Appendix 3C

Construction Assumptions for Water Conveyance Facilities

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Project-level environmental review requires specific information about the timing, nature, and physical extent of those activities necessary to construct the water conveyance facilities proposed under the action alternatives. Table 3C-1 provides a list of major construction activities and elements necessary in constructing these features, along with their anticipated timing and any important information or assumptions that further characterize the activity and provide necessary detail in evaluating their potential effects. These assumptions were developed from a number of sources, including conceptual engineering reports, GIS databases, and written and verbal correspondence with DWR technical staff. Areas required for features associated with the action alternatives, including ancillary areas for parking, lighting, fencing, etc., were included within GIS databases for the purposes of environmental review.

Not all construction assumptions found in this EIR/EIS are intended to include a level of analysis sufficient to support all permit decisions under Section 404 of the Clean Water Act and Sections 10 and 14 of the Rivers and Harbors Act of 1899 for all actions associated with the BDCP. Rather, the EIR/EIS may later be supplemented through additional environmental documentation, if necessary.

Table 3C-1 summarizes only major structures and activities; Tables 3C-3 through 3C-8 summarize the Pipeline/Tunnel Option Alternative (PTO, or pipeline/tunnel alignment) construction activities; Tables 3C-9 through 3C-14 summarize the East Alignment construction activities; Table 3C-15 through 3C-20 summarize West Alignment construction activities, and 3C-21 through 3C-26 summarize Modified Pipeline/Tunnel Option (MPTO) construction activities. Construction components for Alternative 9, Through Delta/Separate Corridors Conveyance, are shown in Table 3C-27 through 3C-29. Additional construction assumptions are addressed in Appendix 22B, Air Quality Assumptions.

A more detailed breakdown of construction schedules for each component can be found in Appendix 22B, *Air Quality Assumptions*. Construction schedules for West Alignment alternatives are assumed to be the same as for East Alignment alternatives, except as noted.

Some components of Alternative 5 have different specifications than those in other pipeline/tunnel alignment alternatives; these specifications are provided for each component for which Alternative 5 differs.

This appendix assumes five intakes would be built under any alternative (except Alternative 9); for any alternative with fewer than five intakes, schedules and data would change accordingly.

Under Alternatives 2A,2B, and 2D, a total of five intakes would be constructed and operated. For 2A and 2B, locations 1–3 and either 4 and 5 or 6 and 7 are being considered. If alternative intake locations 6 and 7 are used, activity timing may be different than that shown in Table 3C-1. See the North Delta Intakes section of Table 3C-1. For Alternative 2D, Intakes 1 through 5 are considered. .

Table 3C-1. Construction Assumptions for Water Conveyance Facilities

Construction Element/Activity	Key Construction Information or Assumptions
North Delta Intakes	• Between one and five intakes would be constructed for Alternatives 1A–8. Sites would be selected from 12 possible on-bank locations on the Sacramento River between Clarksburg and Walnut Grove (between approximate river miles 34 to 44.5). • For Pipeline/Tunnel and East Alignment alternatives, there are seven possible sites on the east bank of the river; Alternatives 2A and 2B could utilize one or two alternate intake sites (Intake 6 or 7). The Modified Pipeline Tunnel Alignment (Alternatives 4, 4A, 2D, and 5A) would include between one and five intake sites on the east bank of the Sacramento River. • For West Alignment alternatives there are five possible sites on the west bank of the river. • Intake construction would require 7 years for all intake construction; The intakes would be constructed simultaneously with in-water work, potentially beginning in November 2021. Alternatives 3, 4, 5, 7, 8 involve fewer intakes, and construction schedules may change accordingly. • For alternatives with five intakes, it was assumed that construction would start with Intake #1, followed by Intakes #3, #5, #2, and #4. Under alternatives with fewer intakes, this same order was assumed for those intakes that would be constructed. For example, under Alternative 3, construction would begin with Intake #1 followed by Intake #2. • Construction is to be continuous year-round with 5 day work-weeks and 10 hour days, unless noted otherwise. • Intake facilities including pumping plants (Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 5, 6A, 6B, 6C, 7, and 8) average approximately 60 acres per site; intake facilities for Alternative 4 (Modified Pipeline/Tunnel alignment) would average approximately 90 to 160 acres per site. • Dimensions of all structures would be the minimum required for the facility to perform its intended function; house all required equipment and storage; and ensure the safety of the facility and all personnel. • For intake construction schedule detail, please see Appendix 22B, *Air Quality Assumptions*.
Concrete Intake Structures (Intakes 1–5 and related components)	• Each intake would range from 40 to 60 feet (ft) wide and 700 to 2,300 ft long (depending on the alignment and intake location), with the long dimension parallel to the river flow. • Intakes would be approximately 55 ft tall from the river bottom to the top of the structure. • The intakes would typically rise above the surface of the river water between approximately 20 and 35 ft. • The intake structure would be made of structural concrete. • Intakes would be offset from the levee road by approximately 100 to135 ft. • A 3.5 ft concrete guardrail would be constructed around the perimeter of the intakes and along the sides of the access bridges.
Clearing and Grubbing/ Demolition (Alternatives 1A–8)	• Work sites would be cleared to the areas required for earthwork operations as approved. Vegetative material from clearing operations would be chipped, stockpiled, and spread over the topsoil after earthwork operations are completed. • Grubbing would consist of removing objects (e.g., stumps, tap roots, debris, organic material) larger than 2 inches in diameter to a depth of 1 foot below the cleared surface. • Clearing and grubbing work could include areas on the levee and berm, as well as along the low flow bank below the OHWM. Mature vegetation would be removed if it occurs where sheet piles would be installed if it occurs where permanent structures will be constructed, or if it hampers movement of equipment. • Timing: Assumed 1 day per intake site.
Construct Detour Roads	• Dewater. • Overexcavate/recompact. • Would require 971,500 cubic yards (cy) for import and compact for roads. • See Table 3C-8, *Access and Construction Work Areas.*
Construct New Perimeter Berm; Widen levee Top	• Realign levee roads at three intake locations to provide turnout access for construction and • Fill space between old and new perimeter berms to create building pad for pumping plant.

Construction Element/Activity	Key Construction Information or Assumptions	
	maintenance needs. The roads will be paved with asphalt concrete surface over an aggregate base. • Each of the three intakes will involve the construction of the following items: o Slurry walls (soil-cement) surrounding the entire site. Inside the slurry wall it is assumed that the ground will require ground improvement using jet grouting methods, this will be determined through further geotechnical investigation. o Intakes structures with fish screens varying in length from 1259' to 1667' x 40' wide. The height of the structures range from 45' to 50.5' from invert to top of structure. Intake structure will be supported on drilled in-place concrete piles o Box culverts connecting the intakes and sedimentation basin is approximately 380' long x 16' wide x16' high o Earthen sedimentation basins with a trash racks and concrete outlet tower. The sedimentation basin is assumed to have asphalt over a gravel base on the bottom and side slopes. The top of the earthen basin embankment will have a 25' minimum wide perimeter road that is approximately 3000' in length. o Drying lagoon will be lined with roller compacted cement and will have a concrete outlet structure o Substation with a concrete slab at each intake o Intake 3 will have a maintenance shop. • The cubic yards of material required for each intake location is showns below:	• Height from ground surface at landside to crest: 20–45 ft. • Width toe-to-toe: 180–360 ft. • Minimum crest width: 20 ft. • Construct cut-off walls.

Intake facilities materials	Cubic Yards of Material		
	Intake 2	Intake 3	Intake 5
Jet Grout	138,916	34,972	432,184
Gravel and Rip-Rap	137,038	139,339	136,304
Asphalt	21,167	21,167	21,167
Earthwork	2,479,922	2,845,789	2,364,108
Soil Cement	81,957	81,957	81,957
Concrete	143,724	120,949	142,253
Roller Compacted Concrete	43,556	43,556	43,556

Construction Element/Activity	Key Construction Information or Assumptions
Construct and Remove Sheetpile Cofferdam	• Work performed only during the allowed in-river work period of June 1 to October 31, when the potential for fish and aquatic species of concern to be in the vicinity of the in-water construction activities would be at a minimum, unless otherwise authorized by relevant permitting agencies. • Each intake site would require a temporary cofferdam to create a dewatered construction area encompassing the entire intake site. The length of the temporary cofferdam at each intake site would vary depending on the alignment and intake but would range from 740 ft to 2,500 ft for the pipeline/tunnel alignment and modified pipeline/tunnel alignment, and 890 ft to 2,440 ft for the west alignment. • Top of sheet piles to align with approximate top of existing levee crown. • Bottom of sheet piles to be driven to a depth that achieves hydraulic cutoff, for an approximate total length of 145 ft with approximately 100 ft driven below ground. Dimensions of the sheet piles will be revised when additional site-specific geotechnical data becomes available. • Sheet piles would be driven from within the river by cranes mounted on barges and temporary decks. • Installation of steel sheet piles and/or king piles would require both impact and vibratory pile driving, depending on geotechnical conditions at the sites. • Sheet piles would be installed in two phases starting with a vibratory hammer and then switching to impact hammer if refusal were encountered before target depths. Refer to Table 3C-2 for assumptions used to evaluate impacts from pile driving. • The in-water area temporarily isolated inside the temporary cofferdam would vary by intake location, but would range from 0.2 to 5 acres. • The distance between the face of the intake and the face of the cofferdam would depend on the foundation design and overall dimensions. It is assumed that the distance between the intake and the cofferdam would be between 10 and 35 ft. • Stone bank protection (or riprap), if present, would be cleared prior to installing sheet piles. • After intake construction is complete the cofferdam would be flooded and removed by underwater divers using torches or plasma cutters to trim the sheet piles at the finished grade/top of structural slab. • A portion of the cofferdam would remain in place to facilitate dewatering as necessary for maintenance and repairs. Depending on the alternative and intake, permanent cofferdams would range in length from 1,220 to 3,360 linear ft, including sheet pile transitions.
Intake Excavation	• Excavate within cofferdam to level of foundation design subgrade. Ground improvement (jet grouting and/or other methods, based on site-specific surface conditions) will be needed beneath the intake, gravity collector pipes, and portions of the pumping plant site. • Affects area enclosed by cofferdam, approximately 0.2–1.9 acres. Remove an approximate depth of 30 to 35 ft of soil, for an excavated volume of 22,600 cy. • An area next to each intake structure would be excavated approximately 750 ft upstream and downstream of the intake structure and approximately 250 ft from the sides of the structure, to facilitate sediment removal during facility operations. • Material excavated for levee foundation improvement would be exported offsite. • Dredging would be required at each of the intake locations on the river bank and in the river channel after the cofferdam is constructed. • Projected solid waste from intake excavation (not dredge material) to be disposed of in landfills estimated at 0.1%.
Excavate Cell and Retrieval Pit	• Used to support earthwork activities. • Would result in the export of 111,500 cy of RTM (for five intakes). • Would require 57,750 cy to be excavated and hauled to the stockpile (for five intakes).

Construction Element/Activity	Key Construction Information or Assumptions
Foundation Pile Driving	• Intake foundation • Matrix of foundation piles, driven within the area enclosed by the cofferdam. • Refer to Table 3C-2 for assumptions used to evaluate impacts from pile driving.* • May be done in the dry or in the wet. If done in the dry, conventional construction methods would be used within the cofferdam. If done in the wet, a barge-mounted rig positioned outside of the cofferdam or a deckmounted pile driving rig located on decking over the top of the cofferdam would be required. • Dredging is assumed to be minimal and to be localized along the fence of the intake at each intake site. * Type, dimensions, and number of piles and installation methods subject to change based on future site-specific geotechnical data and engineering design. If CIDH is chosen for foundation, impact pile driving will not be required.
Dewatering of the Cofferdam Construction Site	• Dewatering would be used to keep the area within the cofferdam dry during construction. • Dewatering within the cofferdam would take place 24 hours a day, 7 days per week throughout intake construction. • Water would be pumped from the cofferdam to tanks on the landside of adjacent levees. • Water pumped from the cofferdams would be treated (settling or removal of sediment) and returned to the river or used for dust control as needed.
Pipe/conduit construction (for installing pipes under the levee)	• Installing gravity collector pipes/conduits between intakes and sedimentation basins; and carry water between intakes and intake pumping plants(except for Alternative 4). • A variety of construction methods may be used, including pipe jacking, shored trench, and open cut trench. • Bored from within the cofferdam, through the levee embankment, to a retrieval pit at the site of the landside sedimentation basin to allow installation of pipe segments to connect the intake to the sedimentation basin. • The solids may be reused as fill after treatment. • 15,876 cy of spoil (including slurry bulking) removed. • Top of tunnel approximately 10 ft from bottom of riverbed. • Approximately 3,000 cy of grout if ground improvement is required.
Cut and Cover Excavation and Pipe Placement	• Cut and cover construction would likely be used for landside pipe placement using long reach backhoes, scrapers and excavators placed on levees or on the landside of the levees. • Pipe installed underground on the landside of the levee and connected to the sedimentation basin. • Minimum of six 12-ft diameter, 420 ft long pipe; approximately 320 ft of length underground. • Potential 63,000 cy of excavation and 55,000 cy of bedding/backfill.
Cast-In-Place Concrete (CIP)	• To form the base, walls and top deck of the intake structure. • 22,090 cy concrete, 1,700 kips of reinforcing bar.
Riprap	• Import 2,800 cy and place around perimeter of cofferdam/intake foundation for protection and to provide a transition from the river bottom to the intake structure. • Would take place only during the allowed in-river work period of June 1 to October 31. • Place riprap, bedding material, fabric.
Cleanup, Demobilize	• 5 days per intake site.
Fish Screens	• Vertical stainless steel screen panels with stainless steel wire fabric. • Designed to meet delta smelt criteria of 5 sq ft/cfs, with mesh openings of 1/16 in. • Screen dimensions would vary depending on location, ranging from 10 to 22 ft high and from 915 to 1,935 ft long. • Several traveling brush screen cleaning systems would be installed on each of the long sides on the water side of the intakes, and a traveling gantry crane may be placed on the top deck of the intakes.

Construction Element/Activity	Key Construction Information or Assumptions
	• Screens also serve to filter large solids from entering the intake, minimizing sedimentation within the conduits. • Under the modified pipeline/tunnel alignment, a sediment jetting system would be placed behind the fish screens.
Intake Pumping Plants (PP) (Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 5, 6A, 6B, 6C, 7, 8, 9)	• Houses seven (six plus one spare) 500-cfs pumps; each discharges into a separate 8 ft diameter pipe. The Modified Pipeline/Tunnel Option would 12 (10 plus 2 spares) 900-cfs pumps; each discharges into a separate 8-ft. diameter pipe. • Each intake pumping plant site would be approximately 1,000 ft by 1,000 ft (approximately 23 acres). • Each intake pumping plant would be approximately 262 ft long by 98 ft wide. • Cast-in-place (CIP) reinforced concrete structure and a superstructure. • Multiple floors would house mechanical and electrical equipment. • The majority of the site would be raised to match the elevation of the adjacent levee, with an approximate raise in grade of 25 ft. • Under East Alignment alternatives, to protect the site and ancillary structures from flooding, the pumping plant, sedimentation basins, and associated solids lagoons would be constructed on engineered fill, with a finished ground level of between 27.9 and 31.2 ft (NAVD88) depending upon the intake pumping plant location. • Primary structural support system of reinforced concrete slabs and walls at and below grade, with steel framing and exterior metal wall and roof panels for the above-grade building.

Intakes and pumping plants (Alternatives 4, 4A, 2D, 5A)	• Under the Modified Pipeline/Tunnel Option, each intake site, including fill pad, would be approximately 1,800 ft by 1,500 ft (approximately 90 to 160 acres).
	• Each MPTO intake facility would consist of the following components.
	  ○ A fish-screened intake structure that would employ state-of-the-art on-bank fish screens.
	  ○ Twelve large gravity collector box conduits that would extend through the levee to convey flow to the sedimentation system.
	  ○ A sedimentation system that would consist of gravity settling basin to capture sand-sized sediment and a drying lagoon for sediment drying and disposal.
	  ○ A sedimentation afterbay that would provide the transition from the sedimentation basins to a shaft that would discharge into a tunnel leading to the intake facility (IF).
	• A substation with transformers and switching equipment would be located on each site for electrical power supply.
	• Under Alternative 4, a pumping plant would not be included with each intake. A combined pumping plant would be located in the vicinity of Clifton Court Forebay, and would consist of two plants that would each be approximately 180 ft wide in diameter.
	• Pumping plants would consist of cast-in-place (CIP) reinforced concrete structure and a superstructure.
	• Multiple floors would house mechanical and electrical equipment.
	• The majority of the site would be raised to match the elevation of the adjacent levee, with an approximate raise in grade of 25 ft.
	• The intake facility would house 12 pumps: 8 of the pumps would have a design capacity of 1,125 cfs and 4 would have a design capacity of 563 cfs.
	• The discharge piping for the large pumps is 12 ft in diameter, and the discharge piping for the small pumps is 8.5 ft in diameter.

Pumping Plant Excavation and Backfill	• Excavation and stockpile or haul to waste. • Place stockpiled material as backfill. • Import and place material. • Pumping plants would require 945,927 cy to be excavated, hauled, stockpiled, and compacted.

Construction Element/Activity	Key Construction Information or Assumptions
	• Projected solid waste from pumping plant excavation (not dredge material) to be disposed of in landfills estimated at 0.1% of spoils.
Sedimentation Basin	The structural system of the basins would consist of reinforced concrete walls and mat slab foundations supported on piles (except under the modified pipeline/tunnel option). Approximately 6 inches of the perimeter and dividing walls would be above the surrounding grade. • Sedimentation basins would be set at depth based on river stage elevations, and at a minimum water depth of 3.5 ft. • Each basin segment would be approximately 120 ft by 40 ft. Assuming an average water depth of 5 ft elevation, and allowing for flood elevation, the basin would be about 55 ft deep. Under the modified pipeline/tunnel alignment, each sedimentation basin channel would be approximately 100 ft by 600 ft, and 23 ft deep. • The bottom of the basins would be at an elevation between -30 and -35 ft, and the top of the walls of the basin would be at an elevation of +32.2 ft. • Uncovered basin with channels would be open to above, and a potentially 3-rail 3.5-ft-tall handrail around the perimeter. • Refer to Table 3C-2 for assumptions used to evaluate impacts from pile driving. Type, dimension and installation method of piles are subject to change based on future site-specific geotechnical data and engineering design. • Sedimentation channels would contain permanent, mechanical solids collection systems, and collected solids would be transferred to solids lagoons. Under MPTO/Alternative 4, the triangular-shaped basins with base and height approximately 700 ft, for Intakes 2, 3 and 5. Normal settling depth would be 20 ft.
Solids Lagoon	• Three uncovered, concrete-lined solids lagoons at each intake or intake pumping plant. • Each lagoon would have a footprint of approximately 86 ft by 165 ft, and would be approximately 10 ft deep. Under the modified pipeline/tunnel alignment, the solids lagoons would be approximately 15 ft deep and would have a bottom width of 200 ft and a bottom length of 400 ft. • Below ground, with the basin lip at the finished grade level. • Under MPTO/Alternative 4, each intake would include four sediment storage and drying lagoons. The drying lagoon size for maximum case sediment quantity is 350-ft-long, 15-ft-deep, with a 160-ft-wide bottom and 1:1 side slopes. The tops of the lagoons would be level with the site and protected from the design flood condition.
Pumping Plant Buildings	The main building above grade footprint would be approximately 100 ft by 320 ft. An attached motor control room would be approximately 25 ft by 110 ft (85 ft by 120 ft for the modified pipeline/tunnel alignment). Total height of the above ground structure is about 30 ft. • Place gravel bedding, drive foundation piles, place concrete fill in piles. • Deep foundation supporting a common concrete mat. • Type, dimensions, and number of piles and installation methods subject to change based on future site-specific geotechnical data and engineering design. • Slab on grade concrete. • Concrete walls and roof. • Seven, 8-ft-diameter discharge pipes to outside; each passing through a concrete flow meter vault to a transition manifold or transition structure. Under MPTO/Alternative 4, the combined pumping plant facilities are approximately 3,000 ft by 900 ft. Total height of the above ground structure is about 100 ft under MPTO.
Dewatering/ Unwatering	• Prior to excavation at the intake locations, a perimeter slurry cutoff wall would be constructed around the perimeter of each intake location to minimize induced seepage from the river during and following construction. Use of the slurry walls around the entire intake facilitiy also would reduce the need for groundwater dewatering during the entire construction period and associated effects on groundwater. This perimeter slurry

Construction Element/Activity	Key Construction Information or Assumptions
	cutoff wall would tie into short sections of diaphragm wall within the widened levee crest. • The slurry wall would be constructed to a depth below the bottom of the excavation of the intake and would extend to a relatively impermeable layer. If the impermeable layers are not consistent along the bottom of the slurry wall, grouting or ground improvement methods would be used to reduce water from seeping into the construction site. • The slurry wall materials would consist of a combination of sand, cement, native soil, and bentonite in similar ratios as described in the American Society for Testing and Materials (ASTM) specifications for slurry materials used in drinking water well sealing procedures, such as described in DWR Well Standards Bulletins 74-81 and 74-90. This combination of materials will be used to avoid changing groundwater and surface water quality in the vicinity of the slurry walls . • Following construction of the slurry walls, dewatering wells would be installed at varying depths to remove groundwater from construction site as excavation in initiated. Some of the dewatering wells would be installed at shallow depths and others would extend to the depth of the slurry walls. The dewatering wells would have varying depths of solid well casing liners which would be installed in the same manner as for drinking water wells to prevent migration of groundwater between different portions of the aquifer. • Dewatering would occur for approximately four to six weeks following installation of the slurry walls and as excavation is initiated. The dewatering activities would only need to remove water from within the slurry walls which would be hydraulically isolated from the surrounding aquifer system.
Transition Structure (Pipeline/ Tunnel, Modified Pipeline/ Tunnel, and West Alignments)	Transition structures serve to move water between discharge pipes and larger conveyances (pipeline, tunnel or canal). For the modified pipeline/tunnel alignment, a discharge header consisting of seven 8-ft-diameter discharge conduits would converge to a single discharge conduit. • The transition structure footprint would be approximately 70 ft by 210 ft, with the majority of the basin below ground, and concrete roof and walls. • The ground around the basin may be graded to slope to approximately 12 ft to the top of the structure deck with approximately 6 inches of the perimeter walls above the finished grade. • If the surrounding ground is not graded to slope to the structure, the perimeter wall would be approximately 13 ft above grade. • A structural deck would be permanently in place over the transition structure, with a potentially 3-rail handrail 3.5 ft tall around the perimeter. • A gantry crane would be placed on top of the deck with a frame that would be approximately 30 ft tall and 10 ft wide. • Excavate, haul, stockpile and compact 102,720 cy.
Transition Structure (East Alignment)	• The transition structure footprint would be approximately 70 ft by 210 ft, with the majority of the basin below ground, and concrete roof and walls. • The ground around the basin may be graded to slope to approximately 8 ft to the top of the structure deck with approximately 6 inches of the perimeter walls above the finished grade. • If the surrounding ground is not graded to slope to the structure, the perimeter wall would be approximately 9 ft above grade. • A structural deck would be permanently in place over the transition structure, with a potentially 3-rail handrail 3.5 ft tall around the perimeter. • A gantry crane would be placed on top of the deck with a frame that would be approximately 30 ft tall and 10 ft wide. • Excavate, haul, stockpile and compact 198,960 cy.

Construction Element/Activity	Key Construction Information or Assumptions
Transition Manifold at Sites 1 and 2 (Pipeline/ Tunnel Alignment)	• The transition manifold would consist of a 16 ft diameter pipe manifold and valve vault that connects the seven 8 ft diameter discharge pipes from the pumping plant to two parallel 16 ft diameter pipes that discharge to Tunnel 1. • The manifold and the pipes would be underground. • Driven or drilled foundation piles with reinforced concrete pile cap to support foundation. • Intake to pumping plant manifold would require excavating, hauling, stockpiling and compacting 106,080 cy.
Surge Towers/Shafts	• Connected to the pumping plant discharge piping. • Intake 1: Two, 16 ft diameter, rim at 70 ft NAVD88. • Intake 2: Two, 16 ft diameter, rim at 65 ft NAVD88. • Proposed height of structure will be 10 to 15 ft above the maximum hydraulic surge elevation. • Under the modified pipeline/tunnel alignment, channels would be used around pumping plants, at an elevation of 29 ft.
Substation and Exterior Transformers	Each intake facility would have a 69 kV substation. See *New Utility Corridors* below; Table 3C-6, *Power Supply and Grid Connection;* and Appendix 22B
General Construction Work Areas (See Table 3C-8, *Access and Construction Work Areas*)	• The anticipated construction area for each intake pumping plant would range from approximately 60 acres to 160 acres. • Of this, approximately 20 acres would be specific to the area for temporary construction needs (including on-site temporary parking, office trailers, staging, equipment laydown, storage and access road). • During the different phases of construction approximately 2 to 8 acres would be used for staging, temporary parking, office trailers, storage and equipment laydown.
Intake Pipelines (Alternatives 1A–8)	• Six 12-ft diameter pipelines to carry water between intakes and intake pumping plants. • Pipes connect intakes to sedimentation basins. • Construction could include microtunneling or open-cut trenching through levee, depending on depth of installation. • RTM from microtunneling would be removed using conveyors or pumps and transferred to a separation plant to remove suspended solids, treated, drained and transported to stockpiles. • Excavated material, if of generally good quality, would be used as embedment and backfill material. Excess material would be transported offsite. • If native materials are not suitable as foundation for the trench, suitable materials would be imported to the site. • Excavate, haul, stockpile and compact 850,559cy. • Excavate and export 1,391,603cy. • Under the MPTO Alternative, (12) 12-ft diameter pipes or 12’ x 12’ box conduits would carry water from intakes to sedimentation collection channels.
Excavation and Backfill (Alternatives 1A–3, 5–8)	Total for all intakes • Intake conduits: export 79,380 cy of RTM. • Excavate cell: export 111,500 cy of RTM.

Construction Element/Activity	Key Construction Information or Assumptions
Conveyance Pipelines	• Transport water to a point of discharge to the conveyance facility (pipeline/tunnel or canal conveyance, depending on the alternative). • Projected solid waste excavation (not dredge material) from conveyance pipelines to be disposed of in landfills is estimated at 0.1%. • PTO Alignment: 620 tons. • Conveyance pipelines constructed under the MPTO alternative would be much shorter and therefore, solid waste excavation associated with this alignment would be substantially lower. • East Alignment: 284 tons • West Alignment: 1,579 tons See tables for each alignment and Appendix 22B, *Air Quality Assumptions*, Table 22B-1, Construction Schedule for additional details of conveyance pipeline construction.
69 kV Substations	• Power would be delivered from the main 69 kV substation at the IPP over 69 kV subtransmission lines strung on poles or towers that would terminate at intake substations located adjacent to each intake structure. See *New utility corridors*, below, and Table 3C-6, *Power Supply and Grid Connections*. • Substations at intake pumping plants would have a footprint of approximately 150 x 150 ft. to 350 x 350 ft. Footprints for substations at the intakes under the Modified Pipeline/Tunnel Alignment would be 175 ft by 130 ft. • Power poles or towers would be approximately 60 ft tall.
New Access Roads	See Table 3C-8, *Access and Construction Work Areas.*
Perimeter Berms/ Levee Modifications	Import and compact 400,000 cy.
Parking, Lighting, Fencing (General)	**Parking** • Temporary construction parking facilities are to be located within the pumping plant construction site staging areas. Parking facilities for construction employees may be located on the construction site, within the construction area, or off-site where practicable. • Temporary staging areas for storage, office trailers and equipment parking would be required. As the construction progresses, the onsite construction parking and staging areas may need to be relocated in order to maintain a minimal construction area footprint if required. • Any temporary onsite parking facilities or staging areas would be cleared and grubbed, roughly graded and spread with mixed, graded gravel and compacted and may be **Lighting** • All permanent artificial outdoor lighting is to be limited to safety and security requirements. Temporary artificial outdoor lighting may also be employed for night work where permitted. • All lighting is to be shielded to direct the light only towards objects requiring illumination. • Lights shall be downcast, cut-off type fixtures with non-glare finishes set at a height that casts low-angle illumination to minimize incidental spillover of light onto adjacent properties, open spaces or backscatter into the nighttime sky. • Lights shall provide good color rendering with natural light qualities with the minimum intensity feasible for security, safety and personnel access. • All outdoor lighting would be high pressure sodium vapor with individual photocells and be designed per the guidelines **Fencing** • Security fencing with access control gates, on perimeter of intake structures and intake pumping plants. • 6 ft or 8 ft chain link with a climbing barrier; more stringent fencing with razor wire may be used around certain facilities. • Additional fencing around the substation and transformer yards may be required. • Masonry walls 6 to 8 ft tall may be used within the facilities.

Construction Element/Activity	Key Construction Information or Assumptions		
	covered with thin asphalt binder mix surfacing. • If at a site soils are soft, expansive or permeable, semi-permanent structures, such as office trailers, may require concrete pads or footings to support them.	of the Illuminating Engineering Society (IES). • All lights are to be energy conserving and aesthetically pleasing. • Lights would have a timed on/off program or have daylight sensors and be programmed to stay on whether or not personnel are present.	
Landscaping/ Vegetation (General)	• If possible, the natural environment would be preserved. Re-vegetation plans would be developed for restoration of areas disturbed by project activities. • Landscaping plans may be to enhance facility attractiveness, for the control of dust/mud/wind/unauthorized access, for reducing equipment noise/glare, for screening of unsightly areas from visually sensitive areas. • Planting would use low water-use plants native to the Delta or the local environment, with an organic/natural landscape theme without formal arrangements. • Low maintenance plants and irrigation designs would be chosen. • Planting plans would use native trees, shrubs or grasses and steps would be taken to avoid inducing growth of non-native invasive plant species/California Native Plant Society weedy species. • Planted vegetation would be compatible with density and patterns of existing natural vegetation areas and would be placed in a manner that does not compromise facility safety and access. • Planting would be done within the first year following the completion of the project and a plant establishment plan would be implemented.		
New Utility Corridors	• A new 230 kV transmission line would deliver power to the new north Delta intake facilities. It is assumed that a new substation would be constructed within or adjacent to the providing utility's existing transmission right of way (ROW). • Alignment of transmission lines and location of interconnection point(s) would be determined based on selection of a conveyance alignment followed by selection of a power provider. • New overhead 69 kV subtransmission lines from the main 69 kV substation at the IPP would deliver power to intakes by looping into each intake substation (for those alternatives with an intermediate pumping plant). • Main launch shafts for constructing deep tunnel segments would require 69kV or 230kV temporary transmission lines. • 12 kV temporary power for construction would be provided at project work sites by local utilities. • Wherever possible, 12 kV line would be constructed on the same poles as the 69 kV subtransmission line. Under Alternatives 4, 4A, 2D, and 5A (the modified pipeline/tunnel alignment), it is assumed that operational power would be provided to the intakes through existing distribution lines. However, it is assumed that a 230kV transmission line would deliver power to the pumping plants northeast of Clifton Court Forebay.		
	12 kV	**69 kV**	**230 kV**
Site Prep	• 230 kV and 69 kV sites: 100 x 150 ft footprint, and 100 x 350 ft at conductor pulling locations • 12 kV sites: 40 x 50 ft footprint, and 50 x 200 ft at conductor pulling locations • Bulldozer and backhoe		

Construction Element/Activity	Key Construction Information or Assumptions			
Tower Construction	Bulldozer, small crane, line truck, water truck, dump truck	Bulldozer, Man 222HD, 100T, 210' Boom (C85MA004), line truck, water truck, concrete truck	Bulldozer, Man 555, 150T, 250' Boom (C85MA005), line truck, water truck, concrete truck	
Line Stringing	Small crane, line truck, other equipment	Line crane, line truck, other equipment	Line crane, line truck, Helicopter (MD 500D/E)	
Pole Tower Spacing (ft)	125-300	450	750	
Pole Tower Height (ft)	35-45	60	95-130	
Pad Footprint	50' x 50'	100' x 150'	100' x 150'	
Permanent Poles (length)	0	10.73 miles	52.62 miles	
Number of Permanent Poles	0	126	370	Total perm. poles: 496
Temporary Poles (length)	22.47 miles	25.02 miles	0 miles	
Number of Temporary Poles	338	171	0	Total temporary poles: 510
	Transmission line construction phasing and activities are assumed to be similar for the Proposed Project and all alternatives, but the number of poles and length of lines would vary by individual alternative. Specifications provided in this table reflect estimates for Alternative 1A.			

Table 3C-2. Assumptions to Evaluate Pile Driving Impacts

Feature	On-land or In-water	Pile Type/ Sizes	Total Piles/ Site	Number of Concurrent Pile Drivers at Site	Piles/ Day	Strikes/ Pile	Strikes/ Day
Intake Cofferdam	In-water	Sheet pile	2,500	4	60	700	42,000
Intake Structure Foundation	In-water	42-inch diameter steel	500	4	60	1,500	90,000
SR-160 Bridge (Realignment) at Intake	On-land	42-inch diameter steel	150	2	30	1,200	36,000
Control Structure at Intake	On-land	42-inch diameter steel	650	4	60	1,200	72,000
Pumping Plant and Concrete Sedimentation Basins at Intake	On-land	42-inch diameter steel	1,650	4	60	1,200	72,000
Barge Unloading Facility	In-water	18-inch diameter steel	800	4	60	1,050	63,000

Feature	On-land or In-water	Pile Type/ Sizes	Total Piles/ Site	Number of Concurrent Pile Drivers at Site	Piles/ Day	Strikes/ Pile	Strikes/ Day
Inlet structure at Intermediate Forebay	On-land	14-inch concrete or steel pipe	1,700	2 or more	15	750	11,250
Outlet structure at Intermediate Forebay	On-land	14-inch concrete or steel pipe	1,700	2 or more	15	750	11,250
SR12 Improvement	On-land	14-inch steel pipe	40	1	6	1,500	9,000
Cofferdam for Modified Clifton Court Forebay Embankments	In-water	Sheet piles (AZ-28-700)	22,000	4 or more	60	700	42,000
Divider Wall for Modified Clifton Court Forebay	In-water	Sheet piles (AZ-28-700)	5,000	4 or more	60	700	42,000
Siphon at North Clifton Court Forebay Outlet	In-water	14-inch concrete or steel pipe	2,160	2 or more	30	1,050	31,500
Siphon under Byron Highway	On-land	14-inch concrete or steel pipe	1,600	2 or more	30	1,050	31,500
Cofferdam for Head of Old River Gate	In-water	Sheet piles (AZ-28-700)	550	1	15	700	10,500
Foundation for Head of Old River Gate	In-water	14-inch steel pipe or H-piles	100	1	15	1,050	15,750

Notes: All assumptions will be refined as part of next engineering phase when site-specific geotechnical data is collected.

Assumptions for the inlet and outlet structures at the intermediate forebay represent the worst case scenario. These structures could be supported on shallow foundations with ground improvement (i.e., no pile driving would be needed).

3C.1 Pipeline Tunnel Option (PTO) Alignment (Alternative 1A, 2A, 3, 5, 6A, 7, and 8)

Table 3C-3. Construction Assumptions for Water Conveyance Facilities by Alignment—Alternatives 1A, 2A, 3, 5, 6A, 7, and 8

Construction Element/Activity	Key Construction Information or Assumptions
PIPELINE/TUNNEL ALIGNMENT (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8) Chapter 3, *Description of Alternatives*, provides a summary of pipeline/tunnel physical characteristics.	

	The pipeline/tunnel alignment is approximately 45 miles long, divided into nine separate reaches, beginning with Reach 1 between Intake 1 or 2 (depending on the alternative) and the confluence of Tunnel 1 and Intake 1 and 2 pipelines, and proceeding down the proposed alignment in ascending order ending with Reach 9 encompassing Byron Tract Forebay (BTF) and the approaches to the Harvey O. Banks Pumping Plant (Banks) and C. W. "Bill" Jones Pumping Plant (Jones) Pumping Plants. Intakes would be constructed with the corresponding alternatives as follows:
	• Alternative 1A: Intakes 1, 2, 3, 4, and 5
	• Alternative 2A: Intakes 1, 2, and 3; Intakes 4 and 5 or 6 and 7 (five total)
	• Alternative 3: Intakes 1 and 2
	• Alternative 5: Intake 1
	• Alternative 6A: Intakes 1, 2, 3, 4, and 5
	• Alternative 7: Intakes 2, 3, and 5
	• Alternative 8: Intakes 2, 3, and 5
	The intake-specific descriptions below would only apply to those alternatives under which each intake would be constructed.
	• Intake 1, approximately 1.5 miles west of Interstate 5 on the south side of the Sacramento River near Freeport, would divert water from the river and pump it through two 16 ft ID pipelines approximately 1.8 miles south to where Intake 2 pipelines connect to the head of Tunnel 1.
	• Intake 2 would pump water through two 16 ft inside diameter (ID) pipelines approximately 800 ft to the head of Tunnel 1 and its junction with Intake 1 pipelines.
	• Tunnel 1 is a single bore 29-ft ID tunnel approximately 20,000 ft long on the northern end of the project, which discharges water from Intakes 1 and 2 into an intermediate forebay (IF).
	• Intakes 3, 4, and 5 would each convey water directly to the IF through two parallel 16 ft ID pipelines of the following approximate lengths.
	  ○ Intake 3: 19,700 ft.
	  ○ Intake 4: 7,820 ft.
	  ○ Intake 5: 4,150 ft.
	• The IF would provide a hydraulic break before diverted water enters the intermediate pumping plant and longer, common tunnel conveyance that outlets to Byron Tract Forebay.
	• An intermediate pumping plant (IPP) to be constructed at the southern end of the IF would discharge water to Tunnel 2.
	• Tunnel 2 is a dual-bore, 33-ft ID/37-ft ED tunnel approximately 183,000 ft on the longer, southern end of the project that discharges water to a new forebay on Byron Tract.
	  ○ Under Alternative 5, tunnels 1 and 2 would both be 23-ft diameter and Tunnel 2 would be only single-bore.
	• The new Byron Tract Forebay (BTF) (Alternatives 1A, 2A, 3, 5, 6A, 7, 8) would be constructed adjacent to Clifton Court Forebay (CCF) to balance daily

Construction Element/Activity	Key Construction Information or Assumptions
	variations in inflow and outflow to Banks and Jones Pumping Plants. See Table 3C-4, *Byron Tract Forebay/Expanded Clifton Court Forebay*.
Excavation	• Except where crossing under a major waterway, intake conveyance pipelines would be installed via open cut. Excavation would include clearing, grubbing, excavation, storage of excess spoil material and dewatering. • All existing vegetation and trees would be cleared and grubbed along the pipeline easement and disposed of offsite. • Materials to be stockpiled may include: 1. Strippings from various excavations, for possible reuse in landscaping 2. RTM that is slated for reuse after treatment for embankment or fill construction 3. Peat spoils for possible use on agricultural land, or as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section) 4. Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas • Such materials can be stockpiled in the construction areas of the project for later use. Some stockpiles may be used for material conditioning and potential reuse of the material. • Temporary stockpile areas may also allow for the staging of deliveries (offloading), for equipment/materials storage, and for temporary field offices for construction. • Tunnel conveyances excavation and backfill material: • Assuming 7,398,691 CY for borrow and 11,445,398 CY for excavation (total for 5 intakes)
Tunnel 1	• Connects Intakes 1 and 2 to the IF. • 20,000 ft long. • 1 tunnel bore, 2 shafts. • Inside diameter: 29 ft • Outside diameter: 33 ft ○ Under Alternative 5, tunnel would have an inside diameter of 23 ft and an outside diameter of 27 ft. • Tunnel 1a connects Intakes 2 and 3 to the IF, and is 46,700 ft long. Tunnel 1a has one tunnel bore and four shaft locations. Its inside diameter is 28 ft (with an outside diameter of 24 ft) between Intakes 2 and 3 (Reach 1) and 40 ft (with an outside diameter of 33 ft) between Intake 3 and the IF (Reach 2). • Tunnel 1b connects Intake 5 to the IF (Reach 3), and is 25,100 ft long. Tunnel 1b has one tunnel bore and three shaft locations. Its inside diameter is 28 ft and its outside diameter is 24 ft.
Tunnel 2	• Connects IPP to Byron Tract Forebay. • 183,000 ft long. • 2 tunnel bores, 13 shaft sites, with one shaft for each bore. ○ Alternative 5 would require only a single tunnel bore connection from the IPP to Byron Tract Forebay. • Inside diameter: 33 ft. • Outside diameter: 37 ft. ○ Under Alternative 5, the single-bore tunnel would have an inside diameter of 23 ft and an outside diameter of 27 ft.

Construction Element/Activity	Key Construction Information or Assumptions

Boring	• Earth pressure balance (EPB) tunnel boring machines (TBM) and slurry tunneling machines would be used to excavate tunnel spoils.
	• The distance between the two bores of Tunnel 2 would be twice the outside diameter of the tunnels, approximately 150 ft below grade.
	  ○ 74 ft between the two bores for most alternatives.
	  ○ 108 ft between bores under the modified pipeline/tunnel alignment (150 ft centerline to centerline), and approximately 160 ft below grade.
	• In alluvial soils, the tunnel would be constructed at depths greater than 60 ft using mechanized closed-face pressurized tunneling machines.
	• If dense gravels, cobbles, or boulders are encountered in the older alluvium depth, other mining methods may be utilized, such as grouting, jet grouting, use of a slurry tunnel boring machine, or freezing and hand mining.
	• RTM would be transferred to storage areas by conveyor, wheeled haul equipment, or barges.
	• The tunnel invert elevation is assumed to be at 160 ft below msl under the San Joaquin River and Stockton Deep Water Channel to maintain sufficient cover between the tunnel and dredging operations in the shipping channel.

Tunnel shafts **Launch (construction) shaft**	• To lower the TBMs to their initial working positions and to support their operation, accommodate construction and construction support operations. • For Tunnel 2, approximately 180 ft deep and approximately 120 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80-100 ft wide. Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts to be excavated from preconstructed fills built to required flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft. • Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres. • After tunnel construction, shafts would be backfilled leaving smaller permanent steel pipe or formed concrete shafts. • Shafts for parallel tunnels would be staggered but would be in the same general vicinity.
Intermediate ventilation shafts	• To facilitate tunnel ventilation and tunnel safety. • Placed midway between launch shafts along the tunnel alignment. • For Tunnel 2, approximately 180 ft deep and approximately 90 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80–100 ft wide. • Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts to be excavated from preconstructed fills built to required flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft.

Construction Element/Activity	Key Construction Information or Assumptions
	• Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres. • Shafts for the parallel tunnels would be staggered but would be in the same general vicinity.
TBM Retrieval Shafts	• Located the end of each machine drive to retrieve it at potentially six locations. • For Tunnel 2, approximately 180 ft deep and approximately 90 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80–100 ft wide. • Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts to be excavated from preconstructed fills built to required flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft. • Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres. • Shafts for the parallel tunnels would be staggered but would be in the same general vicinity. • After tunnel construction, shafts would be backfilled leaving smaller permanent steel pipe or formed concrete shafts.
Surge tower at IPP	• A surge shaft connected to the pumping plant discharge piping is recommended at the IPP. The surge shaft height is proposed to be 10 to 15 ft above the maximum operating hydraulic grade line.
RTM storage/ disposal areas	• For additional details of RTM storage, see Table 3C-7**,** *Borrow/Spoils/Reusable Tunnel Material Storage*; Chapter 3, *Description of Alternatives*; and Appendix 3B, *Environmental Commitments*.
Construction work areas	• Construction work areas may include offices, parking, shop, short-term segment storage, fan line storage, crane, dry houses, settling ponds, daily spoils piles, temporary RTM storage, power supplies, air, water treatment, and other requirements. May also contain space for slurry ponds if slurry wall construction is required. • Work areas for RTM handling and permanent spoils disposal would also be necessary.

Pipelines
Clear and grub/ demolition
Dewatering
Excavate and export
Excavate and haul off excess
Excavate and stockpile
Excavate and haul to stockpile
Place pipe bedding
Place backfill slurry
Install and remove sheet piles
	Pipeline Reaches (See Appendix 22B, *Air Quality Assumptions* for construction schedules)
	• Intake 1 to the junction with Intakes 2 and 3 (south side of the Sacramento River):
	  ○ Two parallel, 16-foot-diameter pipelines.
	  ○ Approximate length: 9,300 ft.
	• Intake 2 to the junction with Intake 1:
	  ○ Two parallel, 16-foot-diameter pipelines.
	  ○ Approximate length: 800 ft
	• Intake 3 to the IF:
	  ○ Two parallel, 16-foot-diameter pipelines.

Construction Element/Activity	Key Construction Information or Assumptions
Load, haul, compact from stockpile Regrade ROW Place invert concrete Flow meter vault concrete Place wall concrete Flow meter vault concrete Elevated slab Roof falsework	○ Approximate length: 19,700 ft • Intake 4 to the IF: ○ Two parallel, 16-foot-diameter pipelines. ○ Approximate length: 7,820 ft • Intake 5 to the IF: ○ Two parallel, 16-foot-diameter pipelines. ○ Approximate length: 4,150 ft
Fencing	• Access openings would be provided where acceptable and necessary. • A woven wire fence (4 ft tall topped with barbed wire) or a barbed wire fence (4.5 ft tall) may be used. • Higher security fencing with 8-foot tall chain link fences and/or razor wire may be used where appropriate for security fencing in work or other facility areas. • The fencing requirements would be continuous for all intermediate facilities. • At intermediate facilities, the more stringent of the ROW or facility fencing requirements would be used. If the facility fencing is to be placed directly adjacent to the facilities, both ROW and facility fencing would be used.
Dismantling	• After construction of the tunnels, the launching and retrieval shafts would be backfilled around steel pipes or formed concrete pipes, or would be cast against reusable forms to the required finished diameter and geometry.

INTERMEDIATE FOREBAY (IF) (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)
Maintenance roads
Dewater forebay Excavation
Excavate
Remove unsuitable
Cut/fill build levees
Moisture condition suitable soil
  Construct drying beds
  Load and haul to levee
  Slope finish
  Bottom finish
  Levee top finish
Slope protection
  Place riprap, bedding material, fabric
  Concrete stilling basin
  Headwall concrete
Gravity bypass system or outlet control structure
	Conceptually designed as hydraulically isolated from other Delta waterways. The only source of water would be the Sacramento River via the new pipeline/tunnel conveyance intakes. The only outlets from the intermediate forebay (IF) would be to the tunnels conveying water to BTF via the new IPP and gravity bypass system.
	• Water in the IF is held temporarily until allowed to flow or be pumped into the tunnel on the south side of the IF through either the gravity by-pass system or the intermediate pumping plant.
	• 925-acre surface footprint (Alternative 5: 480 acres).
	• 760-acre water surface area (Alternative 5: 300 acres).
	• Active storage volume 5,250 acre-feet (af) (Alternative 5: 2,100 af).
	• The IF would be developed by constructing a ring dike to surround the forebay. With the exception of the inlets and the outlet, the ring dike would be constructed of engineered fill.
	• The water surface area of the IF is approximately 750 acres at elevation 15 ft.
	• The IF would store water at an elevation more than 6 ft higher than the surrounding land.
	• The bottom elevation of the IF is proposed to be +0.0 ft except locally at the inlet and outlet connections. The incoming tunnel outlet invert would be at elevation -32.2 ft and discharge to a concrete apron, rising at a 20% slope to elevation +0.0 ft. The Intake 4 and 5 pipeline outlet inverts would be within a transition structure at approximately elevation -22.0 ft.
	• At the south end of the IF, an approach channel, approximately 1,500 ft long and 1,300 ft wide, would connect the IF outlet to the new IPP and the gravity bypass system. The invert of the approach channel would deepen from +0.0 ft to -30.3 ft, matching the depth at the IPP.
	• The IF connection to the gravity bypass system would be just to the west of the connection to the IPP. The invert of the approach channel would gradually deepen from +0.0 ft to approximately -5.0 ft. Flow to each of the two gravity bypass pipes would be controlled by a radial gate.

Construction Element/Activity	Key Construction Information or Assumptions
	• An emergency spillway located at the southeast corner of the IF would carry spill flow to a concrete stilling basin within an 11-acre detention basin located between the IF and Snodgrass Slough. • 150-foot-long spillway would be constructed of roller-compacted concrete (RCC) in place of embankment at the southeast corner of the IF. A short segment of additional embankment would be constructed at the south end of the eastern perimeter to enclose the small stilling basin (if present) between the IF and Snodgrass Slough. • Stop logs would be installed at the three pipeline connections and roller gates would be installed at the tunnel connection to hydraulically isolate the Sacramento River from the IF • The planned embankment crest elevation for the IF would be +32.2 ft, which includes considerations for SLR. The toe of the new embankment would be set at 100 ft from the toe of the parallel old UPRR ROW to the east, and 300 ft from the toe of the parallel existing Snodgrass Slough right bank levee to the southwest. Excavation at the toe of the existing embankment and levees may require the use of tied-back sheet piles, dewatering, and other geotechnical precautions to prevent failure of existing embankments and levees. The embankment cross-section would consist of engineered fill placed on suitable foundation material at a 3H:1V slope on both the inboard and outboard sides of the embankment. • The new stilling basin embankments between the IF and Snodgrass Slough would start at the IF with a matching crest elevation of +32.2 ft, then gradually slope down to +6 ft. The crest width would be maintained at 24 ft. As with the IF embankments, these embankments would consist of engineered fill placed on suitable foundation material at a 3H:1V slope on both the inboard and outboard sides of the embankment. The inboard slopes would be armored with riprap from +3.5 to +14.0 ft. The new embankment for the IF would be constructed by excavating the embankment foundations down to suitable material, dewatering, then constructing the embankments of compacted fill to the desired height. • Approximately 34,075 cy of earth would be excavated from portions of the IF (including embankment foundation) to provide maximum invert elevation of +0.0 ft. Those portions of the IF already below +0.0 ft would remain at the existing elevation. • Approximately 4,000,000 cy of fill material would be required for the IF embankments • The required embankment material would be borrowed from within the limits of the respective forebays. • Dewatering and/or moisture conditioning of the soils would likely be required.
IF transition structures	The pipeline conveyance from Intakes 3, 4, and 5 would discharge to the IF through IF transition structures from each intake. • Above-grade footprints: approximately 90 ft x 135 ft. The majority of the structures would be below ground. • Approximately 2 ft of the perimeter and dividing walls would be above the surrounding grade. • An access platform would be 2 ft above grade for the length of the structure across the forebay entrance. • Walls and access platforms would be concrete. A portion of the IF section in the vicinity of the transition structure would be armored with concrete. • The grade for the structures would be set at the same elevation as the top of the forebay embankment (approximately 30 ft above the existing grade). • Uncovered channels would be open to above.

Construction Element/Activity	Key Construction Information or Assumptions
	• A 3-rail, 3.5 ft tall handrail would be provided around the perimeter. • A gantry crane may be placed on top of the walls with a frame approximately 30 ft tall and 10 ft wide. • Temporary parking areas during construction would be within the 1 to 5 acre construction staging area for each transition structure. • Parking during operation may be available on forebay maintenance roads adjacent to and around three sides of the facilities, approximately 24 ft wide x 400 ft long
Gravity bypass system Bypass inlet structure Excavate and stockpile Place gravel bedding Drive foundation piles Place concrete fill in piles Bypass slab on grade Wall concrete Roof concrete Roof falsework Load/Haul/Compact/ Stockpile Bypass piping Excavate and export Install and remove sheet piles, wales and struts Stage, handle, place pipe Weld pipe (26 ft; 1 in thick) Place backfill slurry Load/Haul/ Compact/ Stockpile Flex couplings, air valves	Two 26-ft diameter gravity bypass pipelines, configured so they can be isolated to allow for maintenance and inspection. • Controlled by radial gates at the inlet structure. • Each pipeline connects to a 26-ft diameter manifold that transitions into six 11-ft pipelines that pass through a concrete valve vault and connect to either 33-ft diameter bore of Tunnel 2. • The valve vault is an enclosed structure, 33 ft x 230 ft, approximately 30 ft above grade. • The bypass structure is constructed of concrete, adjacent to the intermediate pumping plant. The majority of the structure would be below ground. • Approx. 2 ft of the perimeter and dividing walls and walking platforms would be above the surrounding grade. The grade for the structure is set at the same elevation as the top of the forebay embankment (3C-20approximately 30 ft above the existing grade). • Channels would be open to above. • A handrail, potentially 3-rail, 3.5 ft tall, would be provided around the perimeter. • Radial gates would be provided. • A gantry crane may be placed on top of the walls with a frame that is approximately 30 ft tall and 10 ft wide. • Checkered plate walkways and a staircase would be provided in the valve vaults for safe access/ingress. • Excavate and haul to stockpile: 172,016 cy • Excavate and export: 100,862 cy • Haul from stockpile and compact: 120,396 cy
Excavation and backfill	• Excavate, direct haul, and compact: 3,940,000 cy • Excavate and haul to stockpile: 7,518,333 cy • Excavate and export: 1,030,000 cy
INTERMEDIATE PUMPING PLANT (IPP) (Alternatives 1A, 2A, 6A, 3, 5, 7, and 8)	• One intermediate pumping plant (IPP) would be constructed and operated to sustain water levels in the BTF required for optimal pump operations at both Banks and Jones Pumping Plants when the gravity bypass is not utilized. • Required to overcome head loss (energy loss) due to friction as the water is conveyed along the very flat terrain to the delivery pumping plants in the South Delta. • Location depends on choice of alignment. • **Pipeline/Tunnel Alignment:** At southern end of IF; 10 pumps with capacity of 1,500 cfs each (high head); 6 pumps with 1,500 cfs capacity (low head). (For the purposes of modeling, it was assumed that these parameters would apply to all P/T alternatives; however, fewer pumps and/or pumps with different capacities would likely be constructed under Alternatives 3, 5, 7, and 8)
Dewatering	Dewatering is expected to be continuous during construction.
Excavation and backfill	• Excavate and haul to stockpile: 1,730,897 CY for borrow and 843,683 CY for excavator for the intermedatie pumping plant.

Construction Element/Activity	Key Construction Information or Assumptions
Pipelines excavation and backfill	Pipeline/Tunnel: IPP to tunnel • Excavate, haul to stockpile, haul from stockpile and compact: 125,168 cy • Excavate and export: 149,700 cy East: IPP to canal transition structure • Excavate and haul to stockpile, haul from stockpile and compact: 13,845 cy • Excavate and export: 120,962 cy West: IPP to tunnel • Excavate and haul to stockpile: 68,931 cy • Haul from stockpile and compact: 34,563 cy
Approach channel (Pipeline/ Tunnel Alignment)	• Flow from the IF would be directed to the IPP (outlet control structure under Alternative 4) via an approach channel at the southern side of the forebay. • Flow from the approach channel would be directed to each pump intake through wall openings with isolation gates to allow pump wells to be dewatered for maintenance. • Trash racks would be used upstream of the pumps for pump protection. • Discharge pipes from the 1,500-cfs lower head pumps each would be 132-inch diameter, • Discharge pipes from the 1,500-cfs higher head pumps each would be 144-inch diameter. (Pipe sizes would vary depending on the pump supplier.) • Flow from the pumps would be discharged into a transition manifold for transfer to the pressurized tunnels. • Requires excavation, stockpiling, placing stockpile material, and concrete work. • Excavate and haul to stockpile/haul from stockpile and compact: 11,520 cy; excavate and export: 172,560 cy
Transition manifold	• A maximum 33 ft diameter pipe manifold and valve vault that connects the 16 pipes (11 ft and 12 ft diameters) from the IPP to the two 33 ft diameter pipelines. • Manifold and all pipes are underground. • The valve vault is a concrete, enclosed underground structure, with an approximate 6" height of walls/roof above grade, and would have access through a manhole in the roof of the structure.
Weir structure/ Surge towers	Two 33-ft diameter (minimum) surge towers. • Elevation approximately 105 ft (NAVD88) at the rim. • Dewatering • Excavate & Export 263,895 cy • Excavate & Stockpile/haul from stockpile and compact: 50,265 cy • Backfill • Place Bedding • Drive Foundation Piles • Place Concrete Fill In Piles • Invert Concrete • Flow Meter Vault Concrete • Wall Concrete • Flow Meter Vault Concrete
Tunnel outlets to forebays	• Tunnel outlets would be concrete. • The level surface at each of the tunnel outlet sites (into the intermediate forebay and the Byron Tract Forebay) is approximately 160 ft x 140 ft. • The grade for the level surface would be set at the same elevation as the top of the forebay embankment (approximately 20–30 ft above the existing grade). • The majority of the tunnel outlet structures would be below grade/ground.

Construction Element/Activity	Key Construction Information or Assumptions
	• Gantry cranes for each tunnel, with an approximate 50 ft tall and 50 ft wide frame, and equipment for opening and closing tunnel gates would be set on top of grade. • Control buildings, possibly 20 ft x 20 ft and 20 ft tall, may be located at each tunnel outlet. These may be framed of timber, CMU, steel or metal studs.
Substation and exterior transformers	• A main 230 kV substation and a main 69 kV substation would be constructed adjacent to the intermediate pumping plant (IPP), at the flood protection elevation, and provide power to the IPP, control structures and intake facilities. See *Power Supply and Grid Connections*
General construction work areas	• Anticipated construction area for the IPP is approximately 110 acres. • Of this, approximately 20 acres would be specific to the area for temporary construction needs (including on-site temporary parking, office trailers, staging, equipment laydown and storage). • Of this, approximately 15 acres would be specific to the area for temporary construction needs (including onsite temporary parking, office trailers, staging, equipment laydown and storage).
Utilities	• See Table 3C-6, *Power Supply and Grid Connections.*
Roads	• See Table 3C-8, *Access and Construction Work Areas.*
Fencing	• Security fencing, with access control gates, would be placed along the perimeter of the pumping plant facilities. • A 6-foot chain link fence installed around the pumping plant and enclosing the surge towers and gravity bypass structure for ROW fencing. • A substation adjacent to the pumping plant would be fenced with a 6-foot chain link fence with a climbing barrier. More stringent fencing with 8-foot tall chain link fences with climbing barrier and/or razor wire may be used at the pumping plant or substation facilities for security fencing in work or other facility areas. • Masonry walls, 6 to 8 ft tall, may be used within the facilities.
Landscaping/vegetation	• See Landscaping/vegetation under North Delta Intakes, above.
Control structures	While the types of control structures used within and among alignments would vary, controls generally affect the hydraulic grade line at low flow rate by creating additional headlosses to allow better pump selection and more efficient operation over the full range of flows, from 500 to 15,000 cfs. The proposed controls include the following. • Approximate footprint of 90 x 100–160 ft. • Walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • Control structure walls and access platforms would be concrete. • Site grade would be set at the same elevation as the top of the concrete lining that extends 280 ft up- and downstream of the facilities. • The top of the concrete lining is set 29 ft above the structure invert. • A handrail, potentially a 3-rail 3.5 ft tall, would be provided around the perimeter of the access decks. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the control structures. • Butterfly valves at Intakes 1 and 2 to start the pumps for operation at low flow or against low downstream water surface elevation (WSE) • Transition structures at Intakes 3, 4 and 5, with a weir crest elevation near 25 ft (the IF maximum WSE). These structures would provide back pressure on the pumps for operation at low flow or against low downstream WSE. • Weir structure on the 33-foot-diameter conveyance pipeline that leads to each of the two 33-foot-diameter tunnels, with a crest elevation near 30 ft (5 ft above the IF maximum WSE). The weirs would provide back pressure on the

Construction Element/Activity	Key Construction Information or Assumptions
	pumps for startup conditions, when pump operation is required to achieve flows in excess of the capacity of the gravity bypass. • Gravity bypass (one per tunnel) at the IPP, controlled by radial gates at the inlet structure. The gravity bypass system would operate during low flow conditions and when positive gradient is available between the two forebays. Each gravity bypass is sized for a design flow of 3,500 cfs (total capacity 7,000 cfs). • Under the modified pipeline/tunnel alignment, an outlet structure would operate in lieu of the IPP (see *Outlet Structure* under *Intermediate Forebay* features, above)
Byron Tract Forebay (Alternatives 1A, 2A,3, 5, 6A, 7, and 8)	• Byron Tract Forebay (BTF) would be constructed adjacent to CCF to balance daily variations in inflow and outflow to Banks and Jones pumping plants. See Table 3C-4, *Byron Tract Forebay/Expanded Clifton Court Forebay*.
Utilities	• See Table 3C-6, *Power Supply and Grid Connections.*
Control structures	• Siphon and control structures have approximate footprints of 70 ft x 160 ft at siphon inlets, 30 ft x 160 ft at siphon outlets and 90 ft x 160 ft at control structures. • The siphon and control structure walls and access platforms would be concrete. • The walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • The site grade would be set at the same elevation as the top of the canal concrete lining that extends 280 ft up and downstream of the facilities. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the siphon inlets and the control structures. • The gates, in the open position, and the control building may extend above the top of the canal embankment. The remainder of the facilities are likely not to be visible over the top of the embankment.
New access roads	See Table 3C-8, *Access and Construction Work Areas.*
General construction work areas	See Table 3C-8, *Access and Construction Work Areas.*
Rock pile protection	• Rock protection would likely be placed from a barge by a clam shell • Length of permanent bank protection would be 100–2,200 ft. • Area of dredging and channel reshaping would be approximately 2.5–7 acres.

Table 3C-4. Byron Tract Forebay/Expanded Clifton Court Forebay—Alternatives 1A, 2A, 3, 5, 6A, 7, and 8

Construction Element/Activity	Key Construction Information or Assumptions
Byron Tract Forebay (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8) • For Pipeline/Tunnel, BTF would be constructed on the southeast side of Clifton Court Forebay. • Construction may require short shut downs of the existing conveyance system to the Banks and Jones Pumping Plants, to add new control structures to the existing pumping plant approach canals and when BTF is connected to the existing canals. • Water in CCF and Old River would be controlled to prevent blowout of the embankments due to seepage.	
Primary maintenance road **Dewatering** **Excavate and haul off unsuitable** **Cut/fill-build levees** **Export suitable** **Slope protection** **Place riprap, bedding material, fabric**	• The Pipeline/Tunnel conveyance would deliver water near the northeast corner of BTF. The inlet is planned to be controlled by roller gates to isolate the tunnel during dewatering and tunnel maintenance. • The bottom elevation of BTF would be -10.0 ft except locally at the inlet and outlet connections. The tunnel outlet invert would be at EL -45.6 ft. Similar to other tunnel outlet discharges, the tunnel would discharge to a concrete apron, rising at a 20% slope to EL -10.0 ft, meeting the BTF invert elevation. • A new section of canal, approximately 2,000 ft long and situated between CCF and UPRR, would connect BTF to the existing approach canal to the Banks Pumping Plant. A 50-foot-wide buffer separates the toe of the approach canal embankment to the centerline of UPRR. • The new approach canal would deepen from -10.0 ft to -27.9 ft, matching the depth at the existing approach canal to the Banks Pumping Plant. A radial gate control structure would be installed at the upstream end of this new approach canal to hydraulically isolate the existing SWP facilities from BTF. The nominal capacity of this canal would be 10,300 cfs. The connection to the existing approach canal would be at an angle of 60 degrees. • The forebay would be connected to the existing approach canal to the Jones Pumping Plant by breaching a section of the existing canal's embankment adjacent to BTF. The invert of this canal would be at EL -17.4 ft to match the invert of the existing Jones Pumping Plant approach canal at the connection point. A radial gate control structure would be installed at this connection to hydraulically isolate the existing CVP facilities from BTF. This canal would have a capacity of 4,600 cfs matching the capacity of the Jones Pumping Plant. • To provide the ability to isolate BTF from CCF, a new gate structure would be constructed in the existing approach canal downstream of the Skinner Facility. • To provide the ability to isolate BTF from Old River, a new gate structure would be constructed in the existing approach canal to the Jones Pumping Plant just upstream of the connection from BTF. • The planned embankment crest elevation for BTF and approach canals would be +24.5 ft, which includes considerations for SLR. This protection level would gradually lower at an approximately 10% slope to where the forebay approach canal meets the embankment elevation of the existing approach canal to either the Banks or Jones Pumping Plant. The toe of the new embankment would be set at 50 ft from the toe of the parallel existing embankment or levee. Excavation at the toe of the existing embankment and levees may 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 would consist of engineered fill placed on suitable foundation material at a 3H:1V slope on both the inboard and outboard sides of the embankment. The embankment crest would be 20 ft wide to provide road access consistent with existing embankment design. In addition, 28-foot-wide maintenance roads would be provided on the inboard slopes of the new approach canal, joining the roads at the existing approach canal to the Banks Pumping Plant. The forebay side of the new embankment would also be armored with riprap from +0.0 ft (just below the minimum design WSE of +0.5 ft) to +13.5 ft (the top WSE of +9.5 ft plus an additional 4 ft to account for transient waves). • Under the Pipeline/Tunnel Alignment, BTF permanent footprint would be 840 acres, with 600-acre water surface area, and storage volume of 4,300 af. (Under Alternative 5, Byron

Construction Element/Activity	Key Construction Information or Assumptions
	Tract Forebay would be 300 acres, with a 200-acre water surface area, and a storage volume of 1,433 af.) • Byron Tract would be excavated to provide an invert of -10.0 ft over the entire basin (including embankment foundation) requiring the removal of 14,000,000 cy of material, total. • Dewatering would be required for excavation operations. Most of this material is expected to be unsuitable for use in embankment construction and would require disposal • To the extent possible, spoils would be placed in the area between the existing CCF embankments and new forebay embankments, which are offset by 50 ft toe-to-toe. This area would require temporary storage of disposal materials until the new forebay embankment is constructed. • Approximately 30% of the excavated material below the peat layer may be suitable for use as embankment, and would be used in construction of the BTF embankment. • The new embankments for the BTF would be constructed by excavating the embankment foundations down to suitable material, dewatering, then constructing the embankments of compacted fill to the desired height. • Approximately 3,000,000 cy of fill would be required for the BTF embankments. • The required embankment material would be borrowed from within the limits of the respective forebays. • Dewatering and/or moisture conditioning of the soils would likely be required.
Connections to CVP and SWP Systems	• An approximately 2,000 ft long canal would be constructed to connect the Byron Tract Forebay with the Banks Pumping Plant, with a series of radial gates to isolate facilities. • Another series of radial gates constructed in an opening in the embankment of the Byron Tract Forebay would allow for the control of water flow between the forebay and the approach canal to the Jones Pumping Plant. • The canal would be formed by earth embankments constructed of compacted engineered fill where the canal water surface elevation is generally above existing ground. • The crests of the embankments would be wide enough to allow for 2 maintenance vehicles traveling in opposite directions to pass each other. • The canal would be designed with 2 ft of concrete-lined freeboard plus 2 ft of unlined freeboard on the water side. • Waterside embankments could include wind and wave erosion control, such as concrete lining, riprap, or lining with articulated concrete mat.
Excavation	• Canal construction would include use of scrapers, excavators, and/or draglines. • Organic and peat soils deemed unsuitable for support of the canal embankments (up to 25 ft deep in some areas), would be removed and disposed of offsite. This full-depth removal could be limited to the area of the embankment foundations. • Liquefiable soils would need to be removed or stabilized as part of the excavation for the canal embankments. Pipeline/Tunnel Alignment • 6,646,587 CY borrow • 292,768 CY excavate • 7,100,000 CY dredge for the CC Forebay
Seepage Control	• Installation of a slurry cutoff wall through the canal embankments would be necessary to control seepage. • Control efforts could include the use of a drainage ditch parallel to the canal, and the installation of pressure relief wells along the drainage ditch to collect subsurface water and direct it into the parallel drainage ditch. • Open channel, gravity flow, and concrete flumes (overchutes) that pass runoff over the canals could be used where canals are built into a hillside. • Overchutes would require piers similar to bridges to support the structure and would span the width of the canals.

Construction Element/Activity	Key Construction Information or Assumptions
	• Corrugated metal pipe and steel pipe could be used to convey stormwater runoff from adjacent lands over the canals. • A 5 ft deep drainage ditch would be constructed along both sides of the canal where the ground slopes towards a canal on both sides. These ditches would connect to the existing drainage system. • Drainage water could be routed under a canal in a culvert, over a canal in an overchute, or to a collection basin for conveyance to surface waters by gravity or a pump station.
Roads	• Roads on each side of the embankments would provide maintenance access and access to areas intercepted by the canal. • See Table 3C-8, *Access and Construction Work Areas.*

Table 3C-5. Head of Old River Barrier—Alternative 2A

Construction Element/Activity	Key Construction Information or Assumptions
Head of Old River Barrier • Operable barrier (fish control gate) and boat lock would be located at the divergence of the head of Old River and the San Joaquin River, to prevent migrating and outmigrating salmon from entering Old River from the San Joaquin River. • Other components: fish passage (fish passage structure); control building to house emergency generator, control panels for the control gates, circuit breakers; storage area for operation and maintenance equipment; boat lock operator's building; communications antenna • Gate would have an permanent storage area of 180 ft x 60 ft and operator parking. • Fencing and gates would control access to the structure. • Access road would be improved with 2 miles of private access road, minimum 16 ft wide with gravel surface, beginning at the end of Undine Road and running east to the San Joaquin River levee, then south and west along the levee to the gate site. • A construction staging area of approximately 10,000 square ft would be located on the south side of Old River just outside the levee roads. • A sheetpile retaining wall would be installed in the levee where the gate would be constructed. • Complete gate would require approximately 1,500 cy of concrete. • Approximately 11,000 square ft (450 linear ft) of riprap would be used as slope protection on levees near the gate and on the channel bottom. • Fine materials such as sand would be placed adjacent to the riprap to create a smooth slope from channel bottom to the gate sill.	
Fish control gate	• Approximately 210 ft long x 30 ft wide, top elevation 15 ft (NJAVD 88). • Seven bottom-hinged gates approximately 125 ft long. Fish passage structure • Vertical slot, self-regulating, with four sets of baffles. • To be designed according to NOAA Fisheries and USFWS guidelines for species including salmon, steelhead, and green sturgeon. • Approximately 40 ft long x 10 ft wide. • Constructed of reinforced concrete. • Stoplogs would be used to close the fish passage structure in spring when not in use to protect it from damage. Operable barrier Two potential gate construction methods. • *Cofferdam:* Creates a dewatered construction area for ease of access and egress. Construction would take place in three phases between 2022-2024 and in-water work could continue through winter.

Construction Element/Activity	Key Construction Information or Assumptions
	○ Construct cofferdam in half the channel, dewater, and construct gates on the dewatered channel bottom and adjacent levee. Remove or cut off cofferdam at required invert depth. Construct cofferdam in second half of the channel. ○ Construct gate in the other half of the channel using same methods, remove or cut off cofferdam, and incorporate into the final gate layout. Construct equipment storage area and remaining fixtures. ○ Cofferdam construction would begin in August and last approximately 35 days. ○ Construction activities in the cofferdam project area would last until approximately early November, and could continue through winter. • *In-the-wet:* Allows the river to flow unimpeded and eliminates the time, material, and cost of constructing a cofferdam. No cofferdam or dewatering, no levee relocation. ○ The channel invert would be excavated to grade using a sealed clamshell excavator working off the levee or from a barge. ○ H-piles would be placed in the channel. ○ Gravel and tremie concrete would be placed for the foundation within the confines of the H-piles. ○ Reinforced concrete structures would then either be floated in or cast in place using prefabricated forms to be placed on top of the gravel, tremie concrete, and H-piles. ○ Divers would complete the final connections between the concrete structures and the piles. ○ All in-water work would occur between August 1 and November 30 to minimize effects on delta smelt and juvenile salmonids. ○ Construction of other components would take place from a barge or from the levee crown and would occur throughout the year.
Boat lock	• 20 ft wide x 70 ft long • Would be constructed using sheetpiles and include two bottom-hinged gates on each end measuring 20 ft wide and 10 ft high. • The invert of the lock would be at elevation –8.0 ft msl, and the top of the lock wall would be at elevation 15 ft.

Table 3C-6. Power Supply and Grid Connections—Alternatives 1A, 2A, 3, 5, 6A, 7, and 8

Construction Element/Activity	Key Construction Information or Assumptions
Power supply and grid connections	• The electrical power for all facilities would be delivered through a 230 kV transmission line, owned by either the utility or the project, which interconnects with a local utility at a new utility substation assumed to be constructed within or adjacent to the utility's existing transmission ROW. The 230 kV main substation and a 69 kV main substation would be constructed next to the intermediate pumping plant (IPP), at the flood protection elevation. At the main 230 kV substation, the electrical power would be transformed from 230 kV to 69 kV and delivered to the adjacent main 69 kV substation. • From there, power would be delivered directly to the adjacent IPP and over 69 kV subtransmission lines to control structures and 69 kV substations located adjacent to each intake structure. • At the main 69 kV substation and at each intake substation, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. • Construction generally includes three phases: site preparation, tower/pole construction, and line stringing. These phases would include the use of the following types of equipment: bulldozer, backhoe, crane, line truck, water truck, dump truck,

Construction Element/Activity	Key Construction Information or Assumptions	
	Man 222HD, concrete truck, Man 555 150T, helicopter (MD 500D/E), and other equipment. • New transmission lines would generally follow conveyance alignments and be constructed within the project ROW. • Construction of 230 kV and 69 kV lines would require a corridor width of 100 ft, and 100 ft on one side and 50 ft on the other side at each tower pole. • Construction would also require an area of 350 ft along the corridor at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • Construction of separate 12 kV lines would require a corridor of 25 to 40 ft, with 25 ft in each direction at each pole. • Construction would also require 200 ft along the corridor and a 50-ft wide area at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • The work area for a pole-mounted 12 kV/480 volt transformer would only be that normally used by a utility to service the pole (about 20 ft by 30 ft adjacent to the pole). • The work area for a pad-mounted transformer would be approximately 20 ft by 30 ft adjacent to the pad. • Transmission lines from the 69 kV substation would be strung on wood power poles approximately 40 ft tall.	
	Intermediate pumping plant substation footprint	Pipeline/tunnel alignments 230 kV: 260 x 44 ft 69 kV: 270 x 310 ft Approx. 270 x 270 ft.
	Intake pumping plant 69 kV substation footprint	At the main 69 kV substation and at each of the intake substations, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures.

Table 3C-7. Borrow, Spoils and Reusable Tunnel Material Storage—Alternatives 1A, 2A, 3, 5, 6A, 7, and 8

Construction Element/Activity	Key Construction Information or Assumptions
BORROW/SPOILS/RESUABLE TUNNEL MATERIAL (RTM) STORAGE • Final locations for storage of spoils, RTM, and dredged material would be selected based on the guidelines presented in Appendix 3B, *Environmental Commitments*. • Conventional earthmoving equipment, such as bulldozers and graders, would be used to place the spoil. Some spoil, with the exception of RTM, may be placed on the landside toes of canal embankments and/or setback levees. • This may require temporary placement of the soil in borrow pits or temporary spoil laydown areas pending completion of embankment or levee construction. Borrow pits created for this project would be the preferred spoil location. • In the event that limited dewatering is required to excavate a borrow pit, construction shall be timed to allow placement of spoil in the borrow excavation to prevent the creation of new wetlands, if appropriate.	
Pipeline/Tunnel Alignment (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)	• A total of approximately 1,595 acres would be allocated to RTM storage for the pipeline/tunnel. • Designated RTM storage areas would range in size from approximately 100 to 570 acres. • The estimated volume of RTM to be disposed from the tunnels and shafts is approximately 25,000,000 cy.

Construction Element/Activity	Key Construction Information or Assumptions
	• RTM that may be have potential for re-use, such as levee reinforcement, embankment or fill construction, would be stockpiled. The process for testing and reuse of this material is described further in Chapter 3 and Appendix 3B. • A berm of compacted imported soil would be built around the perimeter of the RTM storage area to ensure containment. Berm would conform to U.S. Army Corps of Engineers guidelines for levee design and construction. • It was assumed that RTM would be stacked to a depth of 10 ft. • Maximum capacity of RTM storage ponds would be less than 50 af. • RTM areas may be subdivided by a grid of interior earthen berms in RTM ponds for dewatering. • Dewatering would involve evaporation and a drainage blanket of 2 ft-thick pea gravel or similar material placed over an impervious liner. • Leachate would drain from ponds to a leachate collection system, then pumped to leachate ponds for possible additional treatment. • Transfer of RTM solids to disposal areas may be handled by conveyor, wheeled haul equipment, or barges, at the contractor's discretion. • The invert of RTM ponds would be a minimum of 5 ft above seasonal high groundwater table • An impervious liner would be placed on the invert and along interior slopes of berms, to prevent groundwater contamination. • RTM would not be compacted. • Spoil placed in disposal areas would be placed in 12-inch lifts, with nominal compaction. • A total of approximately 1,220 acres would be allocated to borrow acquisition and/or spoil deposition. • The maximum height for placement of spoil is expected to be 12 ft above preconstruction grade and have side slopes of 5H:1V or flatter. • After final grading of spoil is complete, the area would be restored based on site-specific conditions following project restoration guidelines.

Table 3C-8. Access and Construction Work Areas—Alternatives 1A, 2A, 3, 5, 6A, 7, and 8

Construction Element/Activity	Key Construction Information or Assumptions	
General construction work areas	Work areas during construction may include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Materials to be stockpiled may include: • Strippings from various excavations for possible reuse in landscaping. • RTM that is slated for reuse after treatment for embankment or fill construction. RTM areas may be temporary or permanent. • Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section). • Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas.	Other temporary work areas not specified at left include those associated with the construction of canals, control structures, forebays, intakes, levees, operable barriers, pipelines, pumping plants, safe haven zones, siphons, and tunnels. Areas would also be dedicated to temporary transmission lines. • Pipeline/Tunnel Alignment: between 670 (Alternative 5) and 1,750 acres (Alternative 2A with Intakes 6 and 7).

Construction Element/Activity	Key Construction Information or Assumptions	
	• Borrow and spoils areas may be temporary or permanent.	
Roads	• Wet weather (asphalt paved) • Dry weather roads (minimum 12 inch thick gravel or asphalt paved) for construction activities restricted to dry season • Dust abatement would be addressed in all construction areas at all times. • All-weather roads (asphalt paved) would be required for year-round construction at all facilities, including concrete and steel structures, tunnel portals, tunnel shafts, pumping plants and intakes, and for access to delivery areas and permanent RTM spoil piles. • Permanent paved access road is anticipated along the conveyance pipeline for the canal primary and secondary access road. • Asphalt-paved wet weather temporary access road to provide construction access to the conveyance pipe construction between the canal and the intake facility. • Asphalt-paved temporary access ramps to connect existing public and private roads to construction sites would be constructed to connect to the existing roadways at the existing grade. • Asphalt-paved permanent access ramps would be constructed to the elevated roadways at the final grades. • Heavy construction equipment, such as diesel-powered dozers, excavators, rollers, dump trucks, fuel trucks, and water trucks would be used during excavation, grading, and construction of access/haul roads.	The physical extent of these areas (includes Bridge Work Areas, Highway Work Areas, Road Work Areas, and Temporary Access Road Work Areas) would depend on the conveyance alignment. Additionally, some road work areas are subsumed within the construction footprints associated with other features (i.e., Intakes, Safe Haven Work Areas, etc.). Pipeline/Tunnel Alignment: • Approximately 10 acres. • From launching/retrieving shafts to public road. • From each ventilation shaft to public road. • Access roads between shafts.
Detour roads	• *Intakes:* Detour roads needed for all intakes, for traffic circulation around the work areas. It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Roadway detours would likely be needed around each intake's construction zone (including intake pumping plant construction area) to provide site security and safety.	• It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Import and compact 971,500 cy
Temporary and new access/haul roads	Temporary • Access roads would be constructed from each intake pumping plant to the Sacramento River levee. • 24-foot-wide • Excavated alluvial mineral soils may be used, though additional material may have to be imported onsite.	Permanent • Intake site perimeter access road (approximately 24 ft wide x 2,500 ft long). • Intermediate pumping plant (during operation): The canal primary access road is proposed to be 24 ft wide paved with asphaltic concrete and the secondary access road is

Construction Element/Activity	Key Construction Information or Assumptions	
		proposed to be 20 ft wide with a 12 ft wide gravel section.
Parking	• See Table 3C-1, *Water Assumptions for Water Conveyance Facilities*.	
Temporary barge unloading facility construction and removal	• May be located at each of the five intake structure worksites, tunnel worksites, and culvert siphon worksites, to be used for the delivery and removal of construction materials and equipment. • Barges would be required to use existing barge landings where possible and maintain minimum waterway width greater than 100 ft (assuming maximum barge width of 50 ft). • Under the modified pipeline/tunnel alignment, it is assumed that barge activities would take place on levees using a ramp barge in conjunction with a crane/excavator barge or a crane or excavator positioned on or near the levee. • The physical extent of these areas would depend on the conveyance alignment: • Pipeline/Tunnel Alignment: approximately 180 acres. • Approximately 300 ft by 50 ft, pile-supported dock to provide construction access and construction equipment to portal sites. • 24 inch steel piles placed approximately every 25 ft under the dock for a total of 36 piles. • Impact pile driving may take up to an average of 700 strikes per pile, depending on hammer type and subsurface conditions. • A pier would be built within the worksite footprint of the intake or tunnel and removed at the end of construction. • Facility would be in use during the entire construction period at each location, 5 to 6 years. • Barges could be used for pile-driving rigs and barge-mounted cranes, suction dredging equipment, and microtunnel drives from the in-river cofferdam, transporting RTM, crushed rock and aggregate, pipeline sections, etc., post-construction underwater debris removal, and other activities. • Access roads to construction work areas would be necessary.	• Potential locations depend on the alternative. • SR 160 west of Walnut Grove (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8) • Venice Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8) • Bacon Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8) • Woodward Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8.) • Victoria Island (Alternatives 1A, 2A, 4, 5, 6A, 7, and 8) • Tyler Island (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)

Construction Element/Activity	Key Construction Information or Assumptions
Concrete plants and precast segment plants	• Due to the large amount of concrete required for construction and the schedule demands of the program, it is anticipated that the contractor(s) would set up their own concrete plant at the job sites. Concrete plants are likely to range from 1 to 40 acres. • While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If constructed, these would be located adjacent to concrete plants. • It is likely that each precast segment plant would require approximately 10 acres for offices, concrete plant, materials storage, and casting facilities. • Additional acreage for segment storage would be needed at the precast segment plant site, and could run several times the space required for the plant. • The segments can be transported by barge, rail, or truck where these modes of transport are available; however, it is most likely that trucking of segments would be required. **Pipeline/Tunnel Alignment** • Three concrete plant plants in the southern part of Sacramento County. Size of this batching plant could be from 5 to 10 acres. • Up to six precast segment plants: Two in the southern part of Sacramento County, one in the northern part of San Joaquin County, two in the middle part of San Joaquin County, and another in the southern part of San Joaquin County.
Fuel stations	Would be constructed adjacent to concrete plants and occupy approximately 2 acres.

3C.2 East Alignment (Alternatives 1B, 2B, and 6B)

Table 3C-9. Construction Assumptions for Water Conveyance Facilities by Alignment—Alternatives 1B, 2B, and 6B

Construction Element/Activity	Key Construction Information or Assumptions
EAST ALIGNMENT (Alternatives 1B, 2B, and 6B) Chapter 3, *Description of Alternatives*, Table 3-8 provides summaries of East Alignment physical characteristics. **No intermediate forebay would be constructed under East Alignment alternatives.**	
INTERMEDIATE PUMPING PLANT (IPP) (Alternatives 1B, 2B, and 6B)	• One intermediate pumping plant (IPP) would be constructed and operated to sustain water levels in the BTF required for optimal pump operations at both Banks and Jones Pumping Plants when the gravity bypass is not utilized. • Required to overcome head loss (energy loss) due to friction as the water is conveyed along the very flat terrain to the delivery pumping plants in the South Delta. • Location depends on choice of alignment. • About 3.5 miles south of the point where the alignment crosses the San Joaquin River, within canal footprint on Lower Roberts Island; 15 pumps with capacity of 1,000 cfs per pump; 2 pumps with 500 cfs capacity
Clearing/ Grubbing/ Dewatering	Dewatering is expected to be continuous during construction.
Excavation and backfill	• Excavate and haul to stockpile: 115,000 cy • Excavate and export: 94,401 cy • Haul from stockpile and compact: 115,000 cy
Pipelines excavation and backfill	East: IPP to canal transition structure • Excavate and haul to stockpile, haul from stockpile and compact: 13,845 cy • Excavate and export: 120,962 cy

Construction Element/Activity	Key Construction Information or Assumptions
Approach channel	• The conveyance canal upstream of the intermediate pumping plant would expand from the typical canal width (340 ft at invert) to the width of the pumping plant combined pump bays (655 ft), forming a forebay of approximately 500 ft in length. • Flow from the forebay would be directed to each pump intake through wall openings with isolation gates to allow pump wells to be dewatered for maintenance. • Trash racks would be used upstream of the pumps for pump protection. • The discharge pipes from the 500 cfs pumps each would be 96-inch-diameter and the discharge pipes from the 1,000 cfs pumps would each be 132-inch-diameter. • Flow from the pumps would be discharged into a transition structure for transfer to the canal or tunnel. • Requires excavation, stockpiling, placing stockpile material, and concrete work. • Excavate, direct haul and compact 303,200 cy; import and compact 381,280 cy
Transition manifold	• A maximum 33 ft diameter pipe manifold and valve vault that connects the 16 pipes (11 ft and 12 ft diameters) from the IPP to the two 33 ft diameter pipelines. • Manifold and all pipes are underground. • The valve vault is a concrete, enclosed underground structure, with an approximate 6" height of walls/roof above grade, and would have access through a manhole in the roof of the structure.
Weir structure/ Surge towers	East Alignment: N/A
Tunnel outlets to forebays	• Tunnel outlets would be concrete. • The level surface at each of the tunnel outlet sites (into the intermediate forebay and the Byron Tract Forebay) is approximately 160 ft x 140 ft. • The grade for the level surface would be set at the same elevation as the top of the forebay embankment (approximately 20–30 ft above the existing grade). • The majority of the tunnel outlet structures would be below grade/ground. • Gantry cranes for each tunnel, with an approximate 50 ft tall and 50 ft wide frame, and equipment for opening and closing tunnel gates would be set on top of grade. • Control buildings, possibly 20 ft x 20 ft and 20 ft tall, may be located at each tunnel outlet. These may be framed of timber, CMU, steel or metal studs.
Substation and exterior transformers	• A main 230 kV substation and a main 69 kV substation would be constructed adjacent to the intermediate pumping plant (IPP), at the flood protection elevation, and provide power to the IPP, control structures and intake facilities. See *Power Supply and Grid Connections*
General construction work areas	• Anticipated construction area for the IPP is approximately 110 acres. • Of this, approximately 20 acres would be specific to the area for temporary construction needs (including on-site temporary parking, office trailers, staging, equipment laydown and storage). • Under the East Alignments, the anticipated construction area for the IPP is approximately 40 acres. • Of this, approximately 15 acres would be specific to the area for temporary construction needs (including onsite temporary parking, office trailers, staging, equipment laydown and storage).
Utilities	• See Table 3C-12. *Power Supply and Grid Connections*
Roads	• See Table 3C-14, *Access and Construction Work Areas*
Fencing	• Security fencing, with access control gates, would be placed along the perimeter of the pumping plant facilities. • A 6-foot chain link fence installed around the pumping plant and enclosing the surge towers and gravity bypass structure for ROW fencing. • A substation adjacent to the pumping plant would be fenced with a 6-foot chain link fence with a climbing barrier. More stringent fencing with 8-foot tall chain link fences with

Construction Element/Activity	Key Construction Information or Assumptions
	climbing barrier and/or razor wire may be used at the pumping plant or substation facilities for security fencing in work or other facility areas. • Masonry walls, 6 to 8 ft tall, may be used within the facilities.
Landscaping/ vegetation	• See Landscaping/vegetation under North Delta Intakes, above.
Control structures	While the types of control structures used within and among alignments would vary, controls generally affect the hydraulic grade line at low flow rate by creating additional headlosses to allow better pump selection and more efficient operation over the full range of flows, from 500 to 15,000 cfs. The proposed controls include the following. • Approximate footprint of 90 x 100–160 ft. • Walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • Control structure walls and access platforms would be concrete. • Site grade would be set at the same elevation as the top of the concrete lining that extends 280 ft up- and downstream of the facilities. • The top of the concrete lining is set 29 ft above the structure invert. • A handrail, potentially a 3-rail 3.5 ft tall, would be provided around the perimeter of the access decks. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the control structures. • Butterfly valves at Intakes 1 and 2 to start the pumps for operation at low flow or against low downstream water surface elevation (WSE) • Transition structures at Intakes 3, 4 and 5, with a weir crest elevation near 25 ft (the IF maximum WSE). These structures would provide back pressure on the pumps for operation at low flow or against low downstream WSE. • Weir structure on the 33-foot-diameter conveyance pipeline that leads to each of the two 33-foot-diameter tunnels, with a crest elevation near 30 ft (5 ft above the IF maximum WSE). The weirs would provide back pressure on the pumps for startup conditions, when pump operation is required to achieve flows in excess of the capacity of the gravity bypass. • Gravity bypass (one per tunnel) at the IPP, controlled by radial gates at the inlet structure. The gravity bypass system would operate during low flow conditions and when positive gradient is available between the two forebays. Each gravity bypass is sized for a design flow of 3,500 cfs (total capacity 7,000 cfs). • Under the modified pipeline/tunnel alignment, an outlet structure would operate in lieu of the IPP (see *Outlet Structure* under *Intermediate Forebay* features, above)
Canal conveyance	• East Alignment would convey water through canals to the new Byron Tract Forebay, from which water would be conveyed via connecting canals to the existing pumping plants serving the State Water Project (SWP) and Central Valley Project (CVP). • East Alignment: 6,610 acres • Construction of the canal channel and embankments would proceed in three main phases: • Embankment foundation and channel excavation (approximately 67,000,000 cy) • Embankment construction (approximately 71,000,000 cy) • Spoils placement • Canals may be unlined (earthen) or lined with concrete. • Projected solid waste (not dredge material) excavated to be disposed of in landfill for each alignment is estimated at 0.1% of spoils. • 43,076 tons
Canal excavation and backfill (all sections)	• 64,298,340 CY for borrow • 83,891,452 CY for excavation
Excavation and dewatering	• Excavation of unsaturated soils could be performed using scrapers or excavators loading into large dump trucks.

<table>
<tr><th>Construction Element/Activity</th><th colspan="2">Key Construction Information or Assumptions</th></tr>
<tr><td></td><td colspan="2">• Excavated materials that are suitable for embankment fill could be hauled and placed directly into areas ready for embankment construction or stockpiled for future use; unusable material would be hauled to spoil disposal areas.
• Additional embankment material from off-site borrow locations would be needed.
• Organic materials would be removed and replaced with compacted engineered fill, requiring dewatering.</td></tr>
<tr><td>Culvert Siphons</td><td>See Chapter 3, Description of Alternatives, Table 3-8 and Table 3-9, for locations and specifications of culvert siphons under East Alignments.
• Siphons consisting of (4) 26 x 26 ft box culverts would be constructed where canal crosses waterways or other features.
• East Alignment would require 8 siphons
• East Alignment: 160 surface acres
• Would be constructed as large multiple box culvert structures using cofferdams and open cut-and-cover construction methods with conventional CIP concrete structures.
• Either a bypass channel or a backup (setback) levee would be used as determined appropriate at each site; both would not be used at any one site.
• In-water work would be conducted during June 1–October 31 to the maximum extent possible. Because culverts/siphons need to be placed during low water, i.e., August through November, some in-water work may have to be conducted outside the June 1–October 31 time window.</td><td>Construction activities
Upstream and downstream transitions
• Dewatering, excavation/grading, place gravel bedding, place invert slab concrete, place wall concrete, backfill
Upstream and downstream control structures
• Excavation/grading, place gravel bedding, drive foundation piles, place invert slab concrete, place wall concrete, backfill
Box culvert section
• Overexcavate and recompact, install/remove cutoff, repair levee, dewatering, excavation, drive foundation piles, place gravel bedding, SOG concrete, wall concrete, roof concrete
Backfill</td></tr>
<tr><td>Culvert siphon excavation and backfill (all culvert siphons)</td><td colspan="2">East Alignment
• Excavate and haul to stockpile: 6,460,311 cy
• Haul from stockpile and compact: 5,113,801 cy</td></tr>
<tr><td>Slough diversion and bypass channel</td><td colspan="2">• Provides temporary realignment of the slough, diverting water around the siphon construction area so that work can be conducted year-round.
• Would remain in place for the duration of the construction of the slough.
• Channel would start upstream of the siphon construction area and end at the existing slough downstream of the construction area, using walls of sheetpiles across the slough to transition the water into and out of the bypass channel.
• Bypass channel would consist of two parallel berms, which would be removed when siphon is completed.
• Berms would be founded on 10-ft depth of overexcavated and recompacted in-situ soil and filled with imported and compacted fill.
• Berms would be 25 ft tall above grade; have 3H:1V (Horizontal:Vertical)sloped exterior sides and 1H:1V sloped interior sides; a 20 ft wide level top; and overall width of approximately 120 ft.
• The total width of the channel and two berms would vary depending on the width and flow of the slough being diverted, and the siphon layout.</td></tr>
</table>

Construction Element/Activity	Key Construction Information or Assumptions
	• Sections of levee would be removed and rebuilt after siphon is completed. Removal and rebuilding of the levee sections would be done within a 4-month work window during the low-water season of August 1–November 30.
Sheetpiling/ cofferdams at bypass channels	• Sheetpile walls would cross width of slough upstream and downstream of the siphon construction site, to divert water into and out of the bypass channel and allow siphon to be constructed across the slough channel in one stage. • Sheetpile walls would be constructed of ARBED-type steel sheet piles with the possibility of H king piles and sealing of sheetpile interlocks. • Sheetpiles may be driven from within the water by a barge-mounted crane, or from on top of the adjacent levee. • Top of sheet piles would align with the approximate top of the bypass channel. • 50 ft tall sheet piles would be driven approximately 20 ft below the bottom of the slough. • Linear length of sheetpiles walls would depend on the width of the slough. • Construction/removal within a 4-month work window during the low-water season of August 1–November 30. • Sheetpiles would remain in place for approximately 4 years and be removed at the end of construction.
Backup (setback) levee	• Constructed to allow potential removal of existing levee within the siphon construction area during open cut excavation and to maintain the width of the slough channel when a cofferdam is installed. • Backup levees would be installed when a cofferdam is installed partially across the slough channel and the siphon construction is done in stages. • Would tie in to the existing levee at each end of its length on either side of the construction area. • Founded on 10-ft depth of overexcavated and recompacted in-situ soil and would use import fill. • Backup levee would be 25 ft tall above grade; have 3H:1V sloped exterior sides and 1H:1V sloped interior sides; a 20 ft wide level top; and overall width of approximately 170 ft, depending on siphon layout. • Backup levees would be removed when siphon construction is completed and after the existing levee has been rebuilt.
Sheetpiling/ cofferdams at backup levees	• Encircles siphon work area and provides a dry workspace to allow construction to proceed year-round within the cofferdam. • Used with a backup levee, cofferdam would be built across one-half of the slough at a time and the siphon constructed in two stages, to allow continuous flow through the remaining open portion of the slough. • Sheetpile walls may be constructed in one of two ways: (1) of ARBED-type steel sheet piles with the possibility of H king piles and sealing of sheetpile interlocks; or (2) a series of 50 ft diameter circular sheet pile cells backfilled with compacted granular material. • Sheetpiles may be driven from within the water by a barge-mounted crane, or from on top of the adjacent levee. • Top of sheet piles would align with the approximate top of the backup levee. • 100 ft long sheetpiles would be driven to a depth below the base of excavation for the siphons, with approximately 70 ft of length driven below the bottom of the slough. • Linear length of sheetpiles walls would depend on the width of the slough. • Using vertical open cut excavation would affect a 250-ft length of the slough; using a 3H:1V cut would affect a 500 ft length of slough. • Construction/removal within a 4-month work window during the low-water season of August 1–November 30 • Each phase of the cofferdam would be in place for approximately 2 years and be removed at the end of construction.

Construction Element/Activity	Key Construction Information or Assumptions
Tunnel siphons	Where canals cross existing water bodies, tunnels would be used as siphons to convey water between canal segments. • Dual bore, 33 ft ID concrete lined with pre-cast bolted-and-gasketed segments • 95 acres (subsurface) • The level surface at each of the tunnel inlet and outlet sites is approximately 150 ft x 480 ft. • The tunnel inlet and outlet transitions would be concrete. • The grade for the tunnel would be set at the same elevation as the top of the canal embankment (Under the East Alignment, approximately 25–40 ft above the existing grade). • The majority of the tunnel inlet and outlet structures would be below grade/ground. • Steel gantry cranes for each tunnel (at inlet and outlet), with an approximate 50 ft tall and 50 ft wide frame, and equipment for opening and closing tunnel gates, would be set on top of grade. • Control buildings, possibly 20 ft x 20 ft and 20 ft tall, may be located at each tunnel inlet and outlet. The control building could be framed of timber, CMU, steel or metal studs. • Launching and retrieval shafts (similar to those described above under Pipeline/Tunnel Alignment) would be necessary.
	Lost Slough/ Mokelumne River tunnel Two parallel, 33-ft ID bores would be required to accommodate the maximum 15,000 cfs flow. • Excavate and haul to stockpile, haul from stockpile and compact 203,465 cy • Export RTM: 499,635 cy • Import and compact: 1,117,477 cy • Length: 7,450 ft (1.4 mi) • Tunnel bores: 2 • Tunnel shafts: 4 • Finished inside diameter: 33 ft
	San Joaquin River tunnel The canal flow would be transferred through a set of inlet control structures into two 33-foot ID tunnels, approximately 150 ft deep, and through outlet structures discharging into the canal. • Excavate and haul to stockpile, haul from stockpile and compact: 242,350 cy • Export RTM: 272,234 cy • Import and compact: 982,952 cy • Length: 3,240 ft (0.6 mi) • Tunnel bores: 2 • Tunnel shafts: 4 • Finished inside diameter: 33 ft
	Old River tunnel • Length: 1,920 ft (0.36 mi) • Tunnel bores: 2 • Tunnel shafts: 4 • Finished inside diameter: 33 ft • Excavate and haul to stockpile, haul from stockpile and compact: 106,987 cy • Export RTM: 195,930 cy • Import and compact: 1,078,162 cy • Outlet structures would discharge to the new forebay
Pipelines	• From intakes to intake pumping plants, and from pumping plants to canal transition structures.
Pipelines – Canal transition structure	• Pipelines from canal transition structures to main conveyance
Intermediate pumping plant	See information and assumptions for intermediate pumping plant under *Pipeline/Tunnel Alignment* • Water would travel in a lined or unlined canal between the intake pumping plants and the IPP, and between the IPP and BTF (East Alignment). • No surge towers at the IPP would be required under the East Alignment.
Bridges **Bridge Construction** **Roadway Embankment**	• 19 bridges (2 state highway and 17 local/county/private road bridges) needed to convey existing roads and highways over the canal. • Construction method for bridges over new canals would involve typical materials and bridge/roadway construction techniques. The construction of the bridge structures, and the disturbance it causes, including excavation, pile driving, and stockpiling of materials, would all probably occur within the overall footprint of the proposed canal construction. • 70,177 CY for borrow

Construction Element/Activity	Key Construction Information or Assumptions
Load and haul borrow **Place embankment**	• 500 CY for excavation Bridge type is assumed to be CIP or precast concrete superstructures supported on concrete pier walls and abutments, all founded on pile foundations. • *Deep Foundation Construction.* The bridge piers and abutments are anticipated to be founded on driven pile foundations typically installed with diesel hammer pile driving rigs. • The pile caps (footings) are to be constructed below the final canal invert with abutments founded in the levee embankments. Because scour depths in the canal are minimal, footings can be placed relatively shallow. • *Superstructure Type.* It is anticipated that the bridge superstructures, or main load carrying members, would be comprised either of CIP concrete, precast concrete girders or steel girders. The ability to prefabricate members would expedite construction and allow more flexibility in sequencing. • *Placement of Concrete.* While bridge superstructure material may vary, all substructure elements would be comprised of CIP concrete. Because groundwater levels along the alignment are relatively shallow, dewatering may be required to place concrete for pier pile caps (footings). Depending on the depth below groundwater, this can be accomplished through the use of well or sealed cofferdams. • Equipment to be used includes cranes, pile driving hammers, concrete trucks and concrete pumps. Existing roadways would be used for delivering materials, which would be stockpiled within the canal footprint. • Preliminary span lengths are based on a maximum 145 foot length corresponding to a practical limit for transportation of precast girders. • Length and overall footprint of the approach roadway would vary at each bridge location, dictated primarily by the height of the levee relative to the existing roadway.
Byron Tract Forebay	• Byron Tract Forebay (BTF) would be constructed adjacent to CCF to balance daily variations in inflow and outflow to Banks and Jones pumping plants. See Table 3C-10, *Byron Tract Forebay/Expanded Clifton Court Forebay*.
Utilities	• See Table 3C-12, *Power Supply and Grid Connections*.
Control structures	• Siphon and control structures have approximate footprints of 70 ft x 160 ft at siphon inlets, 30 ft x 160 ft at siphon outlets and 90 ft x 160 ft at control structures. • The siphon and control structure walls and access platforms would be concrete. • The walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • The site grade would be set at the same elevation as the top of the canal concrete lining that extends 280 ft up and downstream of the facilities. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the siphon inlets and the control structures. • The gates, in the open position, and the control building may extend above the top of the canal embankment. The remainder of the facilities are likely not to be visible over the top of the embankment. **East Alignment** • At two new sites on the existing approach canals to the Jones and Banks pumping plants, adjacent to the new BTF outlets. • At two potential locations, control structures would provide a means of controlling system operation at intermediate structures, located no farther than 5 miles apart. • 4 barrel, 26-foot-wide rectangular channels with radial gates (15,000 cfs). • 3 barrel, 24-foot-wide rectangular channels with radial gates (9,000 cfs). • Hood Franklin Control Structure, 1,670 foot long • Cal Pack Road inline control gate • The top of the concrete lining is set 29 ft above the canal invert and the canal invert is set 30–55 ft below the top of the embankment, making the site grade 1–25 ft below the top of the canal embankment.

Construction Element/Activity	Key Construction Information or Assumptions
Forebay Outlet 1 Inline **Forebay Outlet 2 Inline** **California Aqueduct Inline** **Delta-Mendota Inline**	**East Alignment for all culvert siphons:** Excavate and haul to stockpile, haul from stockpile and compact: 138,316* cy for each siphon. * this quantity is included in totals for culvert siphon excavation and backfill
New access roads	See Table 3C-14, *Access and Construction Work Areas.*
General construction work areas	See Table 3C-14, *Access and Construction Work Areas.* • East Alignment: Temporary parking areas would be provided within the construction staging area. Staging areas could be in the range of 15 acres at the inlet and outlet of each of the culvert siphons and control gates.
Rock pile protection	• Rock protection would likely be placed from a barge by a clam shell • Length of permanent bank protection would be 100–2,200 ft. • Area of dredging and channel reshaping would be approximately 2.5–7 acres.

Table 3C-10. Byron Tract Forebay/Expanded Clifton Court Forebay—Alternatives 1B, 2B, and 6B

Construction Element/Activity	Key Construction Information or Assumptions
Byron Tract Forebay (Alternatives 1B, 2B, and 6B) • East Alignments, BTF would be constructed on the southeast side of Clifton Court Forebay. • Construction may require short shut downs of the existing conveyance system to the Banks and Jones Pumping Plants, to add new control structures to the existing pumping plant approach canals and when BTF is connected to the existing canals. • Water in CCF and Old River would be controlled to prevent blowout of the embankments due to seepage.	
Primary maintenance road **Dewatering** **Excavate and haul off unsuitable** **Cut/fill-build levees** **Export suitable** **Slope protection** **Place riprap, bedding material, fabric**	
Connections to CVP and SWP Systems	• An approximately 2,000 ft long canal would be constructed to connect the Byron Tract Forebay with the Banks Pumping Plant, with a series of radial gates to isolate facilities. • Another series of radial gates constructed in an opening in the embankment of the Byron Tract Forebay would allow for the control of water flow between the forebay and the approach canal to the Jones Pumping Plant. • The canal would be formed by earth embankments constructed of compacted engineered fill where the canal water surface elevation is generally above existing ground.

Construction Element/Activity	Key Construction Information or Assumptions
	• The crests of the embankments would be wide enough to allow for 2 maintenance vehicles traveling in opposite directions to pass each other. • The canal would be designed with 2 ft of concrete-lined freeboard plus 2 ft of unlined freeboard on the water side. • Waterside embankments could include wind and wave erosion control, such as concrete lining, riprap, or lining with articulated concrete mat.
Excavation	• Canal construction would include use of scrapers, excavators, and/or draglines. • Organic and peat soils deemed unsuitable for support of the canal embankments (up to 25 ft deep in some areas), would be removed and disposed of offsite. This full-depth removal could be limited to the area of the embankment foundations. • Liquefiable soils would need to be removed or stabilized as part of the excavation for the canal embankments. East Alignment • 860 acres, southeast side of Clifton Court Forebay, north of the town of Holt
Seepage Control	• Installation of a slurry cutoff wall through the canal embankments would be necessary to control seepage. • Control efforts could include the use of a drainage ditch parallel to the canal, and the installation of pressure relief wells along the drainage ditch to collect subsurface water and direct it into the parallel drainage ditch. • Open channel, gravity flow, and concrete flumes (overchutes) that pass runoff over the canals could be used where canals are built into a hillside. • Overchutes would require piers similar to bridges to support the structure and would span the width of the canals. • Corrugated metal pipe and steel pipe could be used to convey stormwater runoff from adjacent lands over the canals. • A 5 ft deep drainage ditch would be constructed along both sides of the canal where the ground slopes towards a canal on both sides. These ditches would connect to the existing drainage system. • Drainage water could be routed under a canal in a culvert, over a canal in an overchute, or to a collection basin for conveyance to surface waters by gravity or a pump station.
Roads	• Roads on each side of the embankments would provide maintenance access and access to areas intercepted by the canal. • See Table 3C-14, *Access and Construction Work Areas.*

Table 3C-11. Head of Old River Barrier—Alternative 2B

Construction Element/Activity	Key Construction Information or Assumptions
Head of Old River Barrier • Operable barrier (fish control gate) and boat lock would be located at the divergence of the head of Old River and the San Joaquin River, to prevent migrating and outmigrating salmon from entering Old River from the San Joaquin River. • Other components: fish passage (fish passage structure); control building to house emergency generator, control panels for the control gates, circuit breakers; storage area for operation and maintenance equipment; boat lock operator's building; communications antenna • Gate would have an permanent storage area of 180 ft x 60 ft and operator parking. • Fencing and gates would control access to the structure. • Access road would be improved with 2 miles of private access road, minimum 16 ft wide with gravel surface, beginning at the end of Undine Road and running east to the San Joaquin River levee, then south and west along the levee to the gate site. • A construction staging area of approximately 10,000 square ft would be located on the south side of Old River just outside the levee roads. • A sheetpile retaining wall would be installed in the levee where the gate would be constructed. • Complete gate would require approximately 1,500 cy of concrete. • Approximately 11,000 square ft (450 linear ft) of riprap would be used as slope protection on levees near the gate and on the channel bottom. • Fine materials such as sand would be placed adjacent to the riprap to create a smooth slope from channel bottom to the gate sill.	
Fish control gate	• Approximately 210 ft long x 30 ft wide, top elevation 15 ft (NJAVD 88). • Seven bottom-hinged gates approximately 125 ft long. Fish passage structure • Vertical slot, self-regulating, with four sets of baffles. • To be designed according to NOAA Fisheries and USFWS guidelines for species including salmon, steelhead, and green sturgeon. • Approximately 40 ft long x 10 ft wide. • Constructed of reinforced concrete. • Stoplogs would be used to close the fish passage structure in spring when not in use to protect it from damage. Operable barrier Two potential gate construction methods. • *Cofferdam:* Creates a dewatered construction area for ease of access and egress. Construction would take place in two phases and in-water work could continue through winter. ○ Phase 1: Construct cofferdam in half the channel, dewater, and construct gates on the dewatered channel bottom and adjacent levee. Remove or cut off cofferdam at required invert depth. Construct cofferdam in second half of the channel. ○ Phase 2: Construct gate in the other half of the channel using same methods, remove or cut off cofferdam, and incorporate into the final gate layout. Construct equipment storage area and remaining fixtures. ○ Cofferdam construction would begin in August and last approximately 35 days. ○ Construction activities in the cofferdam project area would last until approximately early November, and could continue through winter. • *In-the-wet:* Allows the river to flow unimpeded and eliminates the time, material, and cost of constructing a cofferdam. No cofferdam or dewatering, no levee relocation. ○ The channel invert would be excavated to grade using a sealed clamshell excavator working off the levee or from a barge. ○ H-piles would be placed in the channel.

Construction Element/Activity	Key Construction Information or Assumptions
	○ Gravel and tremie concrete would be placed for the foundation within the confines of the H-piles. ○ Reinforced concrete structures would then either be floated in or cast in place using prefabricated forms to be placed on top of the gravel, tremie concrete, and H-piles. ○ Divers would complete the final connections between the concrete structures and the piles. ○ All in-water work would occur between August 1 and November 30 to minimize effects on delta smelt and juvenile salmonids. ○ Construction of other components would take place from a barge or from the levee crown and would occur throughout the year.
Boat lock	• 20 ft wide x 70 ft long • Would be constructed using sheetpiles and include two bottom-hinged gates on each end measuring 20 ft wide and 10 ft high. • The invert of the lock would be at elevation –8.0 ft msl, and the top of the lock wall would be at elevation 15 ft.

Table 3C-12. Power Supply and Grid Connections—Alternatives 1B, 2B, and 6B

Construction Element/Activity	Key Construction Information or Assumptions
Power supply and grid connections	• The electrical power for all facilities would be delivered through a 230 kV transmission line, owned by either the utility or the project, which interconnects with a local utility at a new utility substation assumed to be constructed within or adjacent to the utility's existing transmission ROW. The 230 kV main substation and a 69 kV main substation would be constructed next to the intermediate pumping plant (IPP), at the flood protection elevation. For the MP/T alignment, the main substation would be constructed southeast of Intake 5. • At the main 230 kV substation, the electrical power would be transformed from 230 kV to 69 kV and delivered to the adjacent main 69 kV substation. • From there, power would be delivered directly to the adjacent IPP and over 69 kV subtransmission lines to control structures and 69 kV substations located adjacent to each intake structure. • At the main 69 kV substation and at each intake substation, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. • Construction generally includes three phases: site preparation, tower/pole construction, and line stringing. These phases would include the use of the following types of equipment: bulldozer, backhoe, crane, line truck, water truck, dump truck, Man 222HD, concrete truck, Man 555 150T, helicopter (MD 500D/E), and other equipment. • New transmission lines would generally follow conveyance alignments and be constructed within the project ROW. • Construction of 230 kV and 69 kV lines would require a corridor width of 100 ft, and 100 ft on one side and 50 ft on the other side at each tower pole. • Construction would also require an area of 350 ft along the corridor at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • Construction of separate 12 kV lines would require a corridor of 25 to 40 ft, with 25 ft in each direction at each pole. • Construction would also require 200 ft along the corridor and a 50-ft wide area at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • The work area for a pole-mounted 12 kV/480 volt transformer would only be that normally used by a utility to service the pole (about 20 ft by 30 ft adjacent to the pole). • The work area for a pad-mounted transformer would be approximately 20 ft by 30 ft adjacent to the pad.

Construction Element/Activity	Key Construction Information or Assumptions
	• Transmission lines from the 69 kV substation would be strung on wood power poles approximately 40 ft tall.
	East Alignment 270 x 360 ft Approx. 270 x 270 ft. The new overhead 69 kV subtransmission lines would follow the canal alignment (within the project ROW), looping into each of the terminate at intake substations located adjacent to each of the other intake structures. At the main 69 kV substation and at each of the intake substations, electrical power is transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. To supply power for communications, monitoring, and control of the gates at the tunnel and siphon entrances along the canal, 12 kV distribution lines are extended south from the main 69 kV substation, and north and south from the intermediate pumping plant substation. Wherever possible, this 12 kV line is constructed on the same poles as the 69 kV subtransmission line.

Table 3C-13. Borrow, Spoils and Reusable Tunnel Material Storage—Alternatives 1B, 2B, and 6B

Construction Element/Activity	Key Construction Information or Assumptions
BORROW/SPOILS/RESUABLE TUNNEL MATERIAL (RTM) STORAGE • Final locations for storage of spoils, RTM, and dredged material would be selected based on the guidelines presented in Appendix 3B, *Environmental Commitments*. • Conventional earthmoving equipment, such as bulldozers and graders, would be used to place the spoil. Some spoil, with the exception of RTM, may be placed on the landside toes of canal embankments and/or setback levees. • This may require temporary placement of the soil in borrow pits or temporary spoil laydown areas pending completion of embankment or levee construction. Borrow pits created for this project would be the preferred spoil location. • In the event that limited dewatering is required to excavate a borrow pit, construction shall be timed to allow placement of spoil in the borrow excavation to prevent the creation of new wetlands, if appropriate.	
East Alignment (Alternatives 1B, 2B, and 6B)	• A total of approximately 440 acres would be allocated to RTM storage. The East Alignment can be divided into four distinct reaches for the purpose of identifying spoil areas. • For the northern reach, extending from the Pierson Tract to the Mokelumne River, it is anticipated that construction would consist of nearly balanced cut and fill. Minimal amounts of spoil would be generated and there is adequate room to dispose of spoils along the landside toe of the eastern canal embankment. • The north-central reach extends from the Mokelumne River south to White Slough. Minimal amounts of spoil would be generated and there is adequate room to dispose of spoils along the landside toe of the eastern canal embankment. • The south-central reach extends from White Slough to the San Joaquin River. A substantial quantity of spoil material would likely be generated during construction of this reach. Disposal of this soil material can be in areas immediately adjacent to the canal embankments, in addition to being placed on the landside toe of the canal embankments. Spoil would consist of organic soils, which would be placed on top of in situ organic soils; • The southern reach extends from the San Joaquin River to the CCF. A substantial quantity of spoil material would likely be generated during construction of this reach. Disposal of this soil material can be in areas immediately adjacent to the canal embankments, in addition to being placed on the landside toe of the canal embankments. Spoil would consist of organic soils, which would be placed on top of in situ organic soils.

Construction Element/Activity	Key Construction Information or Assumptions
	• If borrow material is sourced from one of the large contiguous borrow areas outside the project area, all spoil material may be disposed of in the off-site borrow area. • A total of approximately 10,830 acres would be allocated to borrow acquisition and/or spoil deposition.

Table 3C-14. Access and Construction Work Areas—Alternatives 1B, 2B, and 6B

Construction Element/Activity	Key Construction Information or Assumptions	
General construction work areas	Work areas during construction may include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Materials to be stockpiled may include: • Strippings from various excavations for possible reuse in landscaping. • RTM that is slated for reuse after treatment for embankment or fill construction. RTM areas may be temporary or permanent. • Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section). • Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas. • Borrow and spoils areas may be temporary or permanent.	Other temporary work areas not specified at left include those associated with the construction of canals, control structures, forebays, intakes, levees, operable barriers, pipelines, pumping plants, safe haven zones, siphons, and tunnels. Areas would also be dedicated to temporary transmission lines. Alternatives using the East alignments would also include Railroad Work Areas. • East Alignment: between 2,120 (Alternatives 1B and 6B) and 2,680 acres (Alternative 2B with Intakes 6 and 7).
Roads	• Wet weather (asphalt paved) • Dry weather roads (minimum 12 inch thick gravel or asphalt paved) for construction activities restricted to dry season • Dust abatement would be addressed in all construction areas at all times. • All-weather roads (asphalt paved) would be required for year-round construction at all facilities, including concrete and steel structures, tunnel portals, tunnel shafts, pumping plants and intakes, and for access to delivery areas and permanent RTM spoil piles. • Permanent paved access road is anticipated along the conveyance pipeline for the canal primary and secondary access road. • Asphalt-paved wet weather temporary access road to provide construction access to the conveyance pipe construction between the canal and the intake facility. • Asphalt-paved temporary access ramps to connect existing public and private roads to construction	The physical extent of these areas (includes Bridge Work Areas, Highway Work Areas, Road Work Areas, and Temporary Access Road Work Areas) would depend on the conveyance alignment. Additionally, some road work areas are subsumed within the construction footprints associated with other features (i.e., Intakes, Safe Haven Work Areas, etc.). East Alignment: • Approximately 270 acres. • From intake pumping plants to the Sacramento River levee • 24 ft wide • Excavated alluvial mineral soils may be used, additional material may have to be imported onsite

Construction Element/Activity	Key Construction Information or Assumptions	
	sites would be constructed to connect to the existing roadways at the existing grade. • Asphalt-paved permanent access ramps would be constructed to the elevated roadways at the final grades. • Heavy construction equipment, such as diesel-powered dozers, excavators, rollers, dump trucks, fuel trucks, and water trucks would be used during excavation, grading, and construction of access/haul roads.	
Detour roads	• *Intakes:* Detour roads needed for all intakes, for traffic circulation around the work areas. It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Roadway detours would likely be needed around each intake's construction zone (including intake pumping plant construction area) to provide site security and safety.	• It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Import and compact 971,500 cy
Temporary and new access/haul roads	Temporary • Access roads would be constructed from each intake pumping plant to the Sacramento River levee. • 24-foot-wide • Excavated alluvial mineral soils may be used, though additional material may have to be imported onsite.	Permanent • Intake site perimeter access road (approximately 24 ft wide x 2,500 ft long). • Intermediate pumping plant (during operation): The canal primary access road is proposed to be 24 ft wide paved with asphaltic concrete and the secondary access road is proposed to be 20 ft wide with a 12 ft wide gravel section.
Parking	**See Table 3C-1, *Construction Assumptions for Water Conveyance Facilities*.**	
Temporary barge unloading facility construction and removal	• May be located at each of the five intake structure worksites, tunnel worksites, and culvert siphon worksites, to be used for the delivery and removal of construction materials and equipment. • Barges would be required to use existing barge landings where possible and maintain minimum waterway width greater than 100 ft (assuming maximum barge width of 50 ft). • The physical extent of these areas would depend on the conveyance alignment: • East Alignment: approximately 30 acres. • Approximately 300 ft by 50 ft, pile-supported dock to provide construction access and construction equipment to portal sites. • 24 inch steel piles placed approximately every 25 ft under the dock for a total of 36 piles. • Impact pile driving may take up to an average of 700 strikes per pile, depending on hammer type and subsurface conditions.	• Potential locations depend on the alternative. • Hog Island (Alternatives 1B, 2B, and 6B)

Construction Element/Activity	Key Construction Information or Assumptions
	• A pier would be built within the worksite footprint of the intake or tunnel and removed at the end of construction. • Facility would be in use during the entire construction period at each location, 5 to 6 years. • Barges could be used for pile-driving rigs and barge-mounted cranes, suction dredging equipment, and microtunnel drives from the in-river cofferdam, transporting RTM, crushed rock and aggregate, pipeline sections, etc., post-construction underwater debris removal, and other activities. • Access roads to construction work areas would be necessary.
Concrete plants and precast segment plants	• Due to the large amount of concrete required for construction and the schedule demands of the program, it is anticipated that the contractor(s) would set up their own concrete plant at the job sites. Concrete plants are likely to range from 1 to 40 acres. • While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If constructed, these would be located adjacent to concrete plants. • It is likely that each precast segment plant would require approximately 10 acres for offices, concrete plant, materials storage, and casting facilities. • Additional acreage for segment storage would be needed at the precast segment plant site, and could run several times the space required for the plant. • The segments can be transported by barge, rail, or truck where these modes of transport are available; however, it is most likely that trucking of segments would be required. **East Alignment** • Four concrete plant in the southern part of Sacramento County and another plant in the northern part of San Joaquin County. Size of these batching plants could be from 5 to 10 acres. • One precast segment plant in the southern part of San Joaquin County to produce tunnel segments and supply concrete for other planned structures.
Fuel stations	Would be constructed adjacent to concrete plants and occupy approximately 2 acres.

3C.3 West Alignment (Alternatives 1C, 2C, and 6C)

Table 3C-15. Construction Assumptions for Water Conveyance Facilities by Alignment—Alternatives 1C, 2C, and 6C

Construction Element/Activity	Key Construction Information or Assumptions
WEST ALIGNMENT (Alternatives 1C, 2C, and 6C) Chapter 3, *Description of Alternatives*, Table 3-9 provides summaries of West Alignment physical characteristics. **No intermediate forebay would be constructed under West Alignment alternatives.**	
INTERMEDIATE PUMPING PLANT (IPP)	• **West Alignment:** approximately 1.2 miles east of the Sacramento River Deep Water Ship Channel. at the entrance to the tunnel segment, within canal footprint on Ryer Island; 15 pumps with capacity of 1,000 cfs per pump; 2 pumps with 500 cfs capacity • Structure would be constructed of reinforced concrete and would have multiple floors to house mechanical and electrical equipment. • The primary structural support system for the pumping plant would consist of reinforced concrete slabs and walls at and below grade, with steel framing and exterior metal wall and roof panels for the above-grade building. • The upper floor (operating level), located at grade level above the flood protection elevation, would be reinforced concrete floor slab that would support the vertically mounted pumps and motors. This level would be enclosed by a steel-framed building that includes a traveling 125-ton bridge crane. • The lower level would be a concrete mat slab wet well that includes reinforced concrete partition walls at each pump to separate and confine the water flow at each pump suction inlet. • Deep foundation piles are anticipated to be necessary to support the heavy dead and operating loads of the building. • Based on a preliminary pile foundation evaluation, 24-inch concrete-filled pipe pile, an estimated pile length of 60 to 65 ft below the founding level of the IPP would be required. • Main building above grade footprint is approximately 140 ft x 870 ft. • Tops of above ground walls approximately 75 ft above grade and the roof peak at 80 ft above grade. Total height of the above-ground structure is approximately equivalent to an 8-story building. • A concrete cantilevered deck over the pumping plant approach from the intermediate forebay would extend approximately 30 ft from the front of the main building and run the length of the building, approximately 740 ft. • A gantry crane would be located on the cantilevered deck. The frame of the gantry crane is approximately 30 ft tall and 20 ft wide. • The grade for the pumping plant and the top of the gantry crane deck would be set at the same elevation as the top of the forebay embankment, approximately 35–40 ft above the existing grade • Flow from the pumps would be discharged into a transition manifold for transfer to the pressurized tunnels.
Clearing/Grubbing/ Dewatering	Dewatering is expected to be continuous during construction.
Excavation and backfill	• Excavate and haul to stockpile: 115,000 cy • Excavate and export: 94,401 cy • Haul from stockpile and compact: 115,000 cy
Pipelines excavation and backfill	West: IPP to tunnel • Excavate and haul to stockpile: 68,931 cy • Haul from stockpile and compact: 34,563 cy

Construction Element/Activity	Key Construction Information or Assumptions
Approach channel	• The conveyance canal upstream of the intermediate pumping plant would expand from the typical canal width (340 ft at invert) to the width of the pumping plant combined pump bays (655 ft), forming a forebay of approximately 500 ft in length. • Flow from the forebay would be directed to each pump intake through wall openings with isolation gates to allow pump wells to be dewatered for maintenance. • Trash racks would be used upstream of the pumps for pump protection. • The discharge pipes from the 500 cfs pumps each would be 96-inch-diameter and the discharge pipes from the 1,000 cfs pumps would each be 132-inch-diameter. • Flow from the pumps would be discharged into a transition structure for transfer to the canal or tunnel. • Requires excavation, stockpiling, placing stockpile material, and concrete work. • Excavate, direct haul and compact 303,200 cy; import and compact 381,280 cy
Transition manifold	• A maximum 33 ft diameter pipe manifold and valve vault that connects the 16 pipes (11 ft and 12 ft diameters) from the IPP to the two 33 ft diameter pipelines. • Manifold and all pipes are underground. • The valve vault is a concrete, enclosed underground structure, with an approximate 6" height of walls/roof above grade, and would have access through a manhole in the roof of the structure.
Weir structure/ Surge towers	West Alignment • Two, 33-ft diameter surge towers. • Elevation up to 70 to 80 ft (NAVD88) at the rim, depending on final pump selection and pipe arrangement. • Dewatering • Excavate & Export 263,895 cy • Excavate & Stockpile/haul from stockpile and compact: 50,265 cy • Backfill • Place Bedding • Drive Foundation Piles • Place Concrete Fill In Piles • Invert Concrete • Flow Meter Vault Concrete • Wall Concrete • Flow Meter Vault Concrete
Tunnel outlets to forebays	• Tunnel outlets would be concrete. • The level surface at each of the tunnel outlet sites (into the intermediate forebay and the Byron Tract Forebay) is approximately 160 ft x 140 ft. • The grade for the level surface would be set at the same elevation as the top of the forebay embankment (approximately 20–30 ft above the existing grade). • The majority of the tunnel outlet structures would be below grade/ground. • Gantry cranes for each tunnel, with an approximate 50 ft tall and 50 ft wide frame, and equipment for opening and closing tunnel gates would be set on top of grade. • Control buildings, possibly 20 ft x 20 ft and 20 ft tall, may be located at each tunnel outlet. These may be framed of timber, CMU, steel or metal studs.
Substation and exterior transformers	• A main 230 kV substation and a main 69 kV substation would be constructed adjacent to the intermediate pumping plant (IPP), at the flood protection elevation, and provide power to the IPP, control structures and intake facilities. See *Power Supply and Grid Connections*

Construction Element/Activity	Key Construction Information or Assumptions
General construction work areas	• Anticipated construction area for the IPP is approximately 110 acres. • Of this, approximately 20 acres would be specific to the area for temporary construction needs (including on-site temporary parking, office trailers, staging, equipment laydown and storage). • Under the West Alignment, the anticipated construction area for the IPP is approximately 40 acres. • Of this, approximately 15 acres would be specific to the area for temporary construction needs (including onsite temporary parking, office trailers, staging, equipment laydown and storage).
Utilities	• See Table 3C-18. *Power Supply and Grid Connections*
Roads	• See Table 3C-20, *Access and Construction Work Areas*
Fencing	• Security fencing, with access control gates, would be placed along the perimeter of the pumping plant facilities. • A 6-foot chain link fence installed around the pumping plant and enclosing the surge towers and gravity bypass structure. • A substation adjacent to the pumping plant would be fenced with a 6-foot chain link fence with a climbing barrier. More stringent fencing with 8-foot tall chain link fences with climbing barrier and/or razor wire may be used at the pumping plant or substation facilities. • Masonry walls, 6 to 8 ft tall, may be used within the facilities.
Landscaping/ vegetation	• See Landscaping/vegetation under North Delta Intakes, above.
Control structures	While the types of control structures used within and among alignments would vary, controls generally affect the hydraulic grade line at low flow rate by creating additional headlosses to allow better pump selection and more efficient operation over the full range of flows, from 500 to 15,000 cfs. The proposed controls include the following. • Approximate footprint of 90 x 100–160 ft. • Walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • Control structure walls and access platforms would be concrete. • Site grade would be set at the same elevation as the top of the concrete lining that extends 280 ft up- and downstream of the facilities. • The top of the concrete lining is set 29 ft above the structure invert. • A handrail, potentially a 3-rail 3.5 ft tall, would be provided around the perimeter of the access decks. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the control structures. • Butterfly valves at Intakes 1 and 2 to start the pumps for operation at low flow or against low downstream water surface elevation (WSE) • Transition structures at Intakes 3, 4 and 5, with a weir crest elevation near 25 ft (the IF maximum WSE). These structures would provide back pressure on the pumps for operation at low flow or against low downstream WSE. • Weir structure on the 33-foot-diameter conveyance pipeline that leads to each of the two 33-foot-diameter tunnels, with a crest elevation near 30 ft (5 ft above the IF maximum WSE). The weirs would provide back pressure on the pumps for startup conditions, when pump operation is required to achieve flows in excess of the capacity of the gravity bypass. • Gravity bypass (one per tunnel) at the IPP, controlled by radial gates at the inlet structure. The gravity bypass system would operate during low flow conditions and when positive gradient is available between the two forebays. Each gravity bypass is sized for a design flow of 3,500 cfs (total capacity 7,000 cfs).

Construction Element/Activity	Key Construction Information or Assumptions
Canal conveyance	• West Alignment would convey water through canals, into a tunnel beginning on Ryer Island and terminating east of Oakley, to a southern canal flowing to the new Byron Tract Forebay, from which water would be conveyed via connecting canals to the existing pumping plants serving the State Water Project (SWP) and Central Valley Project (CVP). • West Alignment: 4,490 acres • Construction of the canal channel and embankments would proceed in three main phases: • Embankment foundation and channel excavation (approximately 67,000,000 cy) • Embankment construction (approximately 71,000,000 cy) • Spoils placement • Canals may be unlined (earthen) or lined with concrete. • Projected solid waste (not dredge material) excavated to be disposed of in landfill for each alignment is estimated at 0.1% of spoils. • West Alignment: 20,194 tons
Canal excavation and backfill (all sections)	• Excavate, direct haul and compact: 38,303,970 cy • Excavate and export: 16,328,401 cy • Import and compact: 33,247,610 cy
Excavation and dewatering	• Excavation of unsaturated soils could be performed using scrapers or excavators loading into large dump trucks. • Excavated materials that are suitable for embankment fill could be hauled and placed directly into areas ready for embankment construction or stockpiled for future use; unusable material would be hauled to spoil disposal areas. • Additional embankment material from off-site borrow locations would be needed. • Organic materials would be removed and replaced with compacted engineered fill, requiring dewatering.
Culvert Siphons	See Chapter 3, *Description of Alternatives*, Table 3-8 and Table 3-9, for locations and specifications of culvert siphons under West Alignments, respectively. • Siphons consisting of (4) 26 x 26 ft box culverts would be constructed where canal crosses waterways or other features. • West Alignment would require 9 inverted culvert siphons to convey water under 10 shallow water courses and 1 rail line. • West Alignment: 170 surface acres • Would be constructed as large multiple box culvert structures using cofferdams and open cut-and-cover construction methods with conventional CIP concrete structures. • Either a bypass channel or a backup (setback) levee would be used as determined appropriate at each site; both would not be used at any one site. • In-water work would be conducted during June 1–October 31 to the maximum extent possible. Because culverts/siphons need to be placed during low water, i.e., August through November, some in-water work may have to be conducted outside the June 1–October 31 time window. Construction activities Upstream and downstream transitions • Dewatering, excavation/grading, place gravel bedding, place invert slab concrete, place wall concrete, backfill Upstream and downstream control structures • Excavation/grading, place gravel bedding, drive foundation piles, place invert slab concrete, place wall concrete, backfill Box culvert section • Overexcavate and recompact, install/remove cutoff, repair levee, dewatering, excavation, drive foundation piles, place gravel bedding, SOG concrete, wall concrete, roof concrete Backfill

Construction Element/Activity	Key Construction Information or Assumptions
Culvert siphon excavation and backfill (all culvert siphons)	West Alignment • Excavate and haul to stockpile 10,429,866 cy • Haul from stockpile and compact: 9,161,197 cy
Slough diversion and bypass channel	• Provides temporary realignment of the slough, diverting water around the siphon construction area so that work can be conducted year-round. • Would remain in place for the duration of the construction of the slough. • Channel would start upstream of the siphon construction area and end at the existing slough downstream of the construction area, using walls of sheetpiles across the slough to transition the water into and out of the bypass channel. • Bypass channel would consist of two parallel berms, which would be removed when siphon is completed. • Berms would be founded on 10-ft depth of overexcavated and recompacted in-situ soil and filled with imported and compacted fill. • Berms would be 25 ft tall above grade; have 3H:1V (Horizontal:Vertical)sloped exterior sides and 1H:1V sloped interior sides; a 20 ft wide level top; and overall width of approximately 120 ft. • The total width of the channel and two berms would vary depending on the width and flow of the slough being diverted, and the siphon layout. • Sections of levee would be removed and rebuilt after siphon is completed. Removal and rebuilding of the levee sections would be done within a 4-month work window during the low-water season of August 1–November 30.
Sheetpiling/ cofferdams at bypass channels	• Sheetpile walls would cross width of slough upstream and downstream of the siphon construction site, to divert water into and out of the bypass channel and allow siphon to be constructed across the slough channel in one stage. • Sheetpile walls would be constructed of ARBED-type steel sheet piles with the possibility of H king piles and sealing of sheetpile interlocks. • Sheetpiles may be driven from within the water by a barge-mounted crane, or from on top of the adjacent levee. • Top of sheet piles would align with the approximate top of the bypass channel. • 50 ft tall sheet piles would be driven approximately 20 ft below the bottom of the slough. • Linear length of sheetpiles walls would depend on the width of the slough. • Construction/removal within a 4-month work window during the low-water season of August 1–November 30. • Sheetpiles would remain in place for approximately 4 years and be removed at the end of construction.
Backup (setback) levee	• Constructed to allow potential removal of existing levee within the siphon construction area during open cut excavation and to maintain the width of the slough channel when a cofferdam is installed. • Backup levees would be installed when a cofferdam is installed partially across the slough channel and the siphon construction is done in stages. • Would tie in to the existing levee at each end of its length on either side of the construction area. • Founded on 10-ft depth of overexcavated and recompacted in-situ soil and would use import fill. • Backup levee would be 25 ft tall above grade; have 3H:1V sloped exterior sides and 1H:1V sloped interior sides; a 20 ft wide level top; and overall width of approximately 170 ft, depending on siphon layout. • Backup levees would be removed when siphon construction is completed and after the existing levee has been rebuilt.

Construction Element/Activity	Key Construction Information or Assumptions
Sheetpiling/ cofferdams at backup levees	• Encircles siphon work area and provides a dry workspace to allow construction to proceed year-round within the cofferdam. • Used with a backup levee, cofferdam would be built across one-half of the slough at a time and the siphon constructed in two stages, to allow continuous flow through the remaining open portion of the slough. • Sheetpile walls may be constructed in one of two ways: (1) of ARBED-type steel sheet piles with the possibility of H king piles and sealing of sheetpile interlocks; or (2) a series of 50 ft diameter circular sheet pile cells backfilled with compacted granular material. • Sheetpiles may be driven from within the water by a barge-mounted crane, or from on top of the adjacent levee. • Top of sheet piles would align with the approximate top of the backup levee. • 100 ft long sheetpiles would be driven to a depth below the base of excavation for the siphons, with approximately 70 ft of length driven below the bottom of the slough. • Linear length of sheetpiles walls would depend on the width of the slough. • Using vertical open cut excavation would affect a 250-ft length of the slough; using a 3H:1V cut would affect a 500 ft length of slough. • Construction/removal within a 4-month work window during the low-water season of August 1–November 30 • Each phase of the cofferdam would be in place for approximately 2 years and be removed at the end of construction.
Tunnel	West Alignment alternatives include a 17-mile, concrete-lined soft ground tunnel to convey diverted water from the IPP into a new canal leading to the new Byron Tract Forebay. • 75 acres (780 acres permanent subsurface easement) • Excavate and export: 149,226 cy • Export RTM: 10,574,601 cy • Import and compact: 2,844,666 cy • Length: 89,650 ft • Bores: 2 • Inside diameter: 33 ft. • The EPB TBM would bore the tunnel at a minimum of 100 ft below the ground surface. • Intermediate and emergency access shafts would be placed along the length of the tunnel at possibly (15) locations, in addition to any intermediate launch/retrieval shafts at potentially one location. • Intermediate/emergency shafts would be 10 ft diameter with a 2 ft wide curb approximately 1 ft above grade. • Intermediate launch/retrieval shafts would be adjacent to each other and would be at least 200 ft x 100 ft each, with a perimeter concrete slab poured at grade.
Tunnel outlet	• The level surface at the tunnel outlet site (for the parallel tunnels) is approximately 150 ft x 480 ft. • The grade for the outlet would be at the same elevation as the top of the canal embankment (approximately 30 ft above the existing grade). • The majority of the tunnel outlet structure would be below grade/ground. • Gantry cranes for the tunnel, with an approximately 50 ft tall and 50 ft wide frame, and equipment for opening and closing tunnel gates would be set on top of grade. • Control buildings, possibly 20 ft x 20 ft and 20 ft tall, may be located at the tunnel outlet.
Pipelines	• From intakes to intake pumping plants, and from pumping plants to canal transition structures.
Pipelines – Canal transition structure	• Pipelines from canal transition structures to main conveyance

Construction Element/Activity	Key Construction Information or Assumptions
Intermediate pumping plant	See information and assumptions for intermediate pumping plant under *Pipeline/Tunnel Alignment* • Water would travel in a lined or unlined canal between the intake pumping plants and the IPP through a dual-bore, 33 ft diameter tunnel to another lined or unlined canal leading to BTF (West Alignment).
Bridges	• Import and compact: 1,183,285 cy • A railroad bridge is proposed to carry the existing track over the canal near the California Aqueduct at the southern end of the water conveyance facilities.
Byron Tract Forebay	• Byron Tract Forebay (BTF) would be constructed adjacent to CCF to balance daily variations in inflow and outflow to Banks and Jones pumping plants. See Table 3C-16, *Byron Tract Forebay/Expanded Clifton Court Forebay*.
Utilities	• See Table 3C-18, *Power Supply and Grid Connections.*
Control structures	• Siphon and control structures have approximate footprints of 70 ft x 160 ft at siphon inlets, 30 ft x 160 ft at siphon outlets and 90 ft x 160 ft at control structures. • The siphon and control structure walls and access platforms would be concrete. • The walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • The site grade would be set at the same elevation as the top of the canal concrete lining that extends 280 ft up and downstream of the facilities. • Radial gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the siphon inlets and the control structures. • The gates, in the open position, and the control building may extend above the top of the canal embankment. The remainder of the facilities are likely not to be visible over the top of the embankment. • At two potential locations, where the canal intersects Central Ave Bridge and Road 159 bridge; at a forebay outlet at the north of the forebay; two new sites on the existing approach canals to the Jones and Banks pumping plants, adjacent to the new BTF outlets. • The canal invert is set 30–45 ft below the top of the embankment, making the site grade 1–15 ft below the top of the canal embankment. • A handrail, potentially 3-rail, 3.5 ft tall, would be provided around the perimeter of the access decks.
New access roads	See Table 3C-20, *Access and Construction Work Areas.*
General construction work areas	See Table 3C-20, *Access and Construction Work Areas.* • Temporary parking areas would be provided within the construction staging area. Staging areas could be in the range of 15 acres at the inlet and outlet of each of the culvert siphons and control gates.
Rock pile protection	• Rock protection would likely be placed from a barge by a clam shell • Length of permanent bank protection would be 100–2,200 ft. • Area of dredging and channel reshaping would be approximately 2.5–7 acres.

1 **Table 3C-16. Byron Tract Forebay/Expanded Clifton Court Forebay—Alternatives 1C, 2C, and 6C**

Construction Element/Activity	Key Construction Information or Assumptions
Byron Tract Forebay (Alternatives 1C, 2C, and 6C) • It would be on the northwest side of CCF. • Construction may require short shut downs of the existing conveyance system to the Banks and Jones Pumping Plants, to add new control structures to the existing pumping plant approach canals and when BTF is connected to the existing canals. • Water in CCF and Old River would be controlled to prevent blowout of the embankments due to seepage.	
Primary maintenance road **Dewatering** **Excavate and haul off unsuitable** **Cut/fill-build levees** **Export suitable** **Slope protection** **Place riprap, bedding material, fabric**	• The bottom elevation of BTF would be -10.0 ft except locally at the inlet and outlet connections. The tunnel outlet invert would be at EL -45.6 ft. Similar to other tunnel outlet discharges, the tunnel would discharge to a concrete apron, rising at a 20% slope to EL -10.0 ft, meeting the BTF invert elevation. • A new section of canal, approximately 2,000 ft long and situated between CCF and UPRR, would connect BTF to the existing approach canal to the Banks Pumping Plant. A 50-foot-wide buffer separates the toe of the approach canal embankment to the centerline of UPRR. • The new approach canal would deepen from -10.0 ft to -27.9 ft, matching the depth at the existing approach canal to the Banks Pumping Plant. A radial gate control structure would be installed at the upstream end of this new approach canal to hydraulically isolate the existing SWP facilities from BTF. The nominal capacity of this canal would be 10,300 cfs. The connection to the existing approach canal would be at an angle of 60 degrees. • The forebay would be connected to the existing approach canal to the Jones Pumping Plant by breaching a section of the existing canal's embankment adjacent to BTF. The invert of this canal would be at EL -17.4 ft to match the invert of the existing Jones Pumping Plant approach canal at the connection point. A radial gate control structure would be installed at this connection to hydraulically isolate the existing CVP facilities from BTF. This canal would have a capacity of 4,600 cfs matching the capacity of the Jones Pumping Plant. • To provide the ability to isolate BTF from CCF, a new gate structure would be constructed in the existing approach canal downstream of the Skinner Facility. • To provide the ability to isolate BTF from Old River, a new gate structure would be constructed in the existing approach canal to the Jones Pumping Plant just upstream of the connection from BTF. • The planned embankment crest elevation for BTF and approach canals would be +24.5 ft, which includes considerations for SLR. This protection level would gradually lower at an approximately 10% slope to where the forebay approach canal meets the embankment elevation of the existing approach canal to either the Banks or Jones Pumping Plant. The toe of the new embankment would be set at 50 ft from the toe of the parallel existing embankment or levee. Excavation at the toe of the existing embankment and levees may 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 would consist of engineered fill placed on suitable foundation material at a 3H:1V slope on both the inboard and outboard sides of the embankment. The embankment crest would be 20 ft wide to provide road access consistent with existing embankment design. In addition, 28-foot-wide maintenance roads would be provided on the inboard slopes of the new approach canal, joining the roads at the existing approach canal to the Banks Pumping Plant. The forebay side of the new embankment would also be armored with riprap from +0.0 ft (just below the minimum design WSE of +0.5 ft) to +13.5 ft (the top WSE of +9.5 ft plus an additional 4 ft to account for transient waves). • Under the West Canal Alignment, BTF would be 780 acres, with a 600-acre water surface area, and a storage volume of 4,300 af. • Byron Tract would be excavated to provide an invert of -10.0 ft over the entire basin (including embankment foundation) requiring the removal of 14,000,000 cy of material, total.

Construction Element/Activity	Key Construction Information or Assumptions
	• Dewatering would be required for excavation operations. Most of this material is expected to be unsuitable for use in embankment construction and would require disposal • To the extent possible, spoils would be placed in the area between the existing CCF embankments and new forebay embankments, which are offset by 50 ft toe-to-toe. This area would require temporary storage of disposal materials until the new forebay embankment is constructed. • Approximately 30% of the excavated material below the peat layer may be suitable for use as embankment, and would be used in construction of the BTF embankment. • The new embankments for the BTF would be constructed by excavating the embankment foundations down to suitable material, dewatering, then constructing the embankments of compacted fill to the desired height. • Approximately 3,000,000 cy of fill would be required for the BTF embankments. • The required embankment material would be borrowed from within the limits of the respective forebays. • Dewatering and/or moisture conditioning of the soils would likely be required.
Connections to CVP and SWP Systems	• An approximately 2,000 ft long canal would be constructed to connect the Byron Tract Forebay with the Banks Pumping Plant, with a series of radial gates to isolate facilities. • Another series of radial gates constructed in an opening in the embankment of the Byron Tract Forebay would allow for the control of water flow between the forebay and the approach canal to the Jones Pumping Plant. • The canal would be formed by earth embankments constructed of compacted engineered fill where the canal water surface elevation is generally above existing ground. • The crests of the embankments would be wide enough to allow for 2 maintenance vehicles traveling in opposite directions to pass each other. • The canal would be designed with 2 ft of concrete-lined freeboard plus 2 ft of unlined freeboard on the water side. • Waterside embankments could include wind and wave erosion control, such as concrete lining, riprap, or lining with articulated concrete mat.
Excavation	• Canal construction would include use of scrapers, excavators, and/or draglines. • Organic and peat soils deemed unsuitable for support of the canal embankments (up to 25 ft deep in some areas), would be removed and disposed of offsite. This full-depth removal could be limited to the area of the embankment foundations. • Liquefiable soils would need to be removed or stabilized as part of the excavation for the canal embankments. West Alignment • 780 acres, northwest side of Clifton Court Forebay • Excavate, direct haul and compact: 4,458,535 cy • Excavate and export: 7,698,075 cy • Import and compact: 634,126 cy
Seepage Control	• Installation of a slurry cutoff wall through the canal embankments would be necessary to control seepage. • Control efforts could include the use of a drainage ditch parallel to the canal, and the installation of pressure relief wells along the drainage ditch to collect subsurface water and direct it into the parallel drainage ditch. • Open channel, gravity flow, and concrete flumes (overchutes) that pass runoff over the canals could be used where canals are built into a hillside. • Overchutes would require piers similar to bridges to support the structure and would span the width of the canals. • Corrugated metal pipe and steel pipe could be used to convey stormwater runoff from adjacent lands over the canals.

Construction Element/Activity	Key Construction Information or Assumptions
	• A 5 ft deep drainage ditch would be constructed along both sides of the canal where the ground slopes towards a canal on both sides. These ditches would connect to the existing drainage system. • Drainage water could be routed under a canal in a culvert, over a canal in an overchute, or to a collection basin for conveyance to surface waters by gravity or a pump station.
Roads	• Roads on each side of the embankments would provide maintenance access and access to areas intercepted by the canal. • See Table 3C-20, *Access and Construction Work Areas.*

Table 3C-17. Head of Old River Barrier—Alternative 2C

Construction Element/Activity	Key Construction Information or Assumptions
Head of Old River Barrier • Operable barrier (fish control gate) and boat lock would be located at the divergence of the head of Old River and the San Joaquin River, to prevent migrating and outmigrating salmon from entering Old River from the San Joaquin River. • Other components: fish passage (fish passage structure); control building to house emergency generator, control panels for the control gates, circuit breakers; storage area for operation and maintenance equipment; boat lock operator's building; communications antenna • Gate would have an permanent storage area of 180 ft x 60 ft and operator parking. • Fencing and gates would control access to the structure. • Access road would be improved with 2 miles of private access road, minimum 16 ft wide with gravel surface, beginning at the end of Undine Road and running east to the San Joaquin River levee, then south and west along the levee to the gate site. • A construction staging area of approximately 10,000 square feet would be located on the south side of Old River just outside the levee roads. • A sheetpile retaining wall would be installed in the levee where the gate would be constructed. • Complete gate would require approximately 1,500 cy of concrete. • Approximately 11,000 square feet (450 linear feet) of riprap would be used as slope protection on levees near the gate and on the channel bottom. • Fine materials such as sand would be placed adjacent to the riprap to create a smooth slope from channel bottom to the gate sill.	
Fish control gate	• Approximately 210 ft long x 30 ft wide, top elevation 15 ft (NJAVD 88). • Seven bottom-hinged gates approximately 125 ft long. Fish passage structure • Vertical slot, self-regulating, with four sets of baffles. • To be designed according to NOAA Fisheries and USFWS guidelines for species including salmon, steelhead, and green sturgeon. • Approximately 40 ft long x 10 ft wide. • Constructed of reinforced concrete. • Stoplogs would be used to close the fish passage structure in spring when not in use to protect it from damage. Operable barrier Two potential gate construction methods. • *Cofferdam:* Creates a dewatered construction area for ease of access and egress. Construction would take place in two phases and in-water work could continue through winter.

Construction Element/Activity	Key Construction Information or Assumptions
	○ Phase 1: Construct cofferdam in half the channel, dewater, and construct gates on the dewatered channel bottom and adjacent levee. Remove or cut off cofferdam at required invert depth. Construct cofferdam in second half of the channel. ○ Phase 2: Construct gate in the other half of the channel using same methods, remove or cut off cofferdam, and incorporate into the final gate layout. Construct equipment storage area and remaining fixtures. ○ Cofferdam construction would begin in August and last approximately 35 days. ○ Construction activities in the cofferdam project area would last until approximately early November, and could continue through winter. • *In-the-wet:* Allows the river to flow unimpeded and eliminates the time, material, and cost of constructing a cofferdam. No cofferdam or dewatering, no levee relocation. ○ The channel invert would be excavated to grade using a sealed clamshell excavator working off the levee or from a barge. ○ H-piles would be placed in the channel. ○ Gravel and tremie concrete would be placed for the foundation within the confines of the H-piles. ○ Reinforced concrete structures would then either be floated in or cast in place using prefabricated forms to be placed on top of the gravel, tremie concrete, and H-piles. ○ Divers would complete the final connections between the concrete structures and the piles. ○ All in-water work would occur between August 1 and November 30 to minimize effects on delta smelt and juvenile salmonids. ○ Construction of other components would take place from a barge or from the levee crown and would occur throughout the year.
Boat lock	• 20 ft wide x 70 ft long • Would be constructed using sheetpiles and include two bottom-hinged gates on each end measuring 20 ft wide and 10 ft high. • The invert of the lock would be at elevation –8.0 ft msl, and the top of the lock wall would be at elevation 15 ft.

1

2 **Table 3C-18. Power Supply and Grid Connections—Alternatives 1C, 2C, and 6C**

Construction Element/Activity	Key Construction Information or Assumptions
Power supply and grid connections	• The electrical power for all facilities would be delivered through a 230 kV transmission line, owned by either the utility or the project, which interconnects with an existing utility substation assumed to be constructed within or adjacent to the utility's existing transmission ROW. The 230 kV main substation and a 69 kV main substation would be constructed next to the intermediate pumping plant (IPP), at the flood protection elevation. • At the main 230 kV substation, the electrical power would be transformed from 230 kV to 69 kV and delivered to the adjacent main 69 kV substation. • From there, power would be delivered directly to the adjacent IPP and over 69 kV subtransmission lines to control structures and 69 kV substations located adjacent to each intake structure. • At the main 69 kV substation and at each intake substation, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. • Construction generally includes three phases: site preparation, tower/pole construction, and line stringing. These phases would include the use of the following types of equipment: bulldozer, backhoe, crane, line truck, water truck, dump truck,

Construction Element/Activity	Key Construction Information or Assumptions
	Man 222HD, concrete truck, Man 555 150T, helicopter (MD 500D/E), and other equipment. • New transmission lines would generally follow conveyance alignments and be constructed within the project ROW. • Construction of 230 kV and 69 kV lines would require a corridor width of 100 ft, and 100 ft on one side and 50 ft on the other side at each tower pole. • Construction would also require an area of 350 ft along the corridor at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • Construction of separate 12 kV lines would require a corridor of 25 to 40 ft, with 25 ft in each direction at each pole. • Construction would also require 200 ft along the corridor and a 50-ft wide area at conductor pulling locations at every 2 miles of line or turns greater than 15 degrees. • The work area for a pole-mounted 12 kV/480 volt transformer would only be that normally used by a utility to service the pole (about 20 ft by 30 ft adjacent to the pole). • The work area for a pad-mounted transformer would be approximately 20 ft by 30 ft adjacent to the pad. • Transmission lines from the 69 kV substation would be strung on wood power poles approximately 40 ft tall.
	West Alignment 360 x 700 ft combined Approx. 270 x 270 ft. The new overhead 69 kV subtransmission line would follow the canal ROW north and east to an intake substation adjacent to the southern-most intake structure. The 69 kV line would then follow the canal north, looping into to each of the other intake substations and terminating at the northern-most intake substation. At the main 69 kV substation and each of the intake substations, electrical power would be transformed from 69 kV to the voltage needed for the pumps and auxiliary equipment at the adjacent structures. Power for control of the gates at the tunnel and siphon entrances on the northern portion of the canal would be supplied from 12 kV distribution lines extending north along the canal from the IPP, and west along the canal from the southern-most intake substation. Wherever possible, this 12 kV line would be constructed on the same poles as the 69 kV subtransmission line. If power is needed for gate control along the south canal portion of this alignment, it would be served by the local utility from a local distribution line.

Table 3C-19. Borrow, Spoils and Reusable Tunnel Material Storage—Alternatives 1C, 2C, and 6C

Construction Element/Activity	Key Construction Information or Assumptions
BORROW/SPOILS/RESUABLE TUNNEL MATERIAL (RTM) STORAGE • Final locations for storage of spoils, RTM, and dredged material would be selected based on the guidelines presented in Appendix 3B, *Environmental Commitments*. • Conventional earthmoving equipment, such as bulldozers and graders, would be used to place the spoil. Some spoil, with the exception of RTM, may be placed on the landside toes of canal embankments and/or setback levees. • This may require temporary placement of the soil in borrow pits or temporary spoil laydown areas pending completion of embankment or levee construction. Borrow pits created for this project would be the preferred spoil location. • In the event that limited dewatering is required to excavate a borrow pit, construction shall be timed to allow placement of spoil in the borrow excavation to prevent the creation of new wetlands, if appropriate.	
West Alignment (Alternatives 1C, 2C, and 6C)	• A total of approximately 920 acres would be allocated to RTM storage. • RTM would not be compacted. The ICF West Option can be divided into three distinct reaches for the purpose of identifying borrow and spoil areas. • The northern segment (Reaches 1 through 4) extends from the Lisbon District in the north to the tunnel portal near Cache Slough. It is anticipated that construction of this portion would consist of nearly balanced cut and fill. Amounts of spoil would be generated and disposed of along the landside toe of the eastern canal embankment. Spoil material generated should not be placed along the landside toe of the canal embankment in the area between the canal and the Sacramento Deep Water Ship Channel. • Along the tunnel reach, substantial quantities of RTM would be generated during tunnel construction. When extracted, this material would contain fine-grained soil mixed with biodegradable polymers and have the consistency of a thick paste. Over time, the moisture content of the material would decrease and the polymers would break down, leaving workable soil as the end product. This process may take several years to complete, but farming of this material would accelerate the process. • Temporary spoil laydown areas near the tunnel and shaft portals may be used to store and possibly treat this material. Once treatment is complete, the spoil material, if suitable, can be spread over local agricultural land. If not suitable for this application, the spoil can be disposed of along the landside toe of canal embankments of both the north and south segments of the West Alignment and in borrow pits along the southern segment of the alignment. • Spoil generated during construction of the southern segment may be disposed of in borrow pits and along the landside toe of the canal embankment. • If borrow material is sourced from one of the large contiguous borrow areas outside the project area, all spoil material may be disposed of in the offsite borrow area. • Spoil placed in disposal areas would be placed in 12-inch lifts, with nominal compaction. • The maximum height for placement of spoil is expected to be 12 ft above preconstruction grade and have side slopes of 5H:1V or flatter. • After final grading of spoil is complete, the area would be restored based on site-specific conditions following project restoration guidelines. • A total of approximately 6,770 acres would be allocated to borrow acquisition and/or spoil deposition.

1 **Table 3C-20. Access and Construction Work Areas—Alternatives 1C, 2C, and 6C**

Construction Element/Activity	Key Construction Information or Assumptions	
General construction work areas	Work areas during construction may include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Materials to be stockpiled may include: • Strippings from various excavations for possible reuse in landscaping. • RTM that is slated for reuse after treatment for embankment or fill construction. RTM areas may be temporary or permanent. • Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section). • Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas. • Borrow and spoils areas may be temporary or permanent.	Other temporary work areas not specified at left include those associated with the construction of canals, control structures, forebays, intakes, levees, operable barriers, pipelines, pumping plants, safe haven zones, siphons, and tunnels. Areas would also be dedicated to temporary transmission lines. Alternatives using West alignments would also include Railroad Work Areas. • West Alignment approximately 3,190 acres.
Roads	• Wet weather (asphalt paved) • Dry weather roads (minimum 12 inch thick gravel or asphalt paved) for construction activities restricted to dry season • Dust abatement would be addressed in all construction areas at all times. • All-weather roads (asphalt paved) would be required for year-round construction at all facilities, including concrete and steel structures, tunnel portals, tunnel shafts, pumping plants and intakes, and for access to delivery areas and permanent RTM spoil piles. • Permanent paved access road is anticipated along the conveyance pipeline for the canal primary and secondary access road. • Asphalt-paved wet weather temporary access road to provide construction access to the conveyance pipe construction between the canal and the intake facility. • Asphalt-paved temporary access ramps to connect existing public and private roads to construction sites would be constructed to connect to the existing roadways at the existing grade. • Asphalt-paved permanent access ramps would be constructed to the elevated roadways at the final grades.	The physical extent of these areas (includes Bridge Work Areas, Highway Work Areas, Road Work Areas, and Temporary Access Road Work Areas) would depend on the conveyance alignment. Additionally, some road work areas are subsumed within the construction footprints associated with other features (i.e., Intakes, Safe Haven Work Areas, etc.). West Alignment: • Approximately 350 acres. • Connecting the facilities between the intake conveyance pipelines and the proposed Byron Tract Forebay, except the tunnel section from south of State Route 220 to north of Contra Costa Canal.

Construction Element/Activity	Key Construction Information or Assumptions	
	• Heavy construction equipment, such as diesel-powered dozers, excavators, rollers, dump trucks, fuel trucks, and water trucks would be used during excavation, grading, and construction of access/haul roads.	
Detour roads	• *Intakes:* Detour roads needed for all intakes, for traffic circulation around the work areas. It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Roadway detours would likely be needed around each intake's construction zone (including intake pumping plant construction area) to provide site security and safety.	• It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Import and compact 971,500 cy
Temporary and new access/haul roads	Temporary • Access roads would be constructed from each intake pumping plant to the Sacramento River levee. • 24-foot-wide • Excavated alluvial mineral soils may be used, though additional material may have to be imported onsite.	Permanent • Intake site perimeter access road (approximately 24 ft wide x 2,500 ft long). • Intermediate pumping plant (during operation): The canal primary access road is proposed to be 24 ft wide paved with asphaltic concrete and the secondary access road is proposed to be 20 ft wide with a 12 ft wide gravel section.
Parking	• See Table 3C-1, *Construction Assumptions for Water Conveyance Facilities*.	
Temporary barge unloading facility construction and removal	• May be located at each of the five intake structure worksites, tunnel worksites, and culvert siphon worksites, to be used for the delivery and removal of construction materials and equipment. • Barges would be required to use existing barge landings where possible and maintain minimum waterway width greater than 100 ft (assuming maximum barge width of 50 ft). • Under the modified pipeline/tunnel alignment, it is assumed that barge activities would take place on levees using a ramp barge in conjunction with a crane/excavator barge or a crane or excavator positioned on or near the levee. • The physical extent of these areas would depend on the conveyance alignment: • West Alignment: approximately 70 acres. • Approximately 300 ft by 50 ft, pile-supported dock to provide construction access and construction equipment to portal sites.	• Potential locations depend on the alternative. • Ryer Island (Alternatives 1C, 2C, and 6C) • Brannan Island (Alternatives 1C, 2C, and 6C)

Construction Element/Activity	Key Construction Information or Assumptions	
	• 24 inch steel piles placed approximately every 25 ft under the dock for a total of 36 piles. • Impact pile driving may take up to an average of 700 strikes per pile, depending on hammer type and subsurface conditions. • A pier would be built within the worksite footprint of the intake or tunnel and removed at the end of construction. • Facility would be in use during the entire construction period at each location, 5 to 6 years. • Barges could be used for pile-driving rigs and barge-mounted cranes, suction dredging equipment, and microtunnel drives from the in-river cofferdam, transporting RTM, crushed rock and aggregate, pipeline sections, etc., post-construction underwater debris removal, and other activities. • Access roads to construction work areas would be necessary.	
Concrete plants and precast segment plants	• Due to the large amount of concrete required for construction and the schedule demands of the program, it is anticipated that the contractor(s) would set up their own concrete plant at the job sites. Concrete plants are likely to range from 1 to 40 acres. • While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If constructed, these would be located adjacent to concrete plants. • It is likely that each precast segment plant would require approximately 10 acres for offices, concrete plant, materials storage, and casting facilities. • Additional acreage for segment storage would be needed at the precast segment plant site, and could run several times the space required for the plant. • The segments can be transported by barge, rail, or truck where these modes of transport are available; however, it is most likely that trucking of segments would be required.	
		West Alignment • Approximately five concrete plants: Two in the southern part of Yolo County, one in the northern part of Solano County and another in the southern part of San Joaquin County. Size of these batching plants could be from 5 to 10 acres. • Approximately three precast segment plants: One in the southern part of Sacramento County, one in the southern part of Solano County and another plant in the northern part of Contra Costa County to produce tunnel segments and supply concrete for other planned structures.
Fuel stations	Would be constructed adjacent to concrete plants and occupy approximately 2 acres.	

3C.4 Modified Pipeline/Tunnel Option (Alternatives 4, 4A, 2D, and 5A)

Table 3C-21. Construction Assumptions for Water Conveyance Facilities by Alignment—Alternatives 4, 4A, 2D, and 5A

Construction Element/Activity	Key Construction Information or Assumptions
MODIFIED PIPELINE/TUNNEL ALIGNMENT (Alternatives 4, 4A, 2D, and 5A) Chapter 3, *Description of Alternatives*, provides a summary of modified pipeline/tunnel physical characteristics. Specific construction assumptions in this section were based off Alternative 4 and 4A; however, they are also used for Alternatives 2D and 5A. Some of the estimates (for example, amount of material excavated), would likely be greater for Alternative 2D, or slightly less for Alternative 5A.	
	Descriptions specific to the Modified Pipeline/Tunnel Alignment The modified pipeline/tunnel alignment is also approximately 45 miles long, divided into seven separate reaches beginning with Reach 1 between Intake 2 and a junction structure near Intake 3, and proceeding down the proposed alignment in ascending order ending with Reach 7 at the Clifton Court pumping plants, where water is delivered into the north cell of the expanded Clifton Court Forebay and the approaches to the Harvey O. Banks Pumping Plant (Banks) and C. W. "Bill" Jones Pumping Plant (Jones) Pumping Plants. Intakes would be constructed with the corresponding alternatives as follows: • Alternatives 4 and 4A: Intakes 2, 3 and 5 • Alternative 2D: Intakes 1, 2, 3, 4, and 5 • Alternative 5A: Intake 2 • A series of tunnels would convey water from the intakes to the IF, and from the IF to the combined pumping plants at Clifton Court Forebay. • The intermediate forebay would act as a pass through facility with an outlet structure to convey water into each main tunnel bore (Tunnel 2) via a vertical shaft. • Each tunnel includes a vertical drop shaft at the tunnel's upstream end, and a vertical rising shaft at the downstream end. • Tunnels would be lined with precast concrete bolted-and-gasketed segments. The tunnel concrete liner would serve as permanent ground support and would be installed immediately behind the Tunnel Boring Machine (TBM), forming a near watertight liner. • Temporary concrete plant would be required to produce tunnel segments (See Table 3C-8, *Access and Construction Work Areas*). • In alluvial soils with high groundwater pressures, the tunnel would be constructed at depths greater than 60 ft using mechanized closed-face pressurized tunneling machines. • Because of the high groundwater level throughout the proposed tunnel alignment area, dewatering (via dewatering wells at tunnel shaft sites) and groundwater control in the tunneling operation and shaft construction would likely be required. Tunnel shafts are assumed to be constructed using slurry diaphragm walls, and therefore require only minimal dewatering for approximately four to six weeks as the shaft is excavated, as necessary. Construction of the tunnel shafts is not anticipated to result in significant impacts on surrounding groundwater as the dewatered zone would be hydraulically isolated from the surrounding aquifer system. • The slurry wall materials would consist of a combination of sand, cement, native soil, and bentonite in similar ratios as described in the American Society for Testing and Materials (ASTM) specifications for slurry materials used in drinking water well sealing procedures, such as described in DWR Well Standards Bulletins 74-81 and 74-90. This combination of materials will be used to avoid changing groundwater and surface water quality in the vicinity of the slurry walls . • Following construction of the slurry walls, dewatering wells would be installed at varying depths to remove groundwater from construction site as excavation in initiated. Some of the

Construction Element/Activity	Key Construction Information or Assumptions
	dewatering wells would be installed at shallow depths and others would extend to the depth of the slurry walls. The dewatering wells would have varying depths of solid well casing liners which would be installed in the same manner as for drinking water wells to prevent migration of groundwater between different portions of the aquifer. • Each tunnel reach would include at least one launch shaft, intermediate shaft and retrieval shaft per bore, except the tunnel between Intake 2 and Intake 3 under Alternatives 4, 4A, and 2D. • RTM disposal shafts or tunnel(s)The pumping plant will have 150-ft internal diameter shafts.The pumping plant shafts are assumed to be constructed using slurry diaphragm walls 6 ft thick due to the large diameter and depth. The finished interior walls would be4- to 5-ft-thick.
Excavation	• Except where crossing under a major waterway, intake conveyance pipelines may be installed using pipe jacking, shoring, or open cut. Excavation would include clearing, grubbing, excavation, storage of excess spoil material and dewatering. • All existing vegetation and trees would be cleared and grubbed along the pipeline easement and disposed of offsite. • Materials to be stockpiled may include: 1. Strippings from various excavations, for possible reuse in landscaping 2. RTM that is slated for reuse after treatment for embankment or fill construction 3. Peat spoils for possible use on agricultural land, or as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section) 4. Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas • Such materials can be stockpiled in the construction areas of the project for later use. Some stockpiles may be used for material conditioning and potential reuse of the material. • Temporary stockpile areas may also allow for the staging of deliveries (offloading), for equipment/materials storage, and for temporary field offices for construction. • Tunnel conveyances excavation and backfill material: ○ Borrow and excavate for Tunnel Reach 7 and Combined Pumping Plants: 2,195,000 cy ○ Borrow and excavate for Tunnel Reaches 1-6: 3,403,000 cy • Total Alternative 4 and 4A excavate, direct haul, and compact: 3,940,000 cy • Excavate and haul to stockpile: 7,518,000 cy • Excavate and export: 1,030,000 cy • 35,360,000 cy of borrowed, excavated, and dredged material. • 160,000 cy dredged at each intake site. • 1,030,000 cy dredged at IF. • Construction of Alternative 4 and 4A intakes would require 4,430,000 cy of borrow, total. Each intake, including the perimeter berm, would require between approximately 1,450,000 and 1,490,000 cy of borrow. • Under Alternatives 4 and 4A, the total amount of borrow material for engineered fill is approximately 21,000,000 cy (bank yards), based on the associated number of intakes, size of forebays, and conveyance requirements. The total amount includes approximately 3,000,000 cy for the tunnel shaft pads, 6,500,000 cy for the CCF embankments, 2,000,0000 cy for the IF embankments, and 6,700,000 cy at the three intake sites (approximately 2 million cy each), and 2,600,000 cy at the Clifton Court Pumping Plant site. • Approximately 1,029,000 cy of excavation and 2,045,000 cy of fill material are required for completing the IF embankments. • Approximately 9,300,000 cy of fill are required for the modified CCF embankments, which includes the divider embankment separating the NCCF from the SCCF, approach canal embankments, spillway pad, and siphon outlet pad.

Construction Element/Activity	Key Construction Information or Assumptions
Tunnel 1	The intake-specific descriptions below would only apply to those alternatives under which each intake would be constructed. • Intake 2 would convey water via gravity through one 28-foot ID tunnel (Tunnel 1a) approximately 11,150 ft, or 1.99 miles, to a junction structure in the Intake 3 facilities. • Intake 3 would convey water via gravity from the junction structure through one 40-foot ID tunnel (Tunnel 1a) approximately 36,207 ft, or 6.74 miles, which allows the flow from Intakes 2 and 3 to be conveyed to the IF. • Intake 5 would convey water through one 28-foot ID tunnel (Tunnel 1b) approximately 25,180 ft, or 4.77 miles, to the IF. • Tunnel 1a has one tunnel bore and one shaft location with two shafts at Intake 2 and retrieval shaft at junction structure shaft. Its inside diameter is 28 ft (with an outside diameter of approximately 31 ft) between Intakes 2 and 3. • Tunnel 1b has one tunnel bore and three shaft locations between Intake 5 and the IF. Its inside diameter is 28 ft and its outside diameter is aproximately 31 ft.
Tunnel 2	• Tunnel 2 consists of two 40-foot ID tunnels (dual-bore) stretching approximately 30.1 miles between the intermediate forebay and two 4,500 cfs pumping plants to the northeast of the expanded Clifton Court Forebay. • 2 tunnel bores, 10 shaft sites. • Inside diameter: 40 ft. • Outside diameter: approximately 44 ft.
Boring	• Earth pressure balance (EPB) tunnel boring machines (TBM) and slurry tunneling machines would likely be used to excavate tunnel spoils. • The distance between the two bores of Tunnel 2 would be twice the outside diameter of the tunnels, approximately 150 ft below grade. ○ 108 ft between bores under the modified pipeline/tunnel alignment (150 ft centerline to centerline), and approximately 160 ft below grade. • In alluvial soils, the tunnel would be constructed at depths greater than 60 ft using mechanized closed-face tunneling machines. • If dense gravels, cobbles, or boulders are encountered in the older alluvium depth, other mining methods may be utilized, such as grouting, jet grouting, use of a slurry tunnel boring machine, or freezing and hand mining. • RTM would be transferred to storage areas by conveyor, wheeled haul equipment, or barges. • The tunnel invert elevation is assumed to be at 160 ft below msl under the San Joaquin River and Stockton Deep Water Channel to maintain sufficient cover between the tunnel and dredging operations in the shipping channel.
Tunnel shafts **Launch (construction) shaft**	• Shafts will be constructed to lower the TBMs to their initial working positions and to support their operation, accommodate construction and construction support operations. • For Tunnel 2, approximately 180 ft deep and approximately 120 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80-100 ft wide. Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts to be excavated from preconstructed fills built to required flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft. • Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres.

Construction Element/Activity	Key Construction Information or Assumptions
	• After tunnel construction, shafts would be backfilledleaving smaller permanent steel pipe or formed concrete shafts. • Shafts for parallel tunnels would be staggered but would be in the same general vicinity.
Intermediate Shafts	• Approximately 11 intermediate shafts may be constructed (approximately 1 shaft per tunnel bore) to facilitate tunnel ventilation, access, and safety and TBM maintenance. • Constructed between launch shafts along the tunnel alignment. • For Tunnel 2, approximately 180 ft deep and approximately 90 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80–100 ft wide. • Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts may be excavated from preconstructed fills or surrounded by walls to furnish flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft. • Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres. • Shafts for the adjacent tunnel bores may be staggered if located but would be in the same general vicinity.
TBM Retrieval Shafts	• Located at the end of each TBM drive to enable TBM retrieval, potentially six locations. • For Tunnel 2, approximately 180 ft deep and approximately 90 ft wide. For Tunnel 1, approximately 160 ft deep and approximately 80–100 ft wide. • Potential construction methods include overlapping concrete caisson walls, panel walls, jet-grout column walls, secant piles walls, slurry walls, precast sunken caissons, and potentially other technologies. • Most shafts to be excavated from preconstructed fills built to required flood protection elevation. • Shaft bottoms would need to be stabilized to resist uplift associated with external hydrostatic pressures, during both excavation and operation. It may be necessary to pretreat ground at the shaft area from the surface to the bottom of the shaft to control blowouts during excavation of the shaft. • Concrete working slabs capable of withstanding uplift would be required at all shaft locations to provide a stable bottom and a suitable working environment. • Temporary work areas associated with these shafts could range from approximately 10 to 40 acres. • Shafts for the parallel tunnels would be staggered but would be in the same general vicinity. • After tunnel construction, shafts would be backfilledleaving smaller permanent steel pipe or formed concrete shafts.
RTM Storage/ Disposal Areas	• For additional details of RTM storage, see Table 3C-25**,** *Borrow, Spoils, and Reusable Tunnel Material Storage*; Chapter 3, *Description of Alternatives*; and Appendix 3B, *Environmental Commitments*.
Construction Work Areas	• Construction work areas may include offices, parking, shop, short-term segment storage, fan line storage, crane, dry houses, settling ponds, daily spoils piles, temporary RTM storage, power supplies, air, water treatment, and other requirements. May also contain space for slurry ponds if slurry wall construction is required. • Work areas for RTM handling and permanent spoils disposal would also be necessary.

Construction Element/Activity	Key Construction Information or Assumptions
Fencing	• Access openings would be provided where acceptable and necessary. • A woven wire fence (4 ft tall topped with barbed wire) or a barbed wire fence (4.5 ft tall) may be used. • Higher security fencing with 8-foot tall chain link fences and/or razor wire may be used where appropriate. • The fencing requirements would be continuous for all intermediate facilities. • At intermediate facilities, the more stringent of the ROW or facility fencing requirements would be used. If the facility fencing is to be placed directly adjacent to the facilities, both ROW and facility fencing would be used.
Dismantling	• After construction of the tunnels, the launching and retrieval shafts would be backfilled around steel pipes or formed concrete pipes, or would be cast against reusable forms to the required finished diameter and geometry.
INTERMEDIATE FOREBAY (IF) Maintenance roads Dewater forebay Excavation Excavate Remove unsuitable Cut/fill build levees Moisture condition suitable soil Construct drying beds Load and haul to levee Slope finish Bottom finish Levee top finish Slope protection Place riprap, bedding material, fabric Concrete stilling basin Headwall concrete Gravity Bypass System or Outlet Control Structure	Conceptually designed as hydraulically isolated from other Delta waterways. The only source of water would be the Sacramento River via the new intakes. The only outlets from the intermediate forebay (IF) would be to the tunnels conveying water to the Clifton Court pumping plants and the expanded Clifton Court Forebay. The intermediate forebay would be designed as a pass-through facility that will not have regulating gates controlling flow to the main tunnels; therefore, no daily operational storage will be provided. • 204-acre surface footprint (including both the intermediate forebay and the overflow containment area, and electrical substation). • 37-acre water surface area at elevation 10 ft. • Active storage volume 750 af. • The IF would be developed by constructing a ring dike to surround the forebay. With the exception of the inlets and the outlet, the ring dike would be constructed of engineered fill. • A slurry cutoff wall would be constructed around the entire forebay site to a depth below the bottom of the excavation of the forebay and would extend to a relatively impermeable layer. If the impermeable layers are not consistent along the bottom of the slurry wall, grouting or ground improvement methods would be used to reduce water from seeping into the construction site. • The slurry wall materials would consist of a combination of sand, cement, native soil, and bentonite in similar ratios as described in the American Society for Testing and Materials (ASTM) specifications for slurry materials used in drinking water well sealing procedures, such as described in DWR Well Standards Bulletins 74-81 and 74-90. This combination of materials will be used to avoid changing groundwater and surface water quality in the vicinity of the slurry walls . • Following construction of the slurry walls, dewatering wells would be installed at varying depths to remove groundwater from construction site as excavation in initiated. Some of the dewatering wells would be installed at shallow depths and others would extend to the depth of the slurry walls. The dewatering wells would have varying depths of solid well casing liners which would be installed in the same manner as for drinking water wells to prevent migration of groundwater between different portions of the aquifer. • Dewatering would only be required to remove water from within the slurry walls which would be hydraulically isolated from the surrounding aquifer system. • Beneath the new embankments, a slurry cutoff trench would be included beneath the embankment to protect the foundation of the embankment from underseepage and piping. A drain would also be included at the landside toe of the outer embankment slope to limit saturated conditions at the ground surface due to seepage from the forebay or surface water/groundwater that would accumulated adjacent to the forebay embankments. If necessary, accumulated water in the toe drain could be pumped into the forebay following testing of water quality of the accumulated water. • The operating range would be a depth of +25.0 to -20.0 ft.

Construction Element/Activity	Key Construction Information or Assumptions
	• The bottom elevation of the IF is proposed to be -20.0 ft except locally at the inlet and outlet connections. The incoming tunnels would transition to vertical shafts that terminate in the inlet structure, which would incorporate bulkhead gates. It is assumed flow would then pass through a transition structure that would include roller gates to reduce incoming velocities. • It is assumed that at the south end of the IF, the outlet structure would consist of a concrete structure with a gated overflow weir at elevation +10.0 ft. Flows over the gated weir would discharge to a transition structure directing flow to the vertical outlet shafts. • A 130-foot-wide emergency spillway located on the east side of the IF would carry emergency overflow to a designated adjacent spillway containment area. • The planned embankment crest elevation for the IF would be +32.2 ft, which includes considerations for SLR. The new embankments would be constructed by excavating the embankment foundations down to suitable material and then installing the slurry cutoff wall. After the cutoff wall is completed, the embankments will be constructed of compacted fill to the desired height. • Approximately 1,029,000 cy of excavation and 2,045,000 cy of fill material are required for completing the IF embankments. • The required embankment material would be borrowed from within the limits of the respective forebays to the extent possible or from borrow sites. • Moisture conditioning of the soils would likely be required.
IF Transition Structures	Water would flow from Intake 2 through a 28-foot diameter tunnel to a junction structure at Intake 3, and from there via a 40-foot diameter tunnel to an IF structure. Water would flow from Intake 5 to an IF structure via a 28-foot tunnel. • Above-grade footprints: the inlet and outlet structure are approximately 500 ft x 360 ft. The majority of the structures would be below ground level. • The embankment elevation of an IF structure would be between 27 ft and 30 ft above existing ground elevation. • Inside the top perimeter road would be a 2 ft high concrete barrier. A 6 ft high security fence would be placed on top of the concrete barrier. • Walls and access platforms would be concrete. A portion of the IF section in the vicinity of the transition structure would be armored with concrete. • The top of the structures would be set at the same elevation as the top of the forebay embankment (approximate elevation 32 feet). • Uncovered channels would be open to above. • A 17-ton gate hoist (with clear lift height of 25 ft) will be placed at the inlet side of the IF structure to move roller gates. A 54-ton gate hoist (with clear lift height of 34 ft) will be placed at the outlet side of IF structures. • Temporary parking areas during construction would be within the 1 to 5 acre construction staging area for each transition structure. • Parking during operation may be available on forebay maintenance roads adjacent to and around three sides of the facilities, approximately 24 ft wide x 400 ft long
Outer Structure	• Approximate footprint: 90 ft x 160 ft • Wall of facilities will be below site grade with the top of the walls/access decks at the same level as the site grade. • Walls and access platforms will be concrete. • Handrail and gates will be steel. • Control building approximately 20 ft x 20 ft x 20 ft tall • Control building could be framed of timber, CMU, steel or metal studs. Steel may be painted or galvanized.

Construction Element/Activity	Key Construction Information or Assumptions
Clearing/ Grubbing/ Dewatering	• Prior to excavation at the forebay locations, a perimeter slurry cutoff wall would be constructed around the perimeter of each forebay location to minimize induced seepage from the adjacent waterways and to reduce the need for groundwater dewatering during the entire construction period and associated effects on groundwater. • The slurry wall would be constructed to a depth below the bottom of the excavation of the intake and would extend to a relatively impermeable layer. If the impermeable layers are not consistent along the bottom of the slurry wall, grouting or ground improvement methods would be used to reduce water from seeping into the construction site. • The slurry wall materials would consist of a combination of sand, cement, native soil, and bentonite in similar ratios as described in the American Society for Testing and Materials (ASTM) specifications for slurry materials used in drinking water well sealing procedures, such as described in DWR Well Standards Bulletins 74-81 and 74-90. This combination of materials will be used to avoid changing groundwater and surface water quality in the vicinity of the slurry walls . • Following construction of the slurry walls, dewatering wells would be installed at varying depths to remove groundwater from construction site as excavation in initiated. Some of the dewatering wells would be installed at shallow depths and others would extend to the depth of the slurry walls. The dewatering wells would have varying depths of solid well casing liners which would be installed in the same manner as for drinking water wells to prevent migration of groundwater between different portions of the aquifer. • Dewatering would occur following installation of the slurry walls and as excavation is initiated. The dewatering activities would only need to remove water from within the slurry walls which would be hydraulically isolated from the surrounding aquifer system.
Substation and Exterior Transformers	• See *Power Supply and Grid Connections*
Utilities	• See Table 3C-24, *Power Supply and Grid Connections.*
Roads	• See Table 3C-8, *Access and Construction Work Areas.*
Landscaping/ Vegetation	• See Landscaping/vegetation under North Delta Intakes, above.
Control Structures	While the types of control structures used within and among alignments would vary, controls generally affect the hydraulic grade line at low flow rate by creating additional headlosses to allow better pump selection and more efficient operation over the full range of flows, from 500 to 15,000 cfs. The proposed controls between the Clifton Court Forebay and the existing pumps in the South Delta include the following. • Control structures have approximate footprints ranging from 200 ft x 500 ft to 300 ft x 600 ft. • Walls of the facilities would be below site grade with the top of walls/access decks at the same level as the site grade. • Control structure walls and access platforms would be concrete. • Site grade would be set at the same elevation as the top of the concrete lining that extends 280 ft up- and downstream of the facilities. • The top of the concrete lining is set 29 ft above the structure invert. • A handrail, potentially a 3-rail 3.5 ft tall, would be provided around the perimeter of the access decks. • Roller gates would be installed and a control building, approximately 20 ft x 20 ft and 20 ft tall, would be located at the control structures. • Under the modified pipeline/tunnel alignment, an outlet structure would operate in lieu of the IPP (see *Outlet Structure* under *Intermediate Forebay* features, above) • The gates, in the open position, and the control building may extend above the top of the canal embankment. The remainder of the facilities are likely not to be visible over the top of the embankment.

Construction Element/Activity	Key Construction Information or Assumptions
Utilities	• See Table 3C-24, Power Supply and Grid Connections.
Access Roads	• See Table 3C-8, Access and Construction Work Areas. • SR 160 would be permanently relocated from its current alignment along the top of the river levee to a new alignment established on top of the widened levee aligned approximately 220 ft farther inland from the river.
Rock Pile Protection	• Rock protection would likely be placed from a barge by a clam shell • Length of permanent bank protection would be 100–2,200 ft. • Area of dredging and channel reshaping would be approximately 2.5–7 acres.
Clifton Court Combined Pumping Plants	• Two combined pumping plants would be constructed and operated to sustain water levels in the Clifton Court Forebay required for optimal pump operations at both Banks and Jones Pumping Plants when the gravity bypass is not utilized. • The pump shafts provide multiple functions: ○ 1) Provide for gravity flow when the system hydraulics allows via a spillway, ○ 2) Provide surge protection via the spillway, ○ 3) House the pumps and their controls. The gravity flow will bypass the pumps via three weir gates by allowing flow to discharge directly to NCCF if hydraulic conditions permit. • Final grade for the permanent pump station facilities, including switchyard, electrical buildings, and other infrastructure, will be at a minimum EL. 25 to provide protection from the 200-year flood level with sea level rise (El. 16.5), wave run up (5 ft.), and additional freeboard (3.5 ft.). The site grade of El. 25 will be established prior to construction of the shafts to provide flood protection during construction for the tunnels and pump stations. • For surface drainage, the final surface will be sloped at a minimum of 1%. • The combined pumping plant will encroach past the existing levee road into the Forebay, requiring the redevelopment of the existing levee road. • Required to overcome head loss (energy loss) due to friction as the water is conveyed along the very flat terrain to the delivery pumping plants in the South Delta. • To provide the firm design capacity of 9,000 cfs, a total of 12 pumps will be provided in the two Pumping Plants. Eight of the pumps will have a design capacity of 1,125 cfs and four will have a design capacity of 563 cfs. • The discharge piping for the large pumps is 12 feet in diameter and the discharge piping for the small pumps is 8.5 feet in diameter. • To the north of the combined pumping plants, a gravity bypass channel spillway would allow water to be diverted into the forebay rather than to the pumping plants. • The pumping plant facilities would include: ○ Water treatment facilities ○ Storage detention tanks ○ Electrical buildings

Table 3C-22. Expanded Clifton Court Forebay—Alternatives 4, 4A, 2D, and 5A

Construction Element/Activity	Key Construction Information or Assumptions
Expanded Clifton Court Forebay	• For the modified pipeline/tunnel alignment, the existing Clifton Court Forebay (CCF) would be dredged and the forebay would be expanded to the southeast. A new embankment would be constructed to divide CCF into a northern cell (NCCF) and a southern cell (SCCF) of the forebay. In addition, a new embankment would be constructed within the existing CCF embankment (except for the southern embankment where it will be removed) and the area southeast of CCF. SCCF includes the existing southern portion of CCF and the area southeast of CCF. • Additionally, two culvert siphons would be constructed to convey water into the northern cell, between the northern cell and new approach canals to Banks and Jones Pumping Plants, and under Byron Highway and the Southern Pacific Railroad, connecting the new approach canal to the Banks Pumping Plant with the existing approach canal downstream of Skinner Fish Facility. • Construction may require short shut downs of the existing conveyance system to the Banks and Jones Pumping Plants, to add new control structures to the existing pumping plant approach canals and when new approach canals are connected to the existing canals. • Water in CCF and Old River would be controlled to prevent blowout of the embankments due to seepage.
Clearing and Grubbing **Dewatering** **Sheetpile Cell** **Excavation** **Embankment** **Remove Sheetpiles** **Area Restoration** **Demobilization**	• The modified pipeline/tunnel alignment would deliver water to the Clifton Court combined pumping plants near the northwest corner of CCF. • A siphon structure would be situated underneath the existing CCF outlet to a new approach canal. The inlet to the siphon would be located at the southwest corner of NCCF and would daylight to the transition structure of the new approach canal system south of SCCF. • The area designated for the NCCF would be dredged to provide a bottom elevation -5.0 ft except locally at the inlet and outlet connections. The portion of SCCF that lies within the extent of the existing CCF would be dredged to an elevation of approximately -10.0 ft, which would be the bottom elevation of SCCF. Together, approximately 8 million cy of dredged material is expected to be removed from NCCF and SCCF. • The water surface area for NCCF would be approximately 806 acres (at an elevation of 7.5 ft), with a normal operating range resulting in approximately 4,300 to 10,200 af of active storage availability. The water surface area for SCCF would be approximately 1,691 acres, with a normal operating range resulting in approximately 14,000 af of active storage availability at elevation 8.1 ft. • A new section of approach canals, approximately 2,000 ft long, would connect NCCF to the existing approach canal to the Banks Pumping Plant. • The new approach canal would deepen from the forebay bottom elevation to match the depth at the existing approach canal to the Banks Pumping Plant. Two segments of this new canal would be connected by a siphon, running under Byron Highway and the Southern Pacific Railroad. A radial gate control structure would be installed at the downstream end of this new approach canal to hydraulically isolate the existing SWP facilities from NCCF. • NCCF will also be connected to the Jones Pumping Plant by a new 4,000 ft canal. A branch off of the new canal section will connect to the existing Jones Pumping Plant approach canal. The invert of this canal would match the invert of the existing Jones Pumping Plant approach canal at the connection point. A radial gate control structure would be installed at the downstream end of the new canal to hydraulically isolate the existing CVP facilities from NCCF. This branch of the new canal would have a capacity of 4,600 cfs matching the capacity of the Jones Pumping Plant. • An emergency spillway located on the east side of NCCF will carry emergency overflow to the Old River. • Additional control structures would be installed within the existing approach canals to provide the ability to isolate NCCF from the Banks approach channel upstream of the Skinner Facility and to isolate NCCF from Old River upstream of the approach canal to the

Construction Element/Activity	Key Construction Information or Assumptions
	Jones Pumping Plant. The pumping plants themselves can also be isolated from the approach canals. • NCCF and SCCF would be developed by constructing an embankment within the existing CCF embankment and by constructing a divider embankment through the middle of the existing CCF. • The planned embankment crest elevation for the expanded NCCF, SCCF, divider embankment, and approach canals would be +24.5 ft, which includes considerations for SLR. The toe of the new embankment would be set at 25 ft from the toe of the parallel existing embankment or levee. Excavation at the toe of the existing embankment and levees may 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 would consist of engineered fill placed on suitable foundation material at a 4H:1V slope on both the inboard and outboard sides of the embankment. The embankment crest would be 32 ft wide, which consists of a 24-foot-wide, two-way maintenance access road with 4-foot shoulders on each side. In addition, maintenance roads would be provided at the new approach canal, joining the roads at the existing approach canal to the Banks Pumping Plant. • The existing CCF inlet structure would be modified to meet the new embankment elevation and would consist of a reinforced concrete structure with multi-gated bays. • The inside of the new embankment would include riprap slope protection. The riprap would be placed over an appropriate filter layer and would extend from the toe of the embankment to the crest. • New embankments would be constructed by excavating the embankment down to suitable material, dewatering, and installing the slurry cutoff wall. Approximately 9.3 million cy of fill would be required for the modified CCF embankments, which includes the divider embankment separating the NCCF from the SCCF, approach canal embankments, spillway pad, and siphon outlet pad. The required embankment material would be borrowed from within the limits of the respective forebays to the extent feasible, or from borrow sites. • A slurry cutoff wall would be constructed around the entire forebay site to a depth below the bottom of the excavation of the forebay and would extend to a relatively impermeable layer. If the impermeable layers are not consistent along the bottom of the slurry wall, grouting or ground improvement methods would be used to reduce water from seeping into the construction site. • The slurry wall materials would consist of a combination of sand, cement, native soil, and bentonite in similar ratios as described in the American Society for Testing and Materials (ASTM) specifications for slurry materials used in drinking water well sealing procedures, such as described in DWR Well Standards Bulletins 74-81 and 74-90. This combination of materials will be used to avoid changing groundwater and surface water quality in the vicinity of the slurry walls . • Following construction of the slurry walls, dewatering wells would be installed at varying depths to remove groundwater from construction site as excavation in initiated. Some of the dewatering wells would be installed at shallow depths and others would extend to the depth of the slurry walls. The dewatering wells would have varying depths of solid well casing liners which would be installed in the same manner as for drinking water wells to prevent migration of groundwater between different portions of the aquifer. • Dewatering would only be required to remove water from within the slurry walls which would be hydraulically isolated from the surrounding aquifer system • Moisture conditioning of the soils would likely be required.

Construction Element/Activity	Key Construction Information or Assumptions
Culvert Siphons	• The South CCF outlet siphon would include 4 box culverts, each of which would be 26 ft wide and 26.5 to 38.5 high. This siphon would include 4 radial gates and would be approximately 1,800 ft long. • The Byron Highway/Southern Pacific Railroad siphon would include 4 box culverts, each of which would be 26 ft wide and 26.5 to 38.5 high. This siphon would include 4 radial gates and would be approximately 1,300 ft long. • The culvert siphons would be constructed as large multiple-box culvert structures using cofferdams, shoring, and open cut-and-cover construction methods with conventional CIP concrete structures. A cofferdam would be used at the SCCF Outlet siphon, while shoring would be used at the Byron Highway/Southern Pacific Railroad siphon. Once the cofferdam or shoring were in place, cut-and-cover construction methods would be done within the enclosed space. • It is envisioned that the culvert siphon SCCF Outlet would have to be constructed in two phases. In the first phase, a temporary cofferdam would be installed approximately halfway along the length of the siphon. Half of the total length of the culvert siphon would then be constructed. During the second phase, the cofferdam would be re-installed across the other half of the siphon, and the remainder of the structure would be constructed and backfilled.

Table 3C-23. Head of Old River Barrier—Alternatives 4, 4A, 2D, and 5A

Construction Element/Activity	Key Construction Information or Assumptions
Head of Old River Barrier • Operable barrier (fish control gate) and boat lock would be located at the divergence of the head of Old River and the San Joaquin River, to prevent migrating and outmigrating salmon from entering Old River from the San Joaquin River. • Other components: fish passage (fish passage structure); control building to house emergency generator, control panels for the control gates, circuit breakers; storage area for operation and maintenance equipment; boat lock operator's building; communications antenna • Gate would have an permanent storage area of 180 ft x 60 ft and operator parking. • Fencing and gates would control access to the structure. • Access road would be improved with 2 miles of private access road, minimum 16 ft wide with gravel surface, beginning at the end of Undine Road and running east to the San Joaquin River levee, then south and west along the levee to the gate site. • A construction staging area of approximately 10,000 square feet (ft) would be located on the south side of Old River just outside the levee roads. • A sheetpile retaining wall would be installed in the levee where the gate would be constructed. • Complete gate would require approximately 1,500 cy of concrete. • Approximately 11,000 square feet (450 linear ft) of riprap would be used as slope protection on levees near the gate and on the channel bottom. • Fine materials such as sand would be placed adjacent to the riprap to create a smooth slope from channel bottom to the gate sill.	
Fish Control Gate	• Approximately 210 ft long x 30 ft wide, top elevation 15 ft (NJAVD 88). • Seven bottom-hinged gates approximately 125 ft long. • Fish passage structure • Vertical slot, self-regulating, with four sets of baffles. • To be designed according to NOAA Fisheries and USFWS guidelines for species including salmon, steelhead, and green sturgeon. • Fish passage structure: approximately 40 ft long x 10 ft wide.

Construction Element/Activity	Key Construction Information or Assumptions
	• Constructed of reinforced concrete. • Stoplogs would be used to close the fish passage structure in spring when not in use to protect it from damage. Operable barrier Two potential gate construction methods. • *Cofferdam:* Creates a dewatered construction area for ease of access and egress. Construction would take place in two phases and in-water work could continue through winter. ○ Phase 1: Construct cofferdam in half the channel, dewater, and construct gates on the dewatered channel bottom and adjacent levee. Remove or cut off cofferdam at required invert depth. Construct cofferdam in second half of the channel. ○ Phase 2: Construct gate in the other half of the channel using same methods, remove or cut off cofferdam, and incorporate into the final gate layout. Construct equipment storage area and remaining fixtures. ○ Cofferdam construction would begin in August and last approximately 35 days. ○ Construction activities in the cofferdam project area would last until approximately early November, and could continue through winter. • *In-the-wet:* Allows the river to flow unimpeded and eliminates the time, material, and cost of constructing a cofferdam. No cofferdam or dewatering, no levee relocation. ○ The channel invert would be excavated to grade using a sealed clamshell excavator working off the levee or from a barge. ○ Piles would be placed in the channel. ○ Gravel and tremie concrete would be placed for the foundation within the confines of the piles. ○ Reinforced concrete structures would then either be floated in or cast in place using prefabricated forms to be placed on top of the gravel, tremie concrete, and piles. ○ Divers would complete the final connections between the concrete structures and the piles. ○ All in-water work would occur between August 1 and November 30 to minimize effects on delta smelt and juvenile salmonids. ○ Construction of other components would take place from a barge or from the levee crown and would occur throughout the year.
Boat Lock	• 20 ft wide x 70 ft long • Would be constructed using sheetpiles and include two bottom-hinged gates on each end measuring 20 ft wide and 10 ft high. • The invert of the lock would be at elevation –8.0 ft msl, and the top of the lock wall would be at elevation 15 ft.

Table 3C-24. Power Supply and Grid Connections—Alternatives 4, 4A, 2D, and 5A

Construction Element/Activity	Key Construction Information or Assumptions
Power Supply and Grid Connections	• A new temporary substation would be constructed at each of the drive/launch shaft locations. • Lower voltage subtransmission lines would be used to power intermediate and reception shaft sites between the main drive shafts. • A new substation would be constructed near the IF to support temporary construction load. • To serve permanent loads at the pumping plant located by the Clifton Court area, a new transmission line would be extended from an existing nearby substation to a new

Construction Element/Activity	Key Construction Information or Assumptions
	substation by the pumping plant area, where electrical power would be transformed from 230 kV to 230 or 34.5 kV underbuild subtransmission lines. for transmission to the tunnel shaft areas and to 13.8 kV or appropriate bus voltage for utilization by pumps. • For operation of the one to five intake facilities, depending on the alternative, located by the Sacramento River and of the intermediate forebay facilities, existing distribution lines would be used wherever practical, which minimizes ROW issues associated with new higher voltage lines. However, if existing distribution lines cannot support the intake operation, there may be a need for a new 69 kV transmission line to serve intake operation. As such, electrical power would be transformed from 69 kV to 480V service, or appropriate equipment terminal voltage, for distribution and use for gate operation, lighting, and auxiliary equipment at the adjacent structures. • At the north end, the project could potentially connect to an existing WAPA 230 kV transmission line east of the IF. From this line, a new transmission line (at 230 kV, 115kV or 69kV, depending on the utility studies) would extend to a new substation at the IF to serve both the North Tunnel and Main Tunnel construction loads. At the south end, the project potentially connects to an existing WAPA 230 kV substation south of the existing CCF. From this substation, a new transmission line would extend north, around the western side of Clifton Court Forebay, toward a PG&E 230kV substation, described below, or east, to a new substation in the pumping plant facilities. From the new substation, a new 230 or 34.5 kV transmission line would continue to extend north toward and along the main conveyance system alignment to Bouldin Island to support construction at sites north of NCCF. Lower voltage lines would be used to power intermediate and reception shaft sites between the main drive shafts. • At the north, there is an existing PG&E 115 kV line south of Hood, from which a new temporary line (either 115 kV or 69 kV, depending on utility studies) could be extended south to a new substation. From there, the line could travel south to the IF, where a new substation would be constructed to serve temporary construction loads. Or, it could travel east to the WAPA point of interconnection, described above. Northwest of CCF, there is an existing PG&E 230 kV substation from which a new 230 kV line could be extended toward CCF, where a new 230 kV substation would be built to serve the pumping plant. From this new substation, a new line would extend north to support construction at sites north of NCCF. • A new transmission line (at 230 kV, 115 kV or 69kV, depending on utility studies) could be extended from an SMUD-planned 230 kV substation to a new substation near IF. To serve construction loads, a new transmission line would be extended from this new substation north toward the intakes as needed and south to support construction sites along the northern tunnels and at the IF. • The Intake and Sedimentation Facilities and the Junction Structure located at Intake No.3 shall be fed from the Utility via two 480V, 3-phase incoming service feeders. Each incoming service feeder shall be routed into the electrical building and feed the arc-resistant, main-tie-main-tie-main configured switchgear, with a standby emergency generator as the backup. The switchgear will then distribute power to all the associated loads. The switchgear will be located within the electrical building's electrical room. • The IF shall be fed from the Utility via two 4160V, 3-phase incoming service feeders. Each incoming service feeder shall be routed into the electrical building to feed an arc-resistant, main-tie-main configured switchgear. The switchgear will then distribute the 4160V to the major loads, including the dewatering pumps and the 4160V to 480V transformers. The switchgear will be located within the electrical building's medium voltage electrical room.

1 **Table 3C-25. Borrow, Spoils, and Reusable Tunnel Material Storage—Alternatives 4, 4A, 2D, and 5A**

Construction Element/Activity	Key Construction Information or Assumptions
Borrow/Spoils/Reusable Tunnel Material (RTM) Storage • Final locations for storage of spoils, RTM, and dredged material would be selected based on the guidelines presented in Appendix 3B, *Environmental Commitments*. • Conventional earthmoving equipment, such as bulldozers and graders, would be used to place the spoil. Some spoil, with the exception of RTM, may be placed on the landside toes of canal embankments and/or setback levees. • This may require temporary placement of the soil in borrow pits or temporary spoil laydown areas pending completion of embankment or levee construction. Borrow pits created for this project would be the preferred spoil location. • In the event that limited dewatering is required to excavate a borrow pit, construction shall be timed to allow placement of spoil in the borrow excavation to prevent the creation of new wetlands, if appropriate.	
Modified Pipeline/ Tunnel Alignment (Alternatives 4, 4A, 2D, and 5A)	• A total of approximately 2,570 acres would be allocated to RTM storage and dredged material for the modified pipeline/tunnel alignment north and main tunnels. • Designated RTM storage areas would range in size from approximately 33 to 1,208 acres. • The estimated volume of RTM to be disposed from tunneling operations is approximately 31,000,000 cy. • RTM that may be have potential for re-use, such as levee reinforcement, embankment or fill construction, would be stockpiled. The process for testing and reuse of this material is described further in Chapter 3 and Appendix 3B. • A berm of compacted imported soil would be built around the perimeter of the RTM storage area to ensure containment. Berm would conform to U.S. Army Corps of Engineers guidelines for levee design and construction. • It was assumed that RTM would be stacked to a depth of 10-12 ft. • Maximum capacity of RTM storage ponds would be less than 50 af. • RTM areas may be subdivided by a grid of interior earthen berms in RTM ponds for dewatering. • Dewatering would involve evaporation and a drainage blanket of 2 ft-thick pea gravel or similar material placed over an impervious liner. • Leachate would drain from ponds to a leachate collection system, then pumped to leachate ponds for possible additional treatment. • Transfer of RTM solids to disposal areas may be handled by conveyor, wheeled haul equipment, or barges, at the contractor's discretion. Two conveyors were assumed to be used under this alignment: one going east from the intermediate forebay and stretching approximately 3,000 ft to an RTM area and another spanning a trenchless crossing from a shaft site northeast of Clifton Court Forebay across Italian Slough to an RTM area on Byron Tract. At Italian Slough a trenchless crossing would be constructed to transport the RTM under the slough to the RTM storage area on Byron Tract. Construction of the trenchless crossing would entrail microtunneling or pipe jacking would be used to construct a small diameter pipe (approximately 72 inches in diameter) under Italian Slough. Once the pipe is in place, an electric conveyor belt would be installed in the pipe. Once construction the water conveyance structure for Alternative 4 has been completed, this pipe would be backfilled with concrete. • Where feasible, the invert of RTM ponds would be a minimum of 5 ft above seasonal high groundwater table. • An impervious liner would be placed on the invert and along interior slopes of berms, to prevent groundwater contamination. • Spoil placed in disposal areas would be placed in 12-inch lifts, with nominal compaction. • Borrow acquisition and/or spoil deposition would occur on areas allocated for other project features, such as the SCCF and RTM storage areas (for example, the expanded area

Construction Element/Activity	Key Construction Information or Assumptions
	for CCF and RTM areas may be used as borrow sites prior to being used for other project purposes). • The maximum height for placement of spoil is expected to be 6-10 ft above preconstruction grade (except for sites adjacent to CCF and on Glannvale Tract, where it would be 10-15 ft), and have side slopes of 5H:1V or flatter. • After final grading of spoil is complete, the area would be restored based on site-specific conditions following project restoration guidelines.

Table 3C-26. Access and Construction Work Areas—Alternatives 4, 4A, 2D, and 5A

Construction Element/Activity	Key Construction Information or Assumptions	
General Construction Work Areas	• Work areas during construction may include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Materials to be stockpiled may include: • Strippings from various excavations for possible reuse in landscaping. • RTM that is slated for reuse after treatment for embankment or fill construction. RTM areas may be temporary or permanent. • Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section). • Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas. • Borrow and spoils areas may be temporary or permanent.	• Other temporary work areas not specified at left include those associated with the construction of canals, control structures, forebays, intakes, levees, operable barriers, pipelines, pumping plants, safe haven zones, siphons, and tunnels. Areas would also be dedicated to temporary transmission lines.
Roads	• Dust abatement would be addressed in all construction areas at all times. • Asphalt-paved wet weather temporary access road to provide construction access to the conveyance pipe construction between the canal and the intake facility. • Asphalt-paved temporary access ramps to connect existing public and private roads to construction sites would be constructed to connect to the existing roadways at the existing grade. • Asphalt-paved permanent access ramps would be constructed to the elevated roadways at the final grades. • Heavy construction equipment, such as diesel-powered dozers, excavators, rollers, dump trucks, fuel trucks, and water trucks would be used during excavation, grading, and construction of access/haul roads.	• The physical extent of these areas (includes Bridge Work Areas, Highway Work Areas, Road Work Areas, and Temporary Access Road Work Areas) would depend on the conveyance alignment. Additionally, some road work areas are subsumed within the construction footprints associated with other features (i.e., Intakes, Safe Haven Work Areas, etc.).

Construction Element/Activity	Key Construction Information or Assumptions	
Detour Roads	• *Intakes:* Detour roads needed for all intakes, for traffic circulation around the work areas. It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Roadway detours would likely be needed around each intake's construction zone (including intake pumping plant construction area) to provide site security and safety.	• It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation.
Temporary and New Access/Haul Roads	• Temporary and permanent access roads would be constructed for features such as intakes, reusable tunnel material areas, the intermediate forebay, work areas, shaft sites, the combined pumping plants, and barge unloading facilities. • 24-foot-wide • Excavated alluvial mineral soils may be used, though additional material may have to be imported onsite.	
Parking	• See Table 3C-1**,** *Construction Assumptions for Water Conveyance Facilities***.**	
Temporary Barge Unloading Facility Construction and Removal	• May be located at each of the intake structure worksites, tunnel worksites, and culvert siphon worksites, to be used for the delivery and removal of construction materials and equipment. • Barges would be required to use existing barge landings where possible and maintain minimum waterway width greater than 100 ft (assuming maximum barge width of 50 ft). • Under the modified pipeline/tunnel alignment, it is assumed that barge activities would take place on levees using a ramp barge in conjunction with a crane/excavator barge, conveyor, crane or excavator positioned on or near the levee. • The physical extent of these areas would depend on the conveyance alignment: • Modified Pipeline/Tunnel Alignment: approximately 180 acres. • Approximately 300 ft x 50 ft, pile-supported dock to provide construction access and construction equipment to portal sites. • Refer to Table 3C-2 for assumptions used to evaluate impacts from pile driving. • A pier would be built within the worksite footprint of the intake or tunnel and removed at the end of construction. • Facility would be in use during the entire construction period at each location. • Barges could be used for pile-driving rigs and barge-mounted cranes, suction dredging equipment, and microtunnel drives from the in-river cofferdam, transporting RTM, crushed rock and aggregate, pipeline sections, etc., post-	• Temporary barge unloading facilities for would be built at the following locations: Snodgrass Slough, Potato Slough, San Joaquin River, Middle River, Connection Slough, Old River, and the West Canal.

Construction Element/Activity	Key Construction Information or Assumptions
	construction underwater debris removal, and other activities. • Access roads to construction work areas would be necessary.
Concrete Plants and Precast Segment Plants	• Due to the large amount of concrete required for construction and the schedule demands of the program, it is anticipated that the contractor(s) would set up their own concrete plant at the job sites. Five concrete batch plants are expected for the MPTO alignment, ranging from 1 to 40 acres. • While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If constructed, these would be located adjacent to concrete plants. • It is likely that each precast segment plant would require approximately 10 acres for offices, concrete plant, materials storage, and casting facilities. • Additional acreage for segment storage would be needed at the precast segment plant site, and could run several times the space required for the plant. • The segments can be transported by barge, rail, or truck where these modes of transport are available; however, it is most likely that trucking of segments would be required.
Fuel Stations	• Would be constructed adjacent to concrete plants and occupy approximately 2 acres.

3C.5 Separate Corridor Option (Alternative 9)

Table 3C-27. Alternative 9, Through Delta/Separate Corridors Conveyance

Construction Element/Activity	Key Construction Information or Assumptions
THROUGH DELTA/SEPARATE CORRIDORS CONVEYANCE (Alternative 9) • No major new water conveyance corridors would be built under Alternative 9. Water would be conveyed through existing channels and rely on existing levees. • Two water supply corridors and two fish movement corridors would be utilized. • Operable barriers would isolate fish movement corridors and estuary habitat from water conveyance corridors. • It is assumed that dredged material would be disposed of in upland disposal sites and that 0.5% may need to be disposed of in landfill. Approximately 0.1% of spoil that is not dredge material may also need to be disposed of in a landfill. • Total approximate tonnage of solid waste: Landfill disposal 22,901 tons / Upland disposal 201,549 tons. • Upland disposal means that the spoil may not be in contact with surface water, that runoff from the spoil may not enter a surface water body, and/or the spoil may not be placed where soluble metals or other contaminants can leach to groundwater. • Possible specialized disposal for dredged material: 1,008 tons. • Chapter 3, *Description of Alternatives*, Table 3-14, provides a summary of Alternative 9 physical characteristics	
Screened intakes (without pumping plants)	• Two Sacramento River locations, one at the Delta Cross Channel (DCC) entrance, and one at Georgiana Slough • 7,500 cfs diversion capacity at each intake • 2,800 ft long x 15 ft high, fish screens with 1/16 in openings • Would divert water into existing channels • No sedimentation basins or solids lagoons • Each to be constructed in two phases

Construction Element/Activity	Key Construction Information or Assumptions
Delta Cross Channel	• 2,800-foot-long fish screen intake on Sacramento River, 7,500 cfs capacity. • Possible new replacement intake control structure with gates. Boat access at this location would be eliminated and provided at Georgiana Slough or Meadows Slough. • Landfill disposal: approximately 81 tons
Georgiana Slough	• 2,800-foot-long fish screen intake on the Sacramento River, 7,500 cfs capacity. • New intake control structure with gates on Slough with a flood flow capacity of 20,600 cfs. • Would require relocating a levee and associated road • Would entail constructing a boat lock and channel to allow continued passage between the slough and Sacramento River. Boat channel landfill disposal: approximately 181 tons • Fish screen intake facility landfill disposal: approximately 580 tons
Diversion pumping plants	• Provide dilution flow into existing channels. • Pumping plant sites include a dewatering sump and discharge piping, flow meter vaults, outfall piping, an electrical and control building, an access road, and transformer. • On San Joaquin River at head of Old River • On Middle River upstream of Victoria Canal • Includes small intake structures without fish screens • Three pumps plus one spare at each, 83 cfs capacity per pump / Total 250 cfs capacity per pumping plant • Include automatic self-cleaning trash racks • Sluice gates between intake and pumps • No sedimentation basins or solids lagoons • Constructed on engineered fill
San Joaquin at Old River	• Final ground level of approximately 25 ft.
Middle River	• Final ground level of approximately 15 ft.
Operable barriers	Operable barriers are included in the Through Delta/Separate Corridors Alternative to minimize fish movement into the Separate Water Supply Corridors; reduce flood potential downstream in DCC and allow floodwaters to continue to pass down Georgiana Slough; and improve water quality. • Barriers used for inlet flow control; fish isolation; irrigation level control; flood control; and boat passage • Type I (Obermeyer gate, full waterway width; used in depths less than 20 ft • Type II (Selected from radial, miter, or wicket gates, full waterway width; used where depths exceed 20 ft) • Type III (Obermeyer gate boat lock with rock wall; used only where gates are required for recreational boat passage and flood neutrality is not an issue) • Each barrier location includes a 15 ft wide by 53 ft long control building. • At barriers with boat locks, the control building would include an operations room on a second floor. • Requires dredging several hundred ft upstream and downstream of gate structures. • Riprap would be installed in dredged areas to control erosion. • Type II barriers would be constructed during summer low-flow periods, in two stages. A closed steel sheet pile cofferdam would be constructed across part of the waterway and the enclosed area dewatered for construction of the first half of the barrier. It would then be removed and a new one installed for construction of the second section. • Additional temporary cofferdams upstream and downstream may be required for deeper gate bays. • Type II barrier structures would include reinforced concrete walls, piers, and foundation mats. • Foundation piles would be driven 60–80 ft below foundation level, assuming a 60-ton bearing capacity. • A barge-mounted crane would install rock walls for Type III barriers; these may require a prepared foundation, depending on site conditions.

Construction Element/Activity	Key Construction Information or Assumptions
	• Majority of dredge material would be disposed of in upland disposal site; approximately 0.5% may go to offsite landfill.
Mokelumne River System	• Mokelumne River near Lost Slough: Type I; control gate with boat lock • Meadows Slough near Sacramento River: Type II; flood gate. • Solid waste upland disposal (dredging): 16,200 tons • Snodgrass Slough north of Delta Cross Channel: Type I; tidal gate with boat lock
Sacramento River system	• Delta Cross Channel: Type II • Georgiana Slough: Type II • Three Mile Slough: Type III. Solid waste upland disposal (dredging): 40,500 tons
South of San Joaquin River	• San Joaquin River at head of Old River: Type I; flood gate. Solid waste upland disposal (dredging): 9,720 tons • Middle River south of Victoria Canal: Type I; tidal gate. Solid waste upland disposal (dredging): 9,720 tons • Victoria Canal/North Canal: Type III; barrier with boat lock • Woodward Canal/North Victoria Canal: Type III; barrier with boat lock. Solid waste upland disposal (dredging):11,991 tons • Railroad Cut: Type III; barrier with boat lock. Solid waste upland disposal (dredging): 12,4810 tons • Connection Slough: Type III; barrier with boat lock. Solid waste upland disposal (dredging): 19,310 tons • Franks Tract: Type III; barrier with boat lock. Solid waste upland disposal (dredging): 45,375 tons • Fisherman's Cut: Type III; barrier with boat lock. Solid waste upland disposal (dredging): 17,919
Temporary work areas	• Up to 15 acres near each barrier for materials storage, fabrication of concrete forms or gate panels, stockpiles, office trailers, shops and construction equipment maintenance. • See Table 3C-29, *Access and Construction Work Areas*
Channel enlargement	
Victoria Canal dredging	• Dredging with side slope of 3H:1V to the average elevation of -25 ft to provide design flow capacity of 15,000 cfs. • Approximate dredging length: 20,000 ft. • Area will increase by approximately 8,100 sq ft. • Solid waste upland disposal: 18,334 tons • Landfill disposal: 9,558 tons
Victoria Canal set back levees	• Construct setback levees on south side of Victoria Canal to accommodate the expanded and dredged canal.
Middle River dredging	• Dredging with side slope of 3H:1V to the average elevation of -25 ft to provide design flow capacity of 15,000 cfs. • Approximate dredging length: 38,000 ft. • Area will increase by: • Approximately 4,700 sq ft between Mildred Island and Railroad Cut • Approximately 4,300 sq ft between Railroad Cut and Woodward Canal • Approximately 3,200 sq ft Between Woodward Canal and Victoria Canal • Landfill disposal: 9,720 tons
River's End Marina Diversion	• Re-channeling to allow access for River's End Marina to Old River. • Approximate dredging length: 1,000 ft. • Install cofferdam or sheet pile wall during construction to prevent flooding. • Earthwork required to construct a new access channel and levees. • Landfill disposal: 28 tons

Construction Element/Activity	Key Construction Information or Assumptions
Culvert siphons	
Victoria Canal under Old River	• Provides isolation for the San Joaquin Separate Water Supply Corridor under Old River. 15,000 cfs capacity. • Approximately 1,200 ft long • Install cofferdams or sheet pile walls, during construction to prevent flooding. • Construct new reinforced concrete and steel inverted siphon.
Victoria Canal under West Canal	• Provides isolation for the South Delta Separate Water Supply Corridor under West Canal. 15,000 cfs capacity. • Approximately 600 ft long • Install cofferdams or sheet pile walls, during construction to prevent flooding. • Construct new reinforced concrete and steel inverted siphon.
Canals and channels	Approximately 1.5 miles combined length of new canals across Coney Island and for CCF intertie with Tracy Fish Collection Facility (Tracy Fish Facility) and Central Valley Project.
Coney Island Canal	• 4,000 ft long, crossing Coney Island connecting enlarged and realigned Victoria Canal to CCF, with culvert siphons conveying water under existing West Canal and Old River. • 15,000 cfs capacity. • Landfill disposal (export unsuitable): 993 tons
Clifton Court Forebay intertie canal	• 4,000 ft long, connecting CCF to Tracy Fish Facility at DMC intake • Install cofferdams or sheet pile walls at CCF and the approach canal to the Jones Pumping Plant, during construction to prevent flooding. • Earthwork required to construct a new Intertie Canal. • Construct a concrete and steel control gate structure. • Export unsuitable to landfill disposal: 1,728 tons • Excavate and export to landfill disposal: 33 tons
Control gate in DMC approach	
Bridges	
Meadow Slough channel connection with Sacramento River	• A bridge would be required to span the gap in the River Road created by the proposed channel connecting the Meadow Slough to Sacramento River.
Mokelumne River channel connection with Lost Slough	• A bridge would be required to span the gap in the levee road created by the proposed channel connecting the Mokelumne River to Lost Slough.
Intertie channel at CCF perimeter road bridge	• Proposed Intertie Canal would interrupt this perimeter roadway requiring a bridge.
Intertie channel at Herdlyn Road Bridge	• Proposed Intertie Canal would interrupt Herdlyn Road and require a bridge.
Siphon to Clifton Court Forebay	• Requires dredging along Middle River from Mildred Island to Victoria Canal, and along Victoria Canal • Gravity flow into Clifton Court Forebay
Fixed barriers	• In development
New access roads	• Access roads would be maintained along landside levee toe or along levee crest. • See Table 3C-29, *Access and Construction Work Areas*

Construction Element/Activity	Key Construction Information or Assumptions
New utility corridors Temporary Power SMAQMD (12 kv) Temporary Power SJVAPCD (12 kv) Temporary Power BAAQMD (12 kv)	• Electric power would be required for intakes, pumping plants, operable barriers, boat locks, and gate controls at the intakes and culvert siphons for the Through Delta/Separate Corridors alternative. • The electrical power for each of the various facilities would come from the local utility distribution system. • Where temporary construction power is needed, appropriate temporary facilities would be installed, used during construction, and then removed.
New levee sections Victoria Canal terminal realignment near Old River To the south and to the east of the Tracy Fish Control facility, near River's End Marina	• Approximately 0.4 miles of new levee would be constructed for Victoria Canal realignment; and approximately 0.7 mile near River's End Marina to protect the new channel fill area as well as the new channels connecting River's End. • Marina to Grant Line Canal. • Construct a 4,000 ft segment of new levee at Old River, isolating Old River from Tracy Fish Facility and connecting CCF to the Tracy Fish Facility. • Majority (99.5%) of dredged material to be disposed of in upland disposal sites; remaining 0.5% may go to an offsite landfill. • Spoils would be disposed of in designated project spoil areas; 0.1% may be disposed of in offsite landfills. • New levees to be constructed around pumping plants and operating equipment for operable barriers. • Levee shape, slope and dimensions similar to those for intake facilities; but height would match that of existing levees in the Delta, between approximately 10 and 15 ft, with corresponding base width of approximately 80 to 260 ft. • Compacted soils would be imported to the site. • Riprap for waterside armoring. • New agricultural channels would need to be constructed where levees cross.
Clifton Court Forebay modifications	• The Through Delta/Separate Corridors Alignment proposes modifying CCF by closing the existing inlet gate structure at the southeast corner and routing Victoria Canal directly into the forebay, isolating Victoria Canal from Old River and isolating Old River from the CVP. • A new Intertie Canal would connect the CVP to CCF. The existing SWP (Skinner) and CVP (Tracy) fish collection facilities would continue in operation in to screen any fish remaining in CCF. • Construction would include installing cofferdams, or sheet pile walls; earthwork for channel enlargement and levees; earthwork for new canal construction; construct concrete or earth embankment for new outlet structure at CCF. • Dredging in CCF near the outlet to support flow capacity of the canal.
Realign Victoria Canal	• Victoria Canal would be realigned starting at approximately 2,000 ft before the confluence with the Old River and redirected approximately 15 to 20 degrees to the south to accommodate an inverted siphon crossing under Old River. • The realigned segment of Victoria Canal would include earthen channel and embankment construction. (See entry at *Canals and channels*)
Clifton Court Forebay intertie canal	• See entry under Canals and channels
Reroute access to River's End Marina and Old River	• Access to River's End Marina would be re-channelized to the south of Hammer Island. • An area between the Tracy Fish Collection Facility and Fabian Tract would be filled and new levees constructed to protect the new channel. Old River would be re-channeled into the west end of the Fabian Tract, east of the existing channel.

Table 3C-28. Borrow, Spoils and Reusable Tunnel Material Storage—Alternative 9

Construction Element/Activity	Key Construction Information or Assumptions
BORROW/SPOILS/RESUABLE TUNNEL MATERIAL (RTM) STORAGE • Final locations for storage of spoils, RTM, and dredged material would be selected based on the guidelines presented in Appendix 3B, *Environmental Commitments*. • Conventional earthmoving equipment, such as bulldozers and graders, would be used to place the spoil. Some spoil, with the exception of RTM, may be placed on the landside toes of canal embankments and/or setback levees. • This may require temporary placement of the soil in borrow pits or temporary spoil laydown areas pending completion of embankment or levee construction. Borrow pits created for this project would be the preferred spoil location. • In the event that limited dewatering is required to excavate a borrow pit, construction shall be timed to allow placement of spoil in the borrow excavation to prevent the creation of new wetlands, if appropriate.	
Through Delta/ Separate Corridors (Alternative 9)	• A total of approximately 2,050 acres would be allocated to borrow acquisition and/or spoil deposition.

Table 3C-29. Access and Construction Work Areas—Alternative 9

Construction Element/Activity	Key Construction Information or Assumptions	
General construction work areas	Work areas during construction may include areas for construction equipment and worker parking, field offices, a warehouse, maintenance shops, equipment and materials laydown and storage, RTM spoils areas, and stockpiles. Materials to be stockpiled may include: • Strippings from various excavations for possible reuse in landscaping. • RTM that is slated for reuse after treatment for embankment or fill construction. RTM areas may be temporary or permanent. • Peat spoils for possible use on agricultural land, as safety berms on the landside of haul roads, or as toe berms on the landside of embankments (cannot be part of the structural section). • Other materials being stockpiled on a temporary basis prior to hauling to permanent stockpile areas. • Borrow and spoils areas may be temporary or permanent.	Other temporary work areas not specified at left include those associated with the construction of canals, control structures, forebays, intakes, levees, operable barriers, pipelines, pumping plants, safe haven zones, siphons, and tunnels. Areas would also be dedicated to temporary transmission lines. • Modified Pipeline/Tunnel Alignment: approximately 3,470 acres.
Roads	• Wet weather (asphalt paved) • Dry weather roads (minimum 12 inch thick gravel or asphalt paved) for construction activities restricted to dry season • Dust abatement would be addressed in all construction areas at all times. • All-weather roads (asphalt paved) would be required for year-round construction at all	The physical extent of these areas (includes Bridge Work Areas, Highway Work Areas, Road Work Areas, and Temporary Access Road Work Areas) would depend on the conveyance alignment. Additionally, some road work areas are subsumed within the construction footprints associated with

Construction Element/Activity	Key Construction Information or Assumptions	
	facilities, including concrete and steel structures, tunnel portals, tunnel shafts, pumping plants and intakes, and for access to delivery areas and permanent RTM spoil piles. • Permanent paved access road is anticipated along the conveyance pipeline for the canal primary and secondary access road. • Asphalt-paved wet weather temporary access road to provide construction access to the conveyance pipe construction between the canal and the intake facility. • Asphalt-paved temporary access ramps to connect existing public and private roads to construction sites would be constructed to connect to the existing roadways at the existing grade. • Asphalt-paved permanent access ramps would be constructed to the elevated roadways at the final grades. • Heavy construction equipment, such as diesel-powered dozers, excavators, rollers, dump trucks, fuel trucks, and water trucks would be used during excavation, grading, and construction of access/haul roads.	other features (i.e., Intakes, Safe Haven Work Areas, etc.). Modified Pipeline/Tunnel Alignment: • Approximately 65 acres. • Around intake work areas. • From public roads to shaft locations or safe haven areas. • From barge unloading facilities to shaft locations. • From launching shafts to RTM areas.
Detour roads	• *Intakes:* Detour roads needed for all intakes, for traffic circulation around the work areas. It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Roadway detours would likely be needed around each intake's construction zone (including intake pumping plant construction area) to provide site security and safety.	• It is expected that earthen ramps would be required to realign the roadways from levee crown to landside ground elevation. • Import and compact 971,500 cy • Under the modified pipeline/tunnel alignment, Byron Highway would need to be temporarily rerouted in order to construct the siphon connecting the new approach canal with an existing approach canal.
Temporary and new access/haul roads	Temporary • Access roads would be constructed from each intake pumping plant to the Sacramento River levee. • 24-foot-wide • Excavated alluvial mineral soils may be used, though additional material may have to be imported onsite.	Permanent • Intake site perimeter access road (approximately 24 ft wide x 2,500 ft long). • Intermediate pumping plant (during operation): The canal primary access road is proposed to be 24 ft wide paved with asphaltic concrete and the secondary access road is proposed to be 20 ft wide with a 12 ft wide gravel section.

Construction Element/Activity	Key Construction Information or Assumptions	
Parking	• See Table 3C-1, *Construction Assumptions for Water Conveyance Facilities*.	
Temporary barge unloading facility construction and removal	• May be located at each of the five intake structure worksites, tunnel worksites, and culvert siphon worksites, to be used for the delivery and removal of construction materials and equipment. • Barges would be required to use existing barge landings where possible and maintain minimum waterway width greater than 100 ft (assuming maximum barge width of 50 ft). • Under the modified pipeline/tunnel alignment, it is assumed that barge activities would take place on levees using a ramp barge in conjunction with a crane/excavator barge or a crane or excavator positioned on or near the levee. • The physical extent of these areas would depend on the conveyance alignment: • Approximately 300 ft by 50 ft, pile-supported dock to provide construction access and construction equipment to portal sites. • 24 inch steel piles placed approximately every 25 ft under the dock for a total of 36 piles. • Impact pile driving may take up to an average of 700 strikes per pile, depending on hammer type and subsurface conditions. • A pier would be built within the worksite footprint of the intake or tunnel and removed at the end of construction. • Facility would be in use during the entire construction period at each location, 5 to 6 years. • Barges could be used for pile-driving rigs and barge-mounted cranes, suction dredging equipment, and microtunnel drives from the in-river cofferdam, transporting RTM, crushed rock and aggregate, pipeline sections, etc., post-construction underwater debris removal, and other activities. • Access roads to construction work areas would be necessary.	• Potential locations depend on the alternative. • Bacon Island • Victoria Island • Clifton Court Forebay on West Canal • Glannvale Tract on Snodgrass Slough near the intermediate forebay • Bouldin Island on San Joaquin River • Mandeville Island at the intersection of Middle River and San Joaquin River

Construction Element/Activity	Key Construction Information or Assumptions
Concrete plants and precast segment plants	• Due to the large amount of concrete required for construction and the schedule demands of the program, it is anticipated that the contractor(s) would set up their own concrete plant at the job sites. Concrete plants are likely to range from 1 to 40 acres. • While it is anticipated that precast tunnel segments would be purchased and transported from existing plants, it is possible that one or more temporary plants would be constructed. If constructed, these would be located adjacent to concrete plants. • It is likely that each precast segment plant would require approximately 10 acres for offices, concrete plant, materials storage, and casting facilities. • Additional acreage for segment storage would be needed at the precast segment plant site, and could run several times the space required for the plant. • The segments can be transported by barge, rail, or truck where these modes of transport are available; however, it is most likely that trucking of segments would be required. **Modified Pipeline/ Tunnel Alignment** • Four concrete batch plants: one within the work area identified for Intake 2, one within the work area identified for Intake 5, one near Twin Cities Road and Interstate 5, and one between Byron Highway and Italian Slough.
Fuel stations	Would be constructed adjacent to concrete plants and occupy approximately 2 acres.