose an additional two feet within the next five to 10 years if recent patterns of California climate, CVP allocations, land use, and groundwater withdrawal continue into the next decade.

Continuing subsidence could increase the cost to deliver water and could significantly reduce the availability of delivered water during peak demand periods. To compensate, higher loading conditions (beyond the original designed capacity) could increase the frequency of aqueduct failures, resulting in more unplanned outages. Loss of aqueduct capacity will also reduce DWR's ability to shift the largest load on California's electrical power grid to periods when renewable generation is abundant.

Although the report does not describe how DWR might address the subsidence problem, it notes that the subsidence predictions could be misleading. Because the projections are based on extrapolating past trends into the future, changes to any of the contributing factors (long-term agricultural land use change, multi-year drought, variations in annual SWP and CVP deliveries, etc.) would alter the actual rates of subsidence. For example, the Sustainable Groundwater Management Act (SGMA) requires that groundwater use be managed to eliminate its contribution to land subsidence by 2040. As groundwater sustainability agencies phase in practices leading to full implementation of SGMA, subsidence rates could decline.

STATUS OF SWP ECOSYSTEM RESTORATION

DWR and the Bureau of Reclamation coordinate operations of the SWP and the CVP to comply with the Endangered Species Act. Restoration efforts are underway to comply with two federal biological opinions on the status of five fish species.

NATIONAL MARINE FISHERIES SERVICE BIOLOGICAL OPINION

In 2009, the National Marine Fisheries Service (NMFS) issued its Biological Opinion and Conference Opinion on the Long-term Operation of the CVP and SWP (2009 NMFS BiOp). The NMFS BiOp determined that proposed CVP and SWP operations were likely to jeopardize the continued existence of four federally-listed anadromous fish species: Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, and Southern Distinct Population Segment (DPS) North American green sturgeon. The NMFS Operation BiOp called for more reliable fish passage through the Yolo Bypass.

The NMFS BiOp sets forth Reasonable and Prudent Alternative (RPA) actions to ensure SWP and CVP operations remain in compliance with the federal Endangered Species Act (ESA).

- Action 1.6.1 of the RPA requires creating 17,000 to 20,000 acres of salmonid floodplain rearing habitat.
- Action 1.7 of the RPA requires reducing migratory delays and mortalities of federally listed fish species within the Yolo Bypass.

An excavator breaches a levee for the Tule Red Tidal Restoration Project, the first restoration project to break ground in compliance with the U.S. Fish and Wildlife mandate for 8,000 acres of tidal habitat to protect threatened or endangered species. The breach allowed brackish tidewaters to return to more than 400 acres of habitat for Delta smelt, longfin smelt, and Chinook salmon. Source: Department of Water Resources

The 2018 SWP Annual Review described three projects being undertaken to comply with this NMFS Operation BiOp: the Wallace Weir Fish Rescue Facility, the Fremont Weir Adult Fish Passage Modification Project, and the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project. Their status is as follows:

Wallace Weir Fish Rescue Facility Project

The Wallace Weir is a water control structure on the Knights Landing Ridge Cut where it enters the west side of the Yolo Bypass. The earthen dam, which washes away during high flow events, was replaced with a permanent structure that prevents migration of salmon and sturgeon into the Knights Landing Ridge Cut and Colusa Basin Drain, where there is no upstream route for them to return to the Sacramento River and spawn. The project, which also includes a facility to allow for efficient trapping and relocation of fish to the Sacramento River, completed construction in 2018 and was commissioned in early 2019. It is now in its operations and maintenance phase which is being done in cooperation with Reclamation District 108 and California Department of Fish and Wildlife (CDFW).

Fremont Weir Adult Fish Passage Modification Project

Built in 1924, the primary purpose of the Fremont Weir is to allow overflow waters of the Sacramento River, Sutter Bypass, and Feather River into the Yolo Bypass. A fish ladder built in 1965 was opened to provide fish passage immediately following overtopping events at the Fremont Weir, which occur on average once every two to three years, however, this ladder provided insufficient passage for adult salmon and

does not provide passage for adult sturgeon. The Fremont Weir Adult Fish Passage Modification Project improves salmonid and sturgeon passage in the Yolo Bypass through the construction of a new wider and deeper operable gate structure and wider and deeper channels. DWR is the lead operator of the facility in coordination with CDFW. Construction was completed in 2018, and the new structure was first used in January 2019. DWR is the lead on operating the facility in coordination with CDFW. During project commissioning operations in 2019, DWR used sonar-imaging technology to monitor fish passage for a subset of the period where flow passed through the structure. During this brief period, DWR recorded roughly 80 sturgeon successfully passing through the newly constructed structure, the first ever recorded data of sturgeon passing the Fremont Weir. Design features that resulted in some channel erosion during the initial operations of the structure in 2019 were improved upon to eliminate this issue.

Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project

This project intends to improve fish passage and increase floodplain fisheries rearing habitat in Yolo Bypass and the lower Sacramento River basin. The project includes a new Fremont Weir headworks structure, a new outlet channel, and downstream channel improvements, each of these a component of the three different proposed outlet channel alignments (east, center, and west) in the Yolo Bypass. Each channel alignment terminates downstream into the existing Tule Pond. In addition, to improve fish passage, the project will also include modification to an agricultural road crossing in the Yolo Bypass. The final environmental documents for this project were issued in 2019. Alternative 1 from the environmental document was selected as the preferred alternative. This alternative would allow up to 6,000 cubic feet per second (cfs) to enter the Yolo Bypass from a gated notch on the east side of the Fremont Weir to enhance fish passage and juvenile rearing habitat for up to 30,000 acres in the Yolo Bypass. DWR and Reclamation are currently securing permits for the project and preparing engineering plans and specifications. Construction of the project is planned to begin in late 2021.

U.S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION

In 2008, the U.S. Fish and Wildlife Service issued its Biological Opinion on the Long-term Operation of the CVP and SWP (USFWS Operation BiOp). The USFWS Operation BiOp determined that proposed CVP and SWP operations were likely to jeopardize the continued existence of federally-threatened Delta smelt. The USFWS Operation BiOp sets forth RPA actions that would allow SWP and CVP operations to remain in compliance with the federal ESA. Action 6 under RPA 4 requires the creation or restoration of a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun marshes to improve habitat conditions for Delta smelt by enhancing food production and availability.

Aerial view looking south of Winter Island in the Sacramento-San Joaquin Delta near Antioch, California. Source: Department of Water Resources

DWR is pursuing implementation of this action through the Fish Restoration Program in conjunction with CDFW. These projects also provide floodplain habitat for protected salmon. To date, DWR has more than 8,000 acres of tidal habitat restoration projects in various stages of planning. In terms of actual construction, the following were completed in 2019:

Decker Island

DWR completed construction of the Decker Island Tidal Habitat Restoration Project in October 2018. Approximately 110 acres of tidal restoration credits are expected for this project. DWR has begun post-construction monitoring and maintenance of this site.

Tule Red Restoration Project

After breaking ground in September 2016, construction of the Tule Red Tidal Habitat Restoration Project was completed in October 2019. Approximately 610 acres of tidal restoration credits are expected for this project. Post-construction permitting requirements and monitoring are currently in progress.

Winter Island Tidal Habitat Restoration Project

Construction of the Winter Island Tidal Habitat Restoration Project was started and completed in 2019. Approximately 544 acres of tidal restoration credits are expected for this project. DWR has begun post-construction monitoring and maintenance of this site.

Yolo Flyway Farms

DWR completed construction of the Yolo Flyway Farms Tidal Habitat Restoration Project in October 2018. Approximately 294 acres of tidal restoration credits are expected for this project. DWR has begun post-construction monitoring and maintenance of this site.

For all four of these completed projects, DWR is working with federal and state resources agencies to finalize the documentation necessary for those agencies to formally award the restoration credits. In addition, DWR is competing the planning and design on seven additional tidal restoration projects. The current estimate is that these projects, along with the completed projects listed above, will give DWR more than 8,000 acres of credit for Delta smelt tidal habitat. These projects also are expected to provide floodplain habitat credits for protected salmon. All projects are expected to be constructed by 2024.

The following tidal restoration projects are in the planning phase and are expected to be completed by 2022:

Prospect Island Tidal Habitat Restoration

The restoration is being done in conjunction with CDFW to convert roughly 1,500 acres of flooded uncultivated land to fully tidal habitat. After two years, which would allow time for the re-vegetation of disturbed soils, the site will be breached to allow full tidal action. A Final EIR was released in 2019, and permitting work continues.

Lookout Slough Tidal Habitat Restoration and Flood Improvement

In partnership with Ecosystem Investment Partners, the Fish Restoration Program (Division of Environmental Services) and the Division of Multi-benefit Initiatives are undertaking a multi-benefit tidal restoration and flood improvement project at Lookout Slough, which aims to restore approximately 3,000 acres to a tidal wetland, creating habitat and producing food for Delta smelt and other listed fish species. The project will also provide flood protection by expanding flood conveyance and storage for the Yolo Bypass. A draft EIR was released in December 2019.

Arnold Slough Tidal Habitat Restoration

The Arnold Slough project will restore approximately 161 acres of managed wetland to tidal wetland. Located in eastern Suisun Marsh, the slough was seasonally flooded as a duck club. Construction of the restoration site is planned to begin and be completed in 2022.

Bradmoor Island Tidal Habitat Restoration

DWR purchased 744 acres at Bradmoor Island for the purpose of restoring approximately 500 acres of managed wetland to tidal habitat. The project's restoration activities include water management, revegetation, and removal of levee segments to restore tidal inundation to the property and promote the establishment of emergent marsh vegetation. Construction of the restoration site is planned to begin in 2022 and completed in 2023.

Wings Landing Tidal Habitat Restoration

Wings Landing is adjacent to Paytonia Ecological Reserve and contains ideal elevations for the restoration of approximately 254 acres of tidal marsh habitat. The project design seeks to restore tidal and sub-tidal marsh habitat through the excavation of channels, breaching of an existing levee, and the removal of an

interior levee and water control structures. Construction of the restoration site is planned to begin in 2021.

Chipps Island Tidal Habitat Restoration

DWR is currently in the design phase to improve aquatic habitat at Chipps Island for native fishes, plants, and wildlife. Primary objectives of the restoration include increasing connectivity within the island, increasing tidal exchange, enhancing pelagic and marsh-based productivity, and increasing aquatic edge habitat. Chipps Island restoration will be designed to be self-sustaining and promote resilience to future change, including climate change, sea level rise, and invasive species.

STATUS OF SWP CONSTRUCTION PROJECTS

This section highlights key projects and those projects of interest to the Commission. It is not a comprehensive list of SWP construction projects.

Thermalito Restoration Project

The Ronald B. Robie Thermalito Pumping–Generating Plant, part of the Oroville complex, suffered a catastrophic fire in 2012 that rendered the plant inoperable. A fire clean-up project removed damaged plant components and hazardous materials resulting from suppressing the fire and was completed in April 2014. The Restoration Project commenced in 2015 to restore the plant's electrical, protection, controls, and communications systems. The plant is being modernized to maximize fire protection and life safety, enhance reliability, reduce maintenance, and minimize unplanned outages. Full operation of the plant will provide as much as 300,000 megawatt hours annually and potentially restore SWP pump-back operational flexibility. The Restoration Project, which includes all four units restored to full operation, was completed in August 2020. Unit 4 was returned to commercial operation in late 2019.

SWP Fire Modernization Project

This program – implemented in response to the 2012 fire at Thermalito Pump-Generating Plant – includes fire detection and alarms, fire suppression systems, protected egress routes, HVAC modifications, and new domestic and water lines. In the Oroville Field Division, they are currently testing and commissioning. The San Luis Field Division design is currently under review by Office of the State Fire Marshal, with construction estimated to begin in May 2020. In the San Joaquin Field Division, the program is at 10 percent design review, with construction expected to start January 2022.

California Aqueduct Canal Liner and Embankment Repair Project

Governor Edmund G. Brown California Aqueduct is approximately 444 miles in length and conveys and stores water for 27 million people. Thirty repair sites were identified through O&M's Condition Assessment Program between 2016 and 2019, including multiple panel replacement and repair methodologies. The project was completed in March 2019.

SWP Pipeline Condition Assessment Project

O&M is investing in new technologies for performing Pipeline Condition Assessments that do not require dewatering, including SmartBall technologies for leak detection and PipeDiver technologies for detecting broken prestressed wires in a prestressed concrete cylinder pipe. In the South Bay Aqueduct Pipeline System, North Bay Aqueduct Pipeline System and Santa Ana Pipeline, all leaks were validated and repaired or planned. An increase in wire breaks were found in the Santa Ana Pipeline. A structural analysis was performed on the entire system.

Gianelli Pump-Turbine, Generator, and Valve Refurbishment Project

The William R. Gianelli Pumping-Generating Plant is a joint use facility shared with the USBR and the CVP. It is used to pump up to 11,000 cfs of water from the California Aqueduct into the San Luis Reservoir for storage, and to generate electricity when water from San Luis is released back into the aqueduct. The pump-turbine units have been repeatedly repaired since their installation in the 1960s. The turbine refurbishment included casing overlay, wear ring replacement, and new coating. The motor generator rewind saw the replacement of the 120 RPM and 150 RPM stator coils, and the replacement of the 120 RPM rotor poles. The butterfly valve refurbishment included weld overlay repair, integrated metal seats and mechanical lock. Four out of the eight units have had the major refurbishment complete at this point. DWR is performing major refurbishment on the fifth unit. This is the first major refurbishment of the units and will ensure 50 additional years of service.

Chrisman Pumping Plant Apron Repair Project

The Ira J. Chrisman Wind Gap Pumping Plant is located at the base of the Tehachapi mountains and pumps water, through four large diameter and above ground discharge lines, over a hill before the aqueduct returns to a gravity canal. In November 2018, damage to the concrete apron under the discharge lines was observed. The repair project included removing and replacing the existing broken concrete panels and placing reinforcing steel and backfill. The work was completed March 2019.

Cedar Springs Dam Spillway Under Drain Repairs and Access Road Improvements

Cedar Springs Dam on Silverwood Lake, has an uncontrolled (ungated) spillway. The dam stores 75,000 acre-feet of water on the SWP's East Branch, overlooking San Bernardino. This project is an outcome of the Phase I Spillway Inspection and Condition Assessment effort. The project includes excavation of original backfill, replacement of longitudinal drain, inspection and cleaning of underdrains, new construction of access roads. and access to the spillway for long term monitoring and accessibility.

Tehachapi Crossing Inspection and Repair Project

This is a vital SWP conveyance artery through the Tehachapi Mountains that consists of four concrete tunnels and a steel siphon from Edmonston Pumping Plant to Check 41 which run more than seven miles with 5,300 cfs capacity. In January

DWR contractors use three-dimensional terrestrial LiDAR (laser scanning) to inspect and survey the Carley V. Porter tunnel, which is 20 feet in diameter and runs more than 25,000 feet across the Tehachapi Mountains in Kern County. Source: Department of Water Resources

2019 the tunnels and siphon underwent a full comprehensive inspection for the first time since being put into operation. After a 3-D tunnel scan, visual structural inspection and non-destructive testing, an emergency concrete repair triggered by damage observed in Carley V Porter Tunnel was completed.

An aerial view of the gated and emergency spillways at Pyramid Dam and Lake, a reservoir near Castaic in Los Angeles County. Source: Department of Water Resources

Pyramid Emergency and Concrete Spillways Investigation

Pyramid Dam and Lake are in Los Angeles County near Castaic and provide water storage for the greater Los Angeles area. This project is Phase II of the Spillway Inspection and Condition Assessment effort and follows 2018 Phase I investigation. Subsurface geophysics (depth of weathering) data collection was completed in July 2019. Rock coring is 33 percent complete, geologic mapping is 90 percent complete, and laboratory testing of rock core samples for geotechnical properties began in November 2019. Concrete coring of the gated spillway is 92 percent complete. Connectivity testing, instrument installation, and outfall drain cleaning and reinspection started October 2019.

CONCLUSION

This document fulfills the Commission's requirement to review the progress of the construction and operation of the State Water Project. The Commission has determined that DWR is working to address the SWP's aging infrastructure, has revised operations in response to increasingly uncertain hydrology and warmer temperatures, and should continue to keep the Commission apprised of operations and construction activities in 2020. These findings and recommendations will be presented to the Department and the Legislature.

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