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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	TESTIMONY OF JOHN BEDNARSKI

I, John Bednarski, do hereby declare:

I. INTRODUCTION

My name is John Bednarski. I am the manager of the Water Supply Initiatives Section at the Metropolitan Water District of Southern California (MWD). Since 2011, I have participated with DWR in the conceptual design and overall engineering program management of the California WaterFix (CWF) and I am a member of the engineering program management team (Engineering Team) for the CWF. I am a registered Civil Engineer in California and have been with MWD for over 25 years. My experience with MWD includes leading project design and construction teams of various facilities of MWD's conveyance, treatment, and distribution system. (Exhibit DWR-17.)[1]

My testimony is submitted to provide the engineering project description for the CWF facilities. The engineering project description is based on the engineering completed to-date for the CWF and is described in detail in the Conceptual Engineering Report, Modified

[1] Exhibit DWR-17 is a true and correct copy of my Statement of Qualifications.

Pipeline/Tunnel Option- Clifton Court Pumping Plant, Volume 1, July 2015 (CER).[2] (Exhibit DWR-212.)

This testimony focuses on potential construction impacts that could affect other users of water and measures to mitigate any impacts.[3] Construction impacts having the potential to affect other users of water are generally limited to potential impacts to existing water supply facilities and potential impacts to groundwater levels. With respect to water quality effects from construction-related activities, as described in the EIR/EIS, because Best Management Practices (BMPs) will be implemented for all activities that may result in discharge of soil, sediment, or other construction-related contaminants to surface water bodies, and because authorization for the construction activities will be obtained under the State Water Board's NPDES Stormwater General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002), no adverse water quality effects to beneficial uses from construction-related activities would occur.[4] My testimony also addresses the potential for flooding and seepage impacts, although these potential impacts are not strictly related to potential affects on other users of water. My testimony is organized in three broad areas: (1) engineering overview of the CWF features; (2) description of the major CWF components, potential effects to water users from construction; and mitigation of

[2] DWR, Metropolitan Water District of Southern California, and consultants prepared the CER. Exhibit DWR-212 is a true and correct copy of the CER.

[3] Other potential impacts and mitigation measures are described and analyzed in the Recirculated Draft Environmental Impact Report/Supplemental Environmental Impact Statement (RDEIR/SDEIS) and will be addressed to the extent necessary in testimony submitted in Part 2 of this hearing.

[4] See SWRCB-3, RDEIR/SDEIS Appendix A, Chapter 8, Impact WQ-31. "CEQA Conclusion: Because environmental commitments would be implemented under Alternative 4 for construction-related activities along with agency-issued permits that also contain construction requirements to protect water quality, the construction-related effects, relative to Existing Conditions, would not be expected to cause or contribute to substantial alteration of existing drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality objectives/criteria, or substantially degrade water quality with respect to the constituents of concern on a long-term average basis, and thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities would be temporary and intermittent in nature, the construction would involve negligible discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected environment. As such, construction activities would not contribute measurably to bioaccumulation of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse. Based on these findings, this impact is determined to be less than significant. No mitigation is required."

effects (3) and measures taken for flood protection.

The information presented in this testimony is based on a conceptual-level of design, which will continue to be refined in future engineering phases. However, any future refinements in preliminary and final design will utilize the mitigation measures described herein and will not result in any effects on other users of water beyond the scope of the discussion contained in this testimony.

II. OVERVIEW OF TESTIMONY

The CWF consists of five key features: three intakes located in the North Delta, tunnels, forebays (Intermediate and Clifton Court), a pumping plant, and an operable gate at the Head of Old River (HORG). Each feature is described in this testimony.

Construction activities with the potential to affect legal users of water are described, as well as measures to avoid effects or to mitigate effects if they cannot feasibly be avoided. Potential effects include temporary and permanent displacement of existing diversions due to the construction of the new intake facilities, impacts to existing agricultural irrigation canals and drains due to construction of certain surface features, and potential groundwater effects due to dewatering activities at the intake and forebay sites. Impacts to existing diversions and existing irrigation canals and drains will be mitigated by providing replacement infrastructure to maintain the existing levels of services. Potential groundwater effects will be mitigated by the use of impermeable slurry and diaphragm cutoff walls at dewatering sites to isolate the effects dewatering activities on the surrounding groundwater.

Modifications to Federal Flood Control Project levees under the jurisdiction of United States Army Corps of Engineers (USACE) and Central Valley Flood Protection Board (CVFPB) will be addressed to the satisfaction of those regulatory bodies through Section 408 permitting process.

III. ENGINEERING OVERVIEW

The new SWP water conveyance facilities proposed for the CWF would introduce new operational flexibility into the SWP and CVP by enabling SWP or CVP water to be diverted from the Sacramento River in the north Delta and conveyed to the south Delta or to be directly diverted in the south Delta at existing SWP and CVP facilities. The proposed facilities would allow water to be diverted through new fish-screened intakes located on the east bank of the Sacramento River between Clarksburg and Courtland. Three intakes are proposed, each with a capacity of 3,000 cfs. The intakes would be situated on the river bank and would range from 1,259 to 1,667 feet in length. Water would flow from the intakes through north tunnels to an Intermediate Forebay. From there, the water would flow by the force of gravity through two 30-mile long, 40-feet diameter main tunnels to the south Delta. A new pumping plant would lift water into the north cell of the redesigned Clifton Court Forebay. Alternatively, at certain river hydraulic conditions, the water can flow by gravity into the north cell of Clifton Court Forebay. The redesigned forebay would allow for water flowing from the north Delta facilities to be isolated from water entering Clifton Court Forebay from the south Delta.

A. ENGINEERING REFINEMENTS

A major focus of the Engineering Team throughout the conceptual design phase for the CWF has been on developing engineering refinements that could reduce environmental impacts and address community concerns and improve operational flexibility and efficiency.

By 2013, significant changes to the proposed water facilities and operations reduced the overall project footprint by one-half of its original size, which greatly minimized community impacts. In 2014, the water facilities were further refined based on further engineering analysis and in consideration of feedback received during the 2014 public comment period. Exhibit DWR-220[5] summarizes the refinements in the project facilities that have been achieved.

More specifically, the changes to the project achieved through the engineering refinements:

- Reduce construction impacts on Delta communities and the environment,

[5] Exhibit DWR-220 is a true and correct copy.

- Reduce power requirements,
- Increase the use of state-owned property,
- Allow for gravity flow at certain river conditions.

Specific changes to the project include:

- Revise the new intake facilities to eliminate pumping plants and permanent power lines from each intake site and make refinements to the sedimentation basin design, which reduce construction impacts.
- Minimize construction activities on Staten Island, which provides important sandhill crane habitat, by removing: major tunnel construction activities, large reusable tunnel material (RTM) storage areas, a barge landing site, and high-voltage power lines.
- Reduce impacts to private landowners by relocating project features to property already owned by DWR and reducing the acreage of lands needing to be acquired from private and other landowners.
- Eliminate two of three tunnel crossings beneath federal flood control project levees by realigning tunnel alignments.
- Eliminate the need for new permanent high-voltage power lines to the intake locations in the north Delta, including near Stone Lakes National Wildlife Refuge.
- Allow water to flow from the Sacramento River and through screened intakes, initial tunnels, an intermediate forebay, main tunnels, and into Clifton Court Forebay entirely by gravity at certain river stages (previously, all flows provided by the CWF had to be pumped, regardless of river conditions).
- Eliminate impacts on Italian Slough (near Clifton Court Forebay) by removing an underground siphon.
- Reduce tunnel operation and maintenance costs.

The elimination of the three separate two-story pumping plants along a 5-mile stretch of the Sacramento River between Clarksburg and Courtland was part of extensive engineering analysis and refinement of the conveyance system hydraulics that determined that it is not necessary to build pumping plants adjacent to each intake to move the water from the river and into tunnels. Instead, water could be moved from the river into tunnels and then to a new consolidated pumping plant constructed 40 miles away entirely by gravity. The pumping plant would be situated on DWR property at the southern end of the tunnels near Clifton Court Forebay. With this change, three 46,000-square-foot buildings at the intake sites would not be needed to house pumping plants; nor would permanent transmission lines, substations, and surge towers be needed at the intake sites. Facilities at the intakes would continue to include fish screens in the river, sedimentation basins, drying lagoons, access roads, and control gate structures.

Additional intake design refinements include converting previously-proposed concrete sedimentation basins into two earthen bays at each intake site. This change eliminates the need to drive hundreds of piles into the ground, reduces equipment noise and truck trips, and significantly reduces the volume of concrete needed to build the intakes. This modification is expected to reduce the number of piles at each intake site by about 75 percent. The design refinements also eliminate the temporary relocation of State Route (SR) 160 by realigning the highway over widened levee sections prior to commencing construction of the intake structures. The modifications would help preserve the views from SR 160 between Hood and Walnut Grove.

Throughout the conceptual design development of the project facilities, the Engineering Team has sought to optimize the engineering from a construction, operation and maintenance standpoint while simultaneously striving to reduce environmental impacts and to minimize potential disruption and dislocation of Delta residents. These objectives will continue to be pursued as the project design moves from the conceptual to more detailed levels of design.

B. SUMMARY OF MAJOR PROJECT FACILITIES AND DESIGN CRITERIA

With the refinements above, the major facilities and associated components proposed for the CWF include the following:

- Three screened on-bank intake facilities along the Sacramento River sized to provide maximum approach velocities of 0.20 feet per second under operating conditions. (Exhibit DWR-212, Section 6.1.)
- North tunnels to convey water from the intakes to the Intermediate Forebay. (Exhibit DWR-212, Sections 11.1.)
- An Intermediate Forebay to receive flow from each intake facility and provide for equal splitting of the gravity flow delivery through dual main tunnels to the North Clifton Court Forebay. (Exhibit DWR-212, Section 14.1.1.)
- Dual main tunnels with vent/access structures along the alignment to convey water from the Intermediate Forebay to North Clifton Court Forebay. (Exhibit DWR-212, Section 11.1.)
- Existing Clifton Court Forebay facility will be divided into two parts: North Clifton Court Forebay and South Clifton Court Forebay.
- North Clifton Court Forebay will receive water from the main tunnels in order to isolate that water from the existing Clifton Court Forebay.
- South Clifton Court Forebay will function as a replacement of the current Clifton Court Forebay. South Clifton Court Forebay will consist of the southern portion of the existing Clifton Court Forebay, with expansion to the south into Byron Tract. (Exhibit DWR-212, Sections 14.1.2 and 14.1.3.)
- Pumping plant located at the northeast corner of North Clifton Court Forebay. (Exhibit DWR-212, Section 7.1.)
- HORG: An operable gate to reduce migration of San Joaquin River watershed salmonids into the South Delta through the Old River and to maintain water quality in the San Joaquin River. The gate will be located where the San Joaquin River and Old River diverge. (Exhibit DWR-212, Section 17.1.)
- High-voltage power lines in the vicinity of Clifton Court Forebay to power the pumping plant.

- Borrow sites: Borrow areas and areas identified for the storage and/or disposal of spoil, RTM, and dredged material. (see SWRCB-3, RDEIR/EIS Mapbook Figure 3-4.)
- Footprint mitigation: As described in the draft Biological Assessment and discussed in the testimony of Ms. Pierre, the project includes a suite of Environmental Commitments primarily in the form of habitat restoration, protection, enhancement, and management activities necessary to offset the footprint and operational impacts from construction of the intake facilities. Of relevance to this testimony, is the up to 4 linear miles of channel margin enhancement to offset the impacts from the intake facilities.

The CWF alignment and facility locations are shown in Exhibit DWR-213, Location of Facilities. (Exhibit DWR-212, Section ES.1.)

The major engineering design criteria reflecting management decisions and that guided the conceptual design for the CWF includes the ability to:

- Deliver up to 9,000 cubic feet per second (cfs) (maximum capacity) to the North Clifton Court Forebay through three 3,000 cfs on-bank river intakes.
- Protect fish with state of art screened intakes (on the Sacramento River and with the installation of the HORG), the basis of which will be discussed in Part 2 of the hearing.
- Provide for operational reliability and flexibility through the use of two parallel 40-feet diameter main tunnels and a 9,000 cfs pumping plant.
- Isolate water supply from existing rivers and sloughs.
- Deliver water to the SWP/Central Valley Project (CVP) export pumping plant approach canals downstream of their respective fish collection facilities.
- Withstand a 200-year flood event with the sea level rise predicted from climate change. (Exhibit DWR-212, Section 3.5.)
- All facilities designed and constructed to withstand maximum considered earthquake loads for the region.

Exhibit DWR-214 illustrates a CWF conveyance schematic. More detailed facility information is available in Exhibit DWR-212.

IV. DESCRIPTION OF THE MAJOR CWF FACILITIES, POTENTIAL EFFECTS, AND MITIGATION

A. INTAKE AND SEDIMENTATION FACILITIES

DWR proposes to construct three intake facilities on the east bank of the Sacramento River (identified as intakes No. 2, 3, and 5 in Exhibit DWR-212, Section 6.1), each with a maximum diversion capacity of 3,000 cubic feet per second (cfs). The 3,000 cfs diversion capacity of each of the proposed intake facilities, their locations, and the "on bank" design were selected based on recommendations from and consultation with the Fish Facilities Technical Team. The Fish Facilities Technical Team was made up of fisheries experts (biologists and engineers) from several State and Federal agencies (U.S. Fish and Wildlife Service, NOAA National Marine Fisheries Service, California Department of Fish and Wildlife, DWR, and US Bureau of Reclamation) as well as private consultants (CH2M Hill, Science Applications International Corporation, The Bay Institute, Black and Veatch, and OttH2O). (Exhibit SWRCB-4, Appendix 3F-Intake Analysis; DWR-219, Fish Facilities Team Technical Memo.)

Basic criteria used by the Fish Facilities Technical Team for site selection included, in no particular order, a site's ability to: minimize effects to aquatic and terrestrial species, maintain a diversion structure's functionality, provide adequate river depth (bed elevations from LIDAR and bathymetry data), provide adequate sweeping flows (positioning along the river), maintain flood neutrality, and minimize effects to land use and community (roadways, structures).[6]

i. Intake Facilities

Exhibit DWR-215 illustrates the intake facilities, which consist of fish screens, sedimentation basins, isolation gates, flow control gates, sediment drying lagoons, and

[6] More details on how these criteria were used in the site selection are documented in the 5-Agency Technical Recommendations for the Location of BDCP Intakes 1-7, December 2011.

electrical power/control equipment. The three intakes along with sedimentation basin facilities will be on-bank structures with state of the art fish screens similar to the Sacramento River intakes owned by the Freeport Regional Water Authority, Glenn-Colusa Irrigation District, and Tehama-Colusa Canal Authority. Each of the three sites will vary slightly in terms of bathymetric conditions and design river levels. All of the intakes are sized to provide approach velocities of less than or equal to 0.20 feet per second (fps) at an intake flow rate of 3,000 cfs at the design water surface elevation.[7] The design water surface elevation for each site was established at 99 percent exceedance (Sacramento River stage) elevation. (Exhibit DWR-212, Section 6.1.1.1.)

There will be six separate screen bay groups per intake facility. The fish screen bay groups are separated by piers with appropriate guides to allow for easy installation and removal of screen and solid panels as well as the flow control baffle system and stop logs. Exhibit DWR-216 shows an isometric view of an intake bay.

A common plenum area behind each screen bay group collects and funnels the flow towards intake collector box conduits located at the back of the intake structure. The intake box conduits include isolation slide gates which will be closed during the periods of extremely high river stage. An emergency electrical power source (an engine-generator) may be used to close the electrically actuated slide gates during concurrent periods of high river stage and utility power outage. (Exhibit DWR-212, Section 6.1.1.1.)

The configuration of the intake structure from the screen face to the intake box conduits on the back wall, including the flow baffles, will be evaluated in detail using computational fluid dynamics and physical modeling during the next engineering phase. The goal is to configure the structure so that uniform flow patterns through the fish screens are achieved under all operating conditions.

ii. Intake Conduits

Each intake consists of 12 intake collector box conduits. The box conduits are sized

[7] The sweeping velocity of less than or equal to 0.20 fps is the state and federal fish agencies' recommendation for protecting Delta smelt. See Exhibit DWR-219.

to minimize hydraulic losses and provide operating velocities to keep sediments in suspension. The intake collector box conduits extend through a widened levee section and terminate with a wing wall transition structure located in the sedimentation basins. The length of each box conduit is approximately 375 feet, which allows for construction of permanent relocation of State Route 160 as part of the initial construction sequencing. (Exhibit DWR-212, Sections 6.1.1.2 and 15.1.)

It was determined that the most effective way to ensure proper flow control/distribution among the three intakes was to install meters and slide gates in each collector box just downstream of the intake common plenum. (Exhibit DWR-212, Section 6.1.1.2.) The flow rate in each box conduit will be controlled by an electrically actuated slide gate that can be modulated up and down to adjust flow. Flow measurement within each box conduit will be provided by a multipath ultrasonic flowmeter. Each flow control slide gate will be modulated by its dedicated flowmeter, allowing for independent operation of each intake box conduit and maximum flexibility to vary flow within each fish screen bay and between each of the three intake facilities. Flow control slide gate positions will be calibrated at system start-up and proper gate positions will be regularly confirmed as a part of normal system operations. Stop logs provided at each end of the intake channels and can be installed as necessary to allow for dewatering of the box conduits, removal of any accumulated sediments, and maintenance and repair of the slide gates and flowmeters. (Exhibit DWR-212, Section 6.1.1.2.)

iii. Sedimentation System

Major components of the sedimentation system at each intake site consists of twin unlined-earthen sedimentation basins on the landside for sediment capture; hydraulic dredging equipment and sludge conveyance piping for annual removal of accumulated sediments in the earthen basins; and sediment drying lagoons for drying and consolidating prior to disposal. (Exhibit DWR-212, Section 6.1.2.)

iv. Outlet Structure

The vertical shafts that will be used for tunnel excavations at each of the intakes will be converted to outlet shafts once the tunnels are completed. (Exhibit DWR-212, Section 6.1.2.5.) The outlet shaft is centrally located between the two earthen sedimentation basins at each of the intakes. Each outlet shaft will receive flow from each pair of sedimentation basins and deliver water directly to the tunnels. The outlet shaft elevation is set above the 200-year flood level with Sea Level Rise. The outlet will normally be open except, when the basin is being dredged or during the 200-year flood to avoid large sediment loads entering into the tunnels. (Exhibit DWR-212, Section 6.1.2.5.)

v. Construction Steps and Sequencing

Construction of the intake and sedimentation facilities will consist of the following major steps:

- Clear and grub, remove unsuitable materials
- Construct slurry cutoff wall (non-structural) along river and along perimeter of landside facilities
- Construct dewatering system
- Excavate to subgrade for intake conduits and new Highway 160
- Construct intake conduits and new Highway 160; transition traffic to new roadway
- Construct diaphragm cutoff wall (structural) along riverbank
- Construct and drain in-water cofferdam
- Excavate between diaphragm cutoff wall and cofferdam
- Install intake structure foundation piles and construct intake structure
- Excavate for outlet shaft and landside facilities
- Construct outlet shaft and landside facilities

vi. Effects to Surface Water Diversions

Construction activities and the permanent footprints associated with physical project features have the potential to create conflicts with existing river diversions in certain areas; specifically, the intake landside and channel margin habitat. With respect to the latter, as noted in the testimony of Jennifer Pierre, the channel margin habitat will be sited to avoid existing river-bank structures such as water diversions, and therefore construction of channel margin habitat will not displace existing water diversions. The intakes, however, cannot be configured to avoid existing diversions within the footprint areas. Thus construction activities for the intake could disconnect existing diversion facilities from the farmland they serve.

The Project is committed to implement measures to ensure that the water supply for water right holders is maintained at all times during CWF construction. Through the use of the State Water Resources Control Board's water rights database[8], conceptual engineering plans, and site visits, the Engineering Team identified existing water diversions that will be effected at the proposed intake sites. (Exhibit DWR-221[9]; Exhibit DWR-217.) Any as yet unidentified diversions will be assessed consistent with the approach described below. Effects to diversions could be temporary or permanent depending on their locations relative to the proposed intake facilities. The diversions that are located within the intake structure footprint and require relocation are considered to be permanently effected, while the diversions that are located upstream or downstream of the intake structures and within the State Route 160 realignment footprint are considered to be temporary effects. Construction activities associated with realignment of SR 160 are estimated to take between 12 and 18 months.

Based on the above effect criteria, five existing diversions (three at Intake 2 and two at Intake 5) would be permanently effected by construction of new conveyance facilities, and ten diversions (three at Intake 2, five at Intake 3, and two at Intake 5) would be temporarily effected during construction activities. For permitted diversions that are impacted, the Project will ensure that water deliveries are maintained in the quantities consistent with the applicable water rights. The Engineering Team has developed the following measures, one or more of which would be implemented depending on site specifics and location of the existing water right diversions.

For temporarily effected diversions:

[8] Electronic Water Rights Information Management System, or eWRIMS.
[9] Attached as Exhibit DWR-221 is a true and correct copy.

- Provide new groundwater wells or temporary river diversion and pumping capabilities
- Provide alternate water supply from a permitted source; such as trucking in water or negotiating to provide water from adjacent land owners
- Once construction is completed, reactivate original diversion and discontinue temporary measures

For permanently effected diversions:

- Provide mitigation measures listed above until the mitigation measures listed below are completed
- Relocate existing diversions outside of the intake structure footprint
- Provide a new turnout from the proposed CWF sedimentation basins

All alternative sources would meet current and appropriate requirements for permitting, water quality, and, as necessary, fish screening. The Department will implement this mitigation through the following steps:

- Prior to commencement of construction activities, the Department will perform field studies to document characteristics of existing diversions and verify that all existing water right diversions that will be impacted during construction have been identified.
- The Department will contact affected water users and notify the nature and impacts expected during construction.
- Working with the affected water right holders and through the use of available records, the Department will determine the current use of the existing diversions, amount and quality of water diverted, and the properties that the diversions are used for. Where records are not available, the Department will perform field tests as necessary to establish baseline water diversion quantities, qualities, and delivery patterns consistent with applicable water rights.
- Based on the above information, and in consultation with the affected water rights holders, the Department will develop and implement substitute water supplies that

ensure that the baseline water deliveries are maintained.

- The Department may assist with securing permits and will design and construct the facilities to meet all applicable legal, regulatory and engineering standards for the substitute water supply (e.g. relocated diversions or wells), and pay for the implementation of selected mitigation measure(s).

i. Potential Effects to Groundwater Levels

The proposed dewatering approach for construction will include the installation of slurry cutoff walls prior to dewatering the construction site. Installation of slurry cutoff walls will be utilized to mitigate the potential effects on surrounding groundwater levels during construction, as well as to facilitate the construction activities. Potential effects to groundwater from construction activities were analyzed in the RDEIR/SDEIS,[10] (Exhibit SWRCB-3.) However, the analysis represents a worst-case scenario because the analysis did not take slurry cutoff walls into consideration. A May19, 2016 memo from Gwendolyn Buchholz, CH2MHill to Russ Stein, DWR provides updated information and results for the Final EIR/EIS based on the use of slurry cutoff walls to reduce the extent of dewatering activities during construction of the conveyance facilities and the use of a combination of toes drains, interceptor wells and, and soil grouting to reduce the potential for seepage onto lands adjacent to the forebays during operations of the conveyance facilities.[11] The memo concludes that as a result of the updated project description, the potential adverse effects to groundwater due to construction and operation of the conveyance facilities will not be adverse.

Dewatering for the construction of proposed intakes, as well as for the pumping plant, forebay embankments, and tunnel shafts will be performed within hydraulically isolated areas using cofferdams, slurry or diaphragm cutoff walls. Therefore, the influence of dewatering on the groundwater table outside of these hydraulically isolated areas is expected to be minimal and limited to the immediate vicinity of the proposed excavation.

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[10] See Section 7.3.3.9, Appendix A of the RDEIR/SDEIS.
[11] Attached as Exhibit DWR-218 is a true and correct copy of the May19, 2016 memo from Gwendolyn Buchholz, CH2MHill to Russ Stein, DWR.

The potential groundwater effects along the tunnel alignments are limited to the locations where there is a shaft and these effects will not be adverse due to the use of diaphragm cutoff wall construction techniques at each shaft site. (Exhibit DWR-212, Figure 3-1.)

Throughout the construction and operation of the project, DWR will implement measures to minimize effects on groundwater levels.[12] The intake sedimentation basin embankments, as well as the embankments at the Intermediate Forebay and the modified Clifton Court Forebay, will be constructed with impermeable cutoff walls to control seepage flow. In addition, toe drains would also be constructed to collect any seeped water along the embankments and pump it back into the forebays. (Exhibit DWR-212, Sections 14.1.1.1, 14.1.2.1, and 14.1.3.1.)

Based on the project features (cutoff walls and toe drains), and the mitigation measures to be implemented during construction described above, the intake facilities, as well as the shafts, pumping plants and forebays, are not expected to have significant on-going effects to groundwater during construction or operation. Before construction begins, geotechnical studies will be completed[13] and a monitoring program will be put in place to monitor groundwater effects.[14] All engineering designs and contractor activities will be conducted to minimize groundwater effects and comply with permit requirements.

B. TUNNELS

The CWF relies primarily on tunnels to convey water south from intakes along the Sacramento River to the Banks and Jones export pumping facilities near Tracy. Tunnel details, including proposed alignment, length, depth, and lining requirements, will be refined as geotechnical data becomes available during the next stages of project design.

The CWF tunnel alignment is currently divided into seven reaches: three North tunnels and four Main tunnel reaches. The size of each tunnel reach is dictated by the hydraulic requirements necessary to move the design volumes of water by gravity to the pumping plants at Clifton Court. The North tunnels (north of Intermediate Forebay) are

[12] For more detail, see RDEIR/SDEIS, Section 7.3.3, Appendix A, Mitigation Measures GW-1 and GW-5.
[13] SWRCB-3, RDEIR/SDEIS, Appendix A, Environmental Commitment 3B.2.1.
[14] SWRCB-3, RDEIR/SDEIS, Appendix A, Mitigation measure GW-5, Section 7.3.3.

designated as Reaches 1 through 3, while the Main tunnels are designated as Reaches 4 through 7. (Exhibit DWR-212, Figure 3-1.)

The conceptual tunnel inverts range from 122 to 135 feet below mean sea level (msl) for the North tunnels and from 147 to 163 feet below msl for the Main tunnels. The conceptual tunnel invert elevations are based on assumed ground conditions with liquefiable soil at the upper strata near the surface. Additional geotechnical investigation will be required during the next engineering phase to finalize the tunnel profile.

Reach 1 conveys water from the shaft at Intake No. 2 to the junction structure of intake No. 3. A single bore 28-feet inside diameter tunnel with a flow capacity of 3,000 cfs will be constructed from the shaft to the junction structure at Intake No. 3. (Exhibit DWR-212, Section 3.2.)

Reach 2 conveys water from the Junction Structure of Intake No. 3 to the intermediate forebay. The reach is a single bore 40-feet inside diameter tunnel with a flow capacity of 6,000 cfs that is sized to convey the combined flows of Intakes 2 and 3 to the intermediate forebay. (Exhibit DWR-212, Section 3.2.)

Reach 3 conveys water from intake No. 5 to the Intermediate Forebay. This reach is a single-bore tunnel with an inside diameter of 28-feet and a flow capacity of 3,000 cfs.

Reaches 4 to 7 consist of two parallel, 40-feet inside diameter tunnels to convey the flow (9,000 cfs) from the Intermediate Forebay to North Clifton Court Forebay. The tunnels are constructed from a combination of launching and receiving shafts along the alignment. Each tunnel is constructed from individual shafts, resulting in two shafts per work site, except possibly at Bouldin Island. On Bouldin Island the conceptual engineering envisions that four tunnel reaches will be driven: two northbound and two southbound. This site may require four construction shafts. (Exhibit DWR-212, Section 3.2.) The Bacon Island and Staten Island shafts are reception shafts for adjacent tunnel reaches.

ii. Tunnel Excavation Methods

The tunnels will be constructed using closed-face pressurized soft ground tunnel boring machines (TBMs) in alluvial soils (soft ground) at depths greater than 100 feet with relatively high groundwater pressures and earth pressures. Pressurized face mechanized TBMs include Earth Pressure Balance (EPB) machines and slurry TBMs. (Exhibit DWR-212, Section 11.2.5.)

Based on the conceptual design, the tunneling methodology for the CWF would likely be a closed-face EPB TBM. The TBM shield supports the excavation until the precast segmental liner is erected at the end of the shield. Proper use of the EPB allows precise control of water in-flows to the tunnel as well as the amount of material removed at the face of the TBM excavation, which greatly reduces the potential for over-excavation and resulting surface settlement.

iii. Tunnel Support

Based on the conceptual engineering, a single-pass tunnel liner system is chosen to balance water conveyance requirements, project schedule, and construction cost. (Exhibit DWR-212, Section 11.2.6.) Coupled with modern TBM technologies in the anticipated ground conditions, the tunnel liner system will consist of precast concrete segmental liner with bolted and gasketed joints. The segmental liner will be designed to support external earth pressures; groundwater pressures; internal operating pressures; seismic loads; and construction loads due to routine handling and TBM thrust forces during mining operations. The segments are bolted together at the circumferential and longitudinal joints. The finished ring formed by the segments is smaller than the excavated tunnel cylinder, so the annular space between the segmental ring and the ground will be pressure grouted to provide full contact for support. The rubberized gasketed joints on the tunnel segments are compressed into place during segment placement and will effectively limit water ingress or egress from the tunnel during its design life. Pressure grout is typically injected through the tail shield of the TBM, which provides full circumferential liner support to ensure successful performance of the tunnel system to prevent water migration around the segment joints. This lining system and tunneling methodologies will minimize potential effects to groundwater during construction and operation.

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iv. Excavated Material Disposal

The excavated material will be saturated with water and might be plasticized due to the use of biodegradable additives (e.g. foam or soil conditioner). [(Reusable Tunnel Material Testing Report, March 2014). Details on disposal and reuse of tunnel material are described in Section 3B.2.18, Appendix A, Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS)]. (Exhibit SWRCB-3.) Treatment and disposal of the decant liquids from the excavated material will require permitting in accordance with current National Pollutant Discharge Elimination System (NPDES) and Regional Water Quality Control Board regulations.

v. Potential Groundwater Effects

The normal operation of the TBM will not require dewatering in the ground around the tunnel alignment. As the tunneling progresses, the tunnel bore is sealed with concrete liners and the annular space between the concrete liners and the bore will be sealed using pressure grout. This sealing action and the concrete liners prevent seepage between the surrounding groundwater and the tunnel. (Exhibit DWR-212, Section 11.2.6.)

The construction of shafts associated with the tunnel construction will employ the use of diaphragm cutoff walls as described for the intake facilities. The use of these walls coupled with the proposed groundwater monitoring will ensure that no significant groundwater effects will occur from construction of the shafts.

vi. Potential Effects to Agricultural Irrigation Canals and Drains

As noted in the RDEIR/SDEIS, the footprint for surface disturbance areas related to the conveyance facilities would cross or interfere with agricultural delivery canals and drainage ditches. Implementation of mitigation measures will include relocating or replacing agricultural infrastructure in support of continued agricultural activities and thus would not result in adverse effects due to these interferences. (Exhibit SWRCB-3, section 14.3.3.9.) The process for relocating or replacing affected agricultural delivery canals and drainage ditches will follow the same overall framework as previously described for dislocated river water diversions.

C. FOREBAYS

The CWF includes a new intermediate forebay in the South Delta and modifying existing Clifton Court Forebay for the following applications. (Exhibit DWR-212, Section 14.1.):

- The Intermediate Forebay is a pass-through facility that collects water from the three intakes and evenly distributes the combined flows into the two Main tunnels. The Intermediate Forebay provides an atmospheric break at the inlet to the Main tunnels from the Intermediate Forebay to North Clifton Court Forebay.[15] The Intermediate Forebay allows for independent operation of the North tunnels and the Main tunnels, enabling isolation of each tunnel for maintenance
- The existing Clifton Court Forebay will be divided into two forebays: North Clifton Court Forebay, which will take water from the tunnels, and South Clifton Court Forebay, which will receive water through operation of the existing Clifton Court intake gates. The South Clifton Court Forebay will be expanded from the existing Clifton Court Forebay into the tract area adjacent and immediately to the south. North Clifton Court Forebay provides daily operational storage to equalize and balance differences between inflow from the tunnels and water exported by Banks and Jones pumping plants.

vii. Intermediate Forebay

The Intermediate Forebay will be located southwest of Glanville Tract and just east of Pearson District. The Intermediate Forebay bottom will be at approximately -20 feet elevation. At the outside toe of the forebay embankment the surface area footprint is approximately 97 acres. (CER, Section 14.1.1.2.)

The embankment crest elevation for the Intermediate Forebay would be approximately +32.2 feet, which includes considerations for flooding and Sea Level Rise. The embankment cross-section would consist of engineered fill placed on suitable foundation material at a 4H:1V slope on both the water and land sides of the embankment.

[15] An atmospheric break provides the system with an open water surface.

The embankment crest is 32 feet wide, which consists of a 24-foot-wide, two-way maintenance access road with 4-foot shoulders on each side. Slurry cutoff walls below the embankment will hydraulically isolate this structure from the surrounding groundwater during construction. The water side of the new embankment will include stone slope protection (riprap or other appropriate linings) from the toe of the embankment to the crest. The results of the conceptual stability analyses of Intermediate Forebay embankment slopes of 4H:1V were determined to be acceptable in regards to slope stability under all the conditions analyzed. (Exhibits DWR-212, Section 14.1.1.3 and DWR-209.) Additional stability analyses will be performed after the completion of site specific geotechnical exploration.

viii. North Clifton Court Forebay

North Clifton Court Forebay will be designed to be hydraulically isolated from other Delta waterways. The only source of water will be from the main tunnels. The only outlet from North Clifton Court Forebay will be the new approach channel connecting to the existing Banks Pumping Plant approach channel and Jones Pumping Plant approach canal. (Exhibit DWR-212, Section 14.1.2.)

The area of the proposed North Clifton Court Forebay is within the existing Clifton Court Forebay perimeter embankment, with a new divider embankment separating Clifton Court Forebay into two cells. (Exhibit DWR-212, Section 14.1.2.1.) The water surface area of North Clifton Court Forebay is approximately 806 acres at minimum pool elevation (Elevation +1.1 feet).

The North Clifton Court Forebay would be dredged to the approximate original design elevation of Clifton Court Forebay Elevation -5.0. (Exhibit DWR-212, Section 14.1.2.2.) Available soil information shows that soils within the vicinity of NCCF North Clifton Court Forebay consist predominantly of silty and fine sand. It is estimated that approximately 50 percent of the dredged materials will be reusable for embankment construction, levee fortifications, and other applications within the Delta.

The North Clifton Court Forebay will be developed by constructing an embankment within the existing Clifton Court Forebay embankment and a divider embankment through the middle of the existing Clifton Court Forebay. The embankment crest elevation for the North Clifton Court Forebay, divider embankment, and the new approach channel will be at +24.5 feet, which includes considerations for flood levels and sea level rise. (Exhibit DWR-212, Table 3-4.) The toe of the new embankment is set at 25 feet from the toe of the parallel existing embankment or levee. Excavation at the toe of the existing embankment and levees might require the use of tied-back sheet piles, dewatering, and other geotechnical precautions to prevent failures of existing embankments and levees.

The embankment cross-section consists of engineered fill placed on suitable foundation material at a 4H:1V slope on both the water and land sides of the embankment. The embankment crest is 32 feet wide, consisting of a 24-foot-wide, two-way maintenance access road with 4-foot shoulders on each side. The water side of the new embankment includes riprap or other appropriate lining. The results of the conceptual stability analyses of North Clifton Court Forebay embankment slopes of 4H:1V were determined to be acceptable in regards to slope stability under all the conditions analyzed. (Exhibits DWR-212, Section 14.1.2.3 and DWR-209.) Additional stability analyses will be conducted as part of next engineering phase.

ix. South Clifton Court Forebay

The South Clifton Court Forebay will be designed to retain the existing Clifton Court Forebay operational criteria. (Exhibit DWR-212, Section 14.1.3.1.) When water is being diverted at the existing diversion facilities, flow will continue to be diverted off of West Canal through the existing intake control structure. The outlet from the proposed South Clifton Court Forebay will remain the same as existing Clifton Court Forebay.

The South Clifton Court Forebay is necessary to enable the Banks Pumping Plant to maximize its operation when electrical power rates are lowest (to minimize operational cost) and divert water from the south Delta when required to meet existing flow and water quality standards. (Exhibit DWR-212, Section 14.1.3.1.)

The portion of the South Clifton Court Forebay that lies within the boundary of the existing Clifton Court Forebay will be dredged to an elevation of approximately -10.0 feet. For detailed information regarding disposal of dredged materials. (see Exhibit SWRCB-3, Section 3B.2.18, Appendix A.) Available subsurface data show that soils within the vicinity of South Clifton Court Forebay consist predominantly of silty and fine sand.

The embankment crest elevation for the South Clifton Court Forebay and approach canals are +24.5 feet, which includes considerations for flood levels and sea level rise. (Exhibit DWR-212, Table 3-4). The embankment cross-section will consist of engineered fill placed on suitable foundation material at a 4H:1V slope on both the water and land sides of the embankment. The embankment crest is 32 feet wide, consisting of a 24-foot-wide, two-way maintenance access road with 4-foot shoulders on each side. The water side of the new embankment includes riprap or other appropriate lining.

x. Potential Groundwater Effects

The construction of the forebays will employ the use of slurry walls as described for the intake facilities. The use of slurry walls coupled with the proposed groundwater monitoring, toe-drains, interceptor wells, and soil grouting will reduce the potential for seepage onto lands adjacent to the forebays during construction operations and will ensure that no significant groundwater effects will occur. (see Exhibit DWR-218.)

D. HEAD OF OLD RIVER GATE

The CWF includes constructing a Head of Old River Gate (HORG). One purpose of the HORG is to keep out-migrating salmonids in the San Joaquin River and to prevent them from moving into the south Delta via Old River; another purpose is to maintain water quality in the San Joaquin River (particularly the Stockton Deep Water Ship Channel) in the fall by keeping more water in the San Joaquin River. The HORG will be located at the divergence of the head of Old River and the San Joaquin River.

The facility will be approximately 210 feet long and 30 feet wide, with top elevation of 15 feet msl. It consists of five independent 25-foot bottom-hinged gates, with a fish passage structure, boat lock with gates at each end, control building, boat lock operator’s building, and communications antenna, as well as floating and pile-supported warning signs, water level recorders, and navigation lights. (Exhibit DWR-212, Section 17.1.)

The gate will be within the confines of the existing channel, with no levee relocation. To ensure the stability of the levee, a sheet pile retaining wall will be installed in the levee where the operable facility connects to it. Construction is planned to occur in two phases. The first phase includes construction of half of the operable facility, masonry control building, operator's building, and boat lock. The control building houses the emergency generator, control panels for the control gates, circuit breakers, and storage area for operation and maintenance equipment. The second phase includes constructing the second half of the operable facility, the equipment storage area and the remaining fixtures, including a communications antenna and fish passage structure. (Exhibit DWR-212, Section 17.3.)

HORG operations can vary from completely open (lying flat on the channel bed) to completely closed (erect in the channel, prohibiting any flow of San Joaquin River water into Old River), with the potential for operations in between that will allow partial flow.

V. FLOOD PROTECTION

B. INTAKE SITES

The Sacramento River levees are Federal Flood Control Project levees under the jurisdiction of United States Army Corps of Engineers (USACE) and Central Valley Flood Protection Board (CVFPB). As part of the next engineering phases, DWR will prepare and submit Section 408 permit application to USACE. Section 408 permit is required for any actions that could lead to alteration and/or modification of federally constructed levees. As part of the permitting process, USACE must determine that the proposed alteration does not impair the usefulness of the USACE project. DWR has requested CVFPB staff to initiate Section 408 permitting process with USACE in December 2015. (Exhibit DWR-203.)

DWR will prepare and submit Section 408 permit application along with engineering plans, specifications, and other relevant documents to USACE. The permit application and the engineering documents will describe these new facilities.

Each intake site includes the following features:

- Widened levee on the land-side to increase the crest width, facilitate intake construction, provide a pad for the sediment handling, and accommodate the State Route 160 realignment (Exhibit DWR-212, Section 15.1)
- On-bank intake structure
- Large gravity collector box conduits behind the intake structure leading through the levee prism to the landside facilities (Exhibit DWR-212, Section 6.1.1.2)
- Cutoff walls within the levee to cut off seepage (slurry and reinforced concrete diaphragm type) (Exhibit DWR-212, Section 15.1)

The elevation of the top of the intake structure is 18 inches above the 200-year flood level (including sea level rise), while the finished levee at the structures is 3 feet above the 200-year flood level with sea level rise. (Exhibit DWR-212, Section 3.5.) At the upstream and downstream ends of the intake structure, a sheet pile training wall will transition from the concrete structure into the water-side of the levee in a manner similar to the Freeport Regional Water Authority intake.

Riprap will be placed on the levee-side slope upstream and downstream of the structure to prevent erosion from anomalies in the river created by the structure. Riprap will also be placed along the face of the structure at the river bottom to resist scour. (Exhibit DWR-212, Section 15.1.)

In addition to levee stability and seepage control, the features described above provide both temporary and long-term flood protection at the intake sites. Temporary flood protection during construction is by a combination of cofferdams, slurry cutoff walls, diaphragm walls, structures, and elevated pad fills for the landside facilities. Long-term flood protection is provided by multiple means at the completed facilities. These features include an improved and stable levee at the intake sites, under-seepage protection, full containment of any water allowed to flow through the gravity collector box conduits to the landside of the facility, and positive closure devices on the gravity collector box conduits to restrict flow from the river side to the landside. The widened levee will provide a finished levee prism with materials and dimensions that exceed those of the existing levees and meet or exceed the current requirements of the CVFPB (Title 23, California Code of Regulations). The diaphragm wall and slurry cutoff walls at the site provide a positive barrier to seepage. The sedimentation basins, including the fills placed to develop the basins, are installed to a level equal to the top of the new levee and provide full flood containment. Positive closure gates are provided within the collector box conduits to isolate river flows. If these gates are closed, a positive barrier to flow from the river to the landside facilities is established. (Exhibit DWR-212, Section 15.3.)

C. SURROUNDING LEVEES

Existing levees in the Delta have been in place and stable for decades. Proposed modifications to the Sacramento River project levees at the intake sites are described above under "Intake Sites" and any effects of these modifications are reduced or eliminated as described above. Construction may generate potential effects to levees in the Delta that include construction traffic, which may increase loads where construction equipment will use the levee crest as haul routes, and ground loss at the tunnel face during construction could result in foundation settlement, leading to levee damage. To the extent possible this trucking will be kept off the levees that are not highway-rated. Haul routes needed for the construction of the approved project will be refined. Prior to construction, existing conditions of levee roads that are identified as potential haul routes and expected to carry significant construction truck traffic will be monitored and documented through field reconnaissance and engineering surveys. Based on the initial assessment from field reconnaissance and engineering surveys, geotechnical exploration and analyses will be performed for levee sections that need further evaluations. (Exhibit SWRCB-3, Environmental Commitment 3B.2.1, Appendix A.) Should the geotechnical evaluations indicate that certain segments of existing levee roads need improvements to carry the expected construction traffic loads, DWR is committed to carry out the necessary improvements to the affected levee sections or to find an alternative route that would avoid the potential deficient levee sections. As discussed in RDEIR/SDEIS, Appendix A, Chapter

19- Transportation, Mitigation Measure Trans- 2c, all affected roadways would be returned to preconstruction condition or better following construction. (Exhibit SWRCB-3.) Implementation of this measure will ensure that construction activities will not worsen pavement and levee conditions, relative to existing conditions.

Monitoring programs needed during construction will be evaluated during design. Construction contracts will include prescriptive specification requirements for monitoring levees to ensure that structural integrity and flood protection capacity are maintained. (Exhibit SWRCB-3, Environmental Commitment 3B.2.2, Appendix A.)

Though not expected, some settlement of the levee foundation could occur as the result of tunneling activities. This potential risk is mitigated through selection of equipment and means and methods of construction. The pre-construction geotechnical exploration (Exhibit SWRCB-3, Environmental Commitment 3B.2.1, Appendix A) of the levee in the vicinity where the tunnels will cross under the embankment will characterize the levee and foundation and provide an indication of any potential for differential settlement. Where such potential exists, the geotechnical designs will include appropriate measures to address potential settlement and increased seepage under or through the levee. As described in RDEIR/SDEIS, Environmental Commitment 3B.2.1.2, Appendix A, should geotechnical reports indicate high settlement risk in certain areas, pre-excavation ground stabilization treatment will be performed ahead of the tunneling. Utilization of an EPB TBM and implementation of a well planned and executed TBM operational plan, and a ground stabilization program will mitigate the potential for ground settlement due to tunnel construction. Ground stabilization methods and settlement monitoring programs will be evaluated during design, with requirements for ground stabilization and settlement monitoring specified during construction. Construction contracts will include prescriptive specification requirements for settlement monitoring at sensitive features, such as levees, to ensure that tunneling-induced settlement remains within specified limits. (Exhibit SWRCB-3, Environmental Commitment 3B.2.2, Appendix A)

V. CONCLUSION

Based on the facilities descriptions, construction methods, and potential effects and mitigations described in my testimony, I believe that the CWF construction will not result in any impairment of water quality or significantly affect other legal users of water.

Executed on this 31st day of May, 2016 in Sacramento, California.

John V. Bednarski