

Draft

Attachment 5 Preliminary Construction Schedule and Work Packages

Engineering Summary Appendix

Shasta Lake Water Resources Investigation

Prepared by:

**United States Department of the Interior
Bureau of Reclamation
Mid-Pacific Region**



**U.S. Department of the Interior
Bureau of Reclamation**

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Exhibit

EXHIBIT A Preliminary Construction Schedule for CP4

Abbreviations and Acronyms

CP	comprehensive plan
CVP	Central Valley Project
main dam	concrete dam crest
NAVD88	North American Vertical Datum of 1988
SWP	State Water Project
TCD	Temperature Control Device
UPRR	Union Pacific Railroad

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1 Preliminary Construction Schedule and Work 2 Packages

3 Construction Schedule

4 Feasibility-level designs and most-probable construction cost estimates for the
5 Shasta Dam and Reservoir enlargement include 3 dam raise alternatives,
6 resulting in five comprehensive plans (CP). At this stage of the Federal planning
7 and National Environmental Policy Act processes, an 18.5-foot raise of Shasta
8 Dam has been identified as the preliminary proposed plan and likely preferred
9 alternative. However, due to uncertainties affecting Central Valley Project
10 (CVP)/State Water Project (SWP) operational constraints, including operations
11 at Shasta Dam and Reservoir, operational parameters have not been specified.
12 Major components, benefits, and effects of the preliminary proposed plan and
13 likely preferred alternative would be similar to the 18.5-foot dam raise
14 comprehensive plans (CP3, CP4, and CP5) described in the Engineering
15 Summary Appendix, but it is recognized that changes may occur to the
16 comprehensive plans with changes in CVP/SWP operational conditions. Based
17 on analysis to-date, CP4 provides the greatest net National Economic
18 Development economic benefits. For this reason, CP4 is used as an example in
19 the following attachment to characterize the feasibility construction schedule of
20 the preliminary proposed plan and likely preferred alternative.

21 Feasibility-level construction schedule for the work to be performed and the
22 sequencing necessary to build the identified new structures and modify the
23 existing structures has been included in this document for CP4. The
24 construction schedule assumes a majority of the project work packages would
25 be awarded in the spring; however, the actual award dates will be dependent on
26 several factors. The overall project construction duration for major facilities is
27 estimated to range from 4.5 to 5 years for all comprehensive plans, excluding
28 small features such as gravel augmentation, which would extend past the
29 completion of the dam raise. Table 1 shows the estimated construction period
30 for each comprehensive plan. Activities in the construction schedule were
31 assigned calendars that allow the work to be performed in accordance with the
32 calendar details. Most construction activities occur based on a normal five-day
33 work week with major holidays as non-work days, and would be phased, when
34 feasible, to avoid environmental impacts. Submittals and fabrication activities
35 had durations assuming a seven-day week in lieu of “work days” that are used
36 for the majority of activities.

37 Construction would require typical heavy construction equipment including
38 excavators, backhoes, bulldozers, scrapers, graders, water trucks, front-end

1 loaders, dump trucks, drill rigs, pump trucks, truck-mounted cranes, pickup
 2 trucks, barges, helicopters, and miscellaneous equipment. Daily highway truck
 3 trips would be required to bring construction material to the site, and carry
 4 construction debris and waste material to a suitable landfill. Estimated daily
 5 highway truck trips and annual construction labor force for each comprehensive
 6 plan are shown in Table 1.

7 **Table 1. Estimated Construction Period, Truck Trips, and Construction**
 8 **Labor Force for SLWRI Comprehensive Plans**

Construction Item	CP1 (6.5-Foot)	CP2 (12.5-Foot)	CP3 (18.5-Foot)	CP4 (18.5-Foot)	CP5 (18.5-Foot)
Construction Period (years)	4.5	5	5	5	5
Construction Labor Force (number/year)	300	300	350	350	360
Daily Truck Trips for Materials (trips/day)	95	118	168	175	177
Daily Truck Trips for Waste (trips/day)	75	56	52	53	54
Total Daily Truck Trips (trips/day)	170	173	220	228	230

9
 Key:
 CP = comprehensive plan
 SLWRI = Shasta Lake Water Resources Investigation

10 Work Packages

11 The construction schedule was based on a logical sequencing of work activities
 12 and interdependencies between features, as applicable, and allowing concurrent
 13 construction activities for a majority of the features. The construction schedule
 14 for each feature was determined based on timing of work, location, and type of
 15 construction. The features of the dam raise were divided into individual “work
 16 packages” to identify discrete projects that could be constructed and/or
 17 contracted independently. Generally, the work packages contain the dam raise
 18 with related operational modifications; bridge, road, railroad, and other
 19 recreation and utility construction and relocations related to the expanding
 20 reservoir perimeter. A summary of possible work package durations and
 21 commentary on contract packaging for CP4 is shown in Table 2. Exhibit A
 22 outlines the Shasta Dam raise preliminary construction schedule for CP4.

23 The attached Government construction schedule bar chart (Exhibit A) shows the
 24 construction of the features utilizing methods associated with the most probable
 25 cost estimate. Overall the construction schedule provides only one scenario of
 26 many possible scenarios to complete the project. Duration and sequencing may

1 and probably will vary as assumptions and constraints evolve and become better
2 defined during the final design and permitting process. Lastly, the construction
3 schedule reflects early starts with only minimal constraints, leading to
4 considerable concurrent work. Consequently, the schedule represents the
5 technical work constraints and does not try to anticipate budget, resource
6 availability, and other stakeholder preferences which could impact the schedule.
7 The schedule provides only a starting point and not the baseline for discussions
8 regarding regional resources, budget restrictions, stakeholder preferences, and
9 contract coordination. As design and permitting progress, relevant assumptions
10 and constraints will increase and become better defined, and it is likely that a
11 longer overall project duration will result.

12 **Clearing Work Package**

13 The clearing work package includes clearing trees and vegetation from the
14 construction areas and reservoir perimeter. Clearing of vegetation is only
15 allowed from September 1 to February 1 of each year, therefore, clearing from
16 the construction areas should begin a year in advance of the award for those
17 work packages. This will allow the construction activities to begin immediately
18 after the contract is awarded and will not impact the start of other construction
19 activities. The clearing of the inundated reservoir area will take approximately
20 ten months to complete and will require several land access points, lake access,
21 and even areas of helicopter operations. Reservoir clearing has been scheduled
22 so that completion of the clearing work will coincide with the completion of the
23 Dam Raise work to minimize sediment stabilization duration and potential
24 objectionable re-growth.

25 **Dam Raise Work Package**

26 The Dam Raise includes the construction or modification of the left wing
27 embankment, right wing dam and access road, spillway, concrete dam crest
28 (main dam), temperature control device (TCD), powerhouse and penstocks, and
29 outlet works. Construction of the core walls and mechanically stabilized earth
30 walls on the left wing dam embankment is the first construction activity
31 scheduled to provide early flood protection for the left abutment. Once
32 completed, the construction of the dam spillway is allowed to begin. The
33 reservoir water surface elevation may need to be drawn down to elevation
34 1008.17 based on North American Vertical Datum of 1988 (NAVD88) prior to
35 demolition of the existing spillway concrete crest and piers, protecting the
36 construction area and downstream facilities from uncontrolled releases. The
37 schedule assumes that a bulkhead or cofferdam will be installed on the upstream
38 face to allow the reservoir to be maintained at elevation 1028.00 (NAVD88)
39 during construction. The spillway bridge and spillway gates will be taken out of
40 service during the construction. Due to access restrictions, a majority of the
41 work will be staged from barges along the upstream face.

42 The right side of the concrete dam crest, labeled as “main dam”, is shown to be
43 constructed before the left side to allow for the TCD and powerhouse and
44 penstock modifications to start after the right crest has been completed. The

1 placement of the main and right wing concrete blocks have been scheduled to
2 occur during the fall, winter, and spring due to concern of the summer heat
3 during placement. Facilitating the main dam construction, the dam crest road
4 and gantry crane will be taken out of service for approximately 30 months. The
5 gantry crane will be operational for the right wing dam after approximately
6 12 months. Modifications to the penstock will require that each unit is
7 sequentially taken temporarily out of service. Only one unit will be out of
8 service at any one time. Modification to the TCD is allowed from October to
9 June due to water temperature concerns. The penstock and powerhouse
10 modifications have been sequenced to occur at the same time as the TCD work
11 to minimize the time that the powerhouse will be offline. The modification to
12 the outlet works is allowed to begin only after the spillway construction has
13 been completed. Depending on the final contract duration and construction
14 schedule requirements, it would be prudent to anticipate select work for the
15 Dam Raise to require multiple shifts.

16 **Lakeshore Drive Work Package**

17 The Lakeshore Drive work package includes relocation of Lakeshore Drive,
18 construction of two new Union Pacific Railroad (UPRR) bridges, construction
19 of Doney and Charlie Creek Road bridges, construction of Doney Creek and
20 Antlers Dikes, and the UPRR embankments, and relocation of the railroad
21 tracks. Early activities include constructing temporary railroad crossings to
22 permit continual unrestricted access along the railroad alignment during the
23 dike, embankment, and track construction.

24 The construction of the four bridges can occur concurrently or sequentially,
25 depending on contract work packaging and related available resources. Once the
26 bridges and embankments are completed, the UPRR will require a brief outage
27 to allow the final connection to the new tracks. The existing four bridges will be
28 demolished after completion and relocation of traffic to the new bridges. This
29 demolition will need to occur during the months in which the reservoir elevation
30 is at its lowest level. Careful planning, coordination, and intense multi-shift
31 work will be required to minimize this outage, which is shown as two days.

32 **Pit River Bridge Modifications Work Package**

33 The Pit River Bridge modifications will take approximately 17 months to
34 complete and requires work to be performed without restricting traffic, and as
35 such, requires barge staged access and substantial shoring and falsework.
36 Timing of some of the construction tasks required for this modification should
37 be sequenced when the reservoir elevation is lowered for the spillway
38 modifications.

39 **Bridge Replacement Work Packages**

40 There are three road bridges, Didallas, Fender's Ferry, and McCloud Bridges
41 that are shown to be constructed concurrently. Didallas and McCloud Bridges
42 each include construction of a new bridge and demolition of the existing bridge.
43 Work for Fender's Ferry bridge includes modification to the existing bridge

1 and, depending on the reservoir levels may require a cofferdam and unwatering
2 for pier construction and work within the reservoir. These bridges are not
3 logically related or tied to each other and are not constrained to begin at a
4 particular time. Nevertheless, as with other aspects of the overall project, it
5 could be beneficial to time their construction with the dam raise or other
6 seasonal reservoir drawdowns.

7 **Recreation Facilities Work Package**

8 The recreation facilities work package includes the work required for relocating
9 the marinas, public boat ramps, campgrounds, and day use areas. Functionally
10 diverse and spread throughout the new shoreline, these recreation facilities are
11 shown to occur concurrently, without inter-related logic and without starting
12 constraints. The overall duration of these features reflects approximately two
13 years, which ultimately will be dependent upon contract packaging and
14 stakeholder preferences. The Bridge Bay Marina work includes the construction
15 of Bridge Bay East and West Dikes. The boat ramps will need to be completed
16 prior to allowing the reservoir filling to begin.

17 **Visitor Center Work Package**

18 The Visitor Center is shown to begin after the Dam Raise has been completed
19 and represents the last critical path work on the construction schedule. This is
20 due to the desire to utilize the existing visitor center parking lots as the
21 contractor staging area for the dam raise work.

Table 2. Work Breakdown Summary and Contract Package Commentary for CP4

Work Package Summary	Work Scope	Duration	Contract and Work Package Comments
Clearing	Work broken into "construction area" and "reservoir perimeter" clearing. The construction area clearing is shown to occur early in the schedule to allow preliminary clearing at each work site during allowable season September 1 – February 1. This will allow construction work to proceed and not be dependent upon clearing with limited dates. No helicopter access to Bridge bay, Lakeshore east, Pit arm, McCloud arm.	43 months	Construction area clearing seems suitable for a single early contract, or perhaps a few very small contracts split by location. Regarding the larger reservoir perimeter clearing, local and small business participation could be increased by considering several clearing contracts, primarily by location, access points, or clearing methods. A single or few larger clearing contracts may bring larger, better equipped contractors to the table, which could protect schedule risk and could reduce costs through better economies of scale.
Dam Raise	Left wing embankment raise, right wing concrete raise, spillway reconstruction, non-overflow main dam raise, right wing access road, TCD, powerhouse improvements, penstock modifications, outlet works modifications.	49 months	Integration of work, access and staging requirements, contracting and sequencing concerns suggest that a single contract would be preferable if not necessary. Possible exceptions might be the powerhouse improvements. The dam raise would require a well-equipped, diverse, civil contractor with extensive dam and marine experience.
Lakeshore Drive	Lakeshore Drive relocation, UPRR Doney Bridge replacement, UPRR Sacramento 2nd Crossing bridge replacement, UPRR embankment and dikes, track relocation, Charlie Creek vehicle bridge replacement, Doney Creek vehicle bridge replacement, and existing bridge demolition.	33 months	Contracts could reasonably be broken into the vehicle bridge construction - one or both; vehicle bridge demolition - one or both; Lakeshore Drive and vicinity temporary access improvements; UPRR bridge construction - one or both; UPRR bridge demolition - one or both; and finally the UPRR alignment reconstruction. While it may not lead to the most competitive pricing, a single contract, perhaps incorporating a degree of design-build, would probably lessen schedule risk, and may afford better coordination and responsiveness to public needs during construction.
Pit River Bridge Modifications	Waiting until after the spillway work has commenced to begin structural concrete pier water level isolation tubs; while not shown delayed, may be beneficial due to lower and stable reservoir elevation.	17 months	Reasonably a stand-alone contract, utilizing a well-equipped civil contractor with marine experience, RFP would be helpful to evaluate capability, methods and potential safety, cost, and schedule risk.
Didallas Bridge Replacement	Highway bridge construction and existing bridge demolition.	12 months	Reasonably a stand-alone contract, utilizing a well-equipped civil contractor with marine experience. Contractor evaluations should include methods and potential safety, cost, and schedule risk.

Table 2. Work Breakdown Summary and Contract Package Commentary for CP4 (contd.)

Work Package Summary	Work Scope	Duration	Contract and Work Package Comments
Fenders Ferry Bridge Reconstruction	Bridge pier expansion / extension and in-place bridge reconstruction; schedule contemplates pier construction requiring cofferdam which is more conservative than the position described possible in the Preliminary Draft EIS.	12 months	Reasonably a stand-alone contract, utilizing a well-equipped civil contractor with marine experience, RFP would be helpful to evaluate capability, methods and potential safety, cost, and schedule risk.
McCloud Bridge Replacement	Highway bridge construction and existing bridge demolition.	14 months	Reasonably a stand-alone contract, utilizing a well-equipped civil contractor with marine experience. Contractor evaluation should include methods and potential safety, cost, and schedule risk.
Recreation Facilities	Bridge Bay dikes construction, Marina removal and replacements, public and private boat ramp reconstruction, campground removal and construction, day use area removal and construction. New 10.7 acres of land for marina and boat ramp.	27 months	Local and small business participation could be increased by considering several recreational facility contracts, which could be issued, primarily by location or potentially by improvement type.
Visitor Center	New building and site construction.	14 months	Presumably a single contract utilizing a diverse commercial contractor.
Utilities and Miscellaneous Infrastructure	Scope and schedule to be developed during final design; presumably relocation and establishment of new potable water lines, waste water lines, power transmission and distribution lines, communication lines, wells and pump services, and other perimeter and site utilities.	20 months	Presumably many contracts and potentially administered and performed by the applicable utility. Separate contracts by utility type and location may be more cost effective.
Pit 7 Dam and Powerplant Modifications	Tailwater depression system and mechanical operation improvements.	7 months	PG&E might perform. Or, single contract, experienced in dam and related mechanical facilities.
Gravel Augmentation	Annual deposition of granular material into the river at one to three locations and totaling 5,000 tons to 10,000 tons per year for 10 years; unclear when this requirement starts.	113 months	Presumably many contracts and potentially administered and performed by the applicable utility. Separate contracts by gravel placement method and location may be more cost effective.
Water/Wastewater Treatment Plants	Construct new treatment facility; size/scope not determined.	11 months	Presumably a single contract utilizing an experienced treatment plant contractor.

Table 2. Work Breakdown Summary and Contract Package Commentary for CP4 (contd.)

Work Package Summary	Work Scope	Duration	Contract and Work Package Comments
Silverton and Jones Valley Road Improvements	Various activities to include grading, drainage, surfacing, and finish road realignments; scope and schedule to be developed during final design phase.	11 months	Local and small business participation could be increased by considering a single contract for each road improvement area.
Turntable Bay Road Improvements	Various activities to include grading, drainage, surfacing, and finish road realignments; scope and schedule to be developed during final design.	11 months	Local and small business participation could be increased by considering a single contract for each road improvement area.
Salt Creek Road Improvements	Various activities to include grading, drainage, surfacing, and finish road realignments; scope and schedule to be developed during final design.	11 months	Local and small business participation could be increased by considering a single contract for each road improvement area.
Gilman Drive Improvements	Various activities to include grading, drainage, surfacing, and finish road realignments; scope and schedule to be developed during final design.	11 months	Local and small business participation could be increased by considering a single contract for each road improvement area.

Key:

CP = comprehensive plan

EIS = Environmental Impact Statement

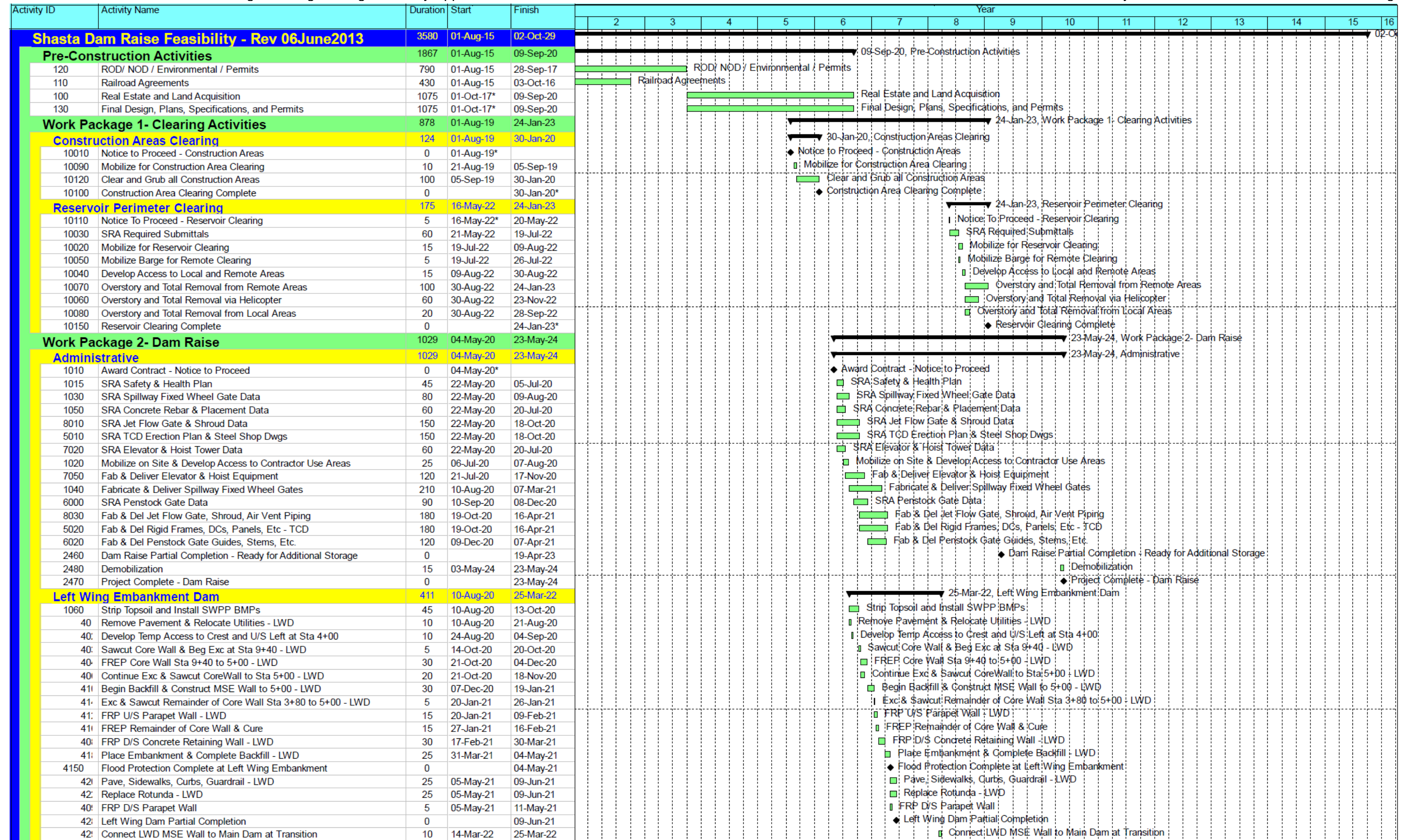
PG&E = Pacific Gas and Electric Company

RFP = Request for Proposal

TCD = Temperature Control Device

UPRR = United Pacific Railroad

EXHIBIT A
Preliminary Construction Schedule for CP4



█ Remaining Level of Effort
 █ Actual Work
 █ Critical Remaining Work
█ Actual Level of Effort
 █ Remaining Work
 ◆ Milestone

Shasta Dam Raise Feasibility SDR7
 Summary-Level Government Construction Schedule

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 Today's Date: 06-Jun-13

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Activity ID	Activity Name	Duration	Start	Finish	Year																		
					2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
13910	Demo & Remove Conc. Piers - Doney Creek RR	30	04-Oct-21	15-Nov-21																			
UPRR - 2nd Crossing Bridge																							
13660	Mobilize to Second Crossing UPRR Bridge	10	02-Jan-20	16-Jan-20																			
13480	Drill Pier 1 and 8 Shaft (dry)- 2nd Crossing	10	16-Jan-20	31-Jan-20																			
13490	Excavation for Abutment 1- 2nd Crossing	5	16-Jan-20	24-Jan-20																			
13500	Excavation for Abutment 2- 2nd Crossing	5	24-Jan-20	31-Jan-20																			
13510	Drill Piers 2-7 Shafts from Barge - 2nd Crossing	75	31-Jan-20	18-May-20																			
13520	Construct Piers 1&8 to Pier Cap - 2nd Crossing	30	18-May-20	30-Jun-20																			
13530	Construct Piers 2-7 to Pier Cap- 2nd Crossing	65	30-Jun-20	01-Oct-20																			
13540	FREP Pier Caps 1-8 - 2nd Crossing	35	01-Oct-20	23-Nov-20																			
13550	Drill Shafts for Abutment 1- 2nd Crossing	5	01-Oct-20	08-Oct-20																			
13590	Construct Abutment 1 Shaft- 2nd Crossing	5	08-Oct-20	16-Oct-20																			
13570	Drill Shafts for Abutment 2- 2nd Crossing	5	08-Oct-20	16-Oct-20																			
13610	FRP Abut 1 Stem Wall and Wingwalls and BF- 2nd Crossing	10	16-Oct-20	30-Oct-20																			
13620	Construct Abutment 2 Shaft- 2nd Crossing	5	16-Oct-20	23-Oct-20																			
13630	FRP Abut 2 Stem Wall and Wingwalls and BF- 2nd Crossing	10	30-Oct-20	16-Nov-20																			
13560	Erect Steel Girders, Bracing, and Diaphragms- 2nd Crossing	50	23-Nov-20	05-Feb-21																			
13580	FRP Conc Bridge Deck and Deck Rails- 2nd Crossing	60	05-Feb-21	30-Apr-21																			
13600	Construct RR Bridge Approaches- 2nd Crossing	20	30-Apr-21	28-May-21																			
13640	Place RR Ties and RR Track- 2nd Crossing	20	28-May-21	28-Jun-21																			
13700	Second Crossing UPRR Bridge Complete	0	28-Jun-21	28-Jun-21																			
13220	Demo Exist. RR Bridge Superstructure - 2nd Xing	60	16-Aug-21*	08-Nov-21																			
13260	Demo Exist. Conc Piers - 2nd Xing	30	09-Nov-21	22-Dec-21																			
Lakeshore Drive Relocation																							
South Lakeshore Dr Relocation Sta 1+00 to 38+80																							
2550	Excavate for Road Relocation - S Lakeshore Dr	45	16-Oct-20	23-Dec-20																			
2544	Place Embankment and Complete Grading- S. Lakeshore Drive	15	23-Dec-20	15-Jan-21																			
2545	Install Utilities - S. Lakeshore Drive	20	15-Jan-21	12-Feb-21																			
2545	Install Drainage Structures - S. Lakeshore Dr.	20	15-Jan-21	12-Feb-21																			
2546	Place Base Course & Pave- S. Lakeshore Drive	15	12-Feb-21	05-Mar-21																			
2547	Install Guardrail and Signage and Striping - S. Lakeshore Dr	15	05-Mar-21	26-Mar-21																			
2548	Complete Final Lakeshore Drive Tie-in to Charlie Creek Bridge	12	11-Jul-22	27-Jul-22																			
North Lakeshore Dr Relocation Sta 47+00 to 86+00																							
1128	Demo Existing Buildings and Structures	15	13-Aug-21	03-Sep-21																			
1122	Excavate for Road Relocation	30	03-Sep-21	18-Oct-21																			
1121	Place Embankment & Complete Grading - N. Lakeshore Dr	10	18-Oct-21	01-Nov-21																			
1124	Relocate/Install Utilities - N. Lakeshore Drive	20	01-Nov-21	01-Dec-21																			
1123	Install Drainage Structures - N. Lakeshore Drive	20	01-Nov-21	01-Dec-21																			
1125	Place Base Course & Pave N. Lakeshore Drive	15	01-Dec-21	22-Dec-21																			
1126	Install Guardrail and Signage and Striping - Lakeshore Dr	15	22-Dec-21	14-Jan-22																			
1127	Complete Final Lakeshore Drive Tie-ins & Remove Temp RR X-ings	18	11-Jul-22	04-Aug-22																			
Charlie Creek Bridge																							
13335	Mobilize to Charlie Creek Bridge	5	04-May-21	11-May-21																			
13340	Develop Abutment Access	5	11-May-21	18-May-21																			
13360	Develop Barge Access	5	18-May-21	25-May-21																			
13350	Drill and Construct CISS piles - Piers 2&5 (dry)	20	18-May-21	16-Jun-21																			
13370	Mobilize Crane Mounted Barge	10	25-May-21	09-Jun-21																			
13380	Construct Cofferdams - Piers 3 & 4	40	09-Jun-21	05-Aug-21																			
13400	FRP Footings & Piers 2&5	20	16-Jun-21	15-Jul-21																			
13410	Drill and Construct CISS Piles - Piers 3&4 from Barge	30	05-Aug-21	17-Sep-21																			
13470	Structural Excavation for Pier Foundation	5	05-Aug-21	12-Aug-21																			
13390	Drive Abutment CL 140 Piles 1&6	15	12-Aug-21	02-Sep-21																			
13420	FRP Abutments 1&6 - Charlie Creek	20	02-Sep-21	01-Oct-21																			
13440	FRP Footings & Piers 3 & 4	20	17-Sep-21	15-Oct-21																			
13430	Backfill Abutments & Piers - Charlie Creek	15	15-Oct-21	05-Nov-21																			
13450	Remove Cofferdams - Charlie Creek	15	05-Nov-21	30-Nov-21																			
13460	FRP Concrete Box Girder - Charlie Creek	110	30-Nov-21	05-May-22																			
13710	FRP Concrete Barrier - Charlie Creek	20	05-May-22	03-Jun-22																			
13720	Final Approach Grading & Bridge/Approach Paving	25	03-Jun-22	11-Jul-22																			
13730	Install Signage, Striping, Railing, Misc	10	11-Jul-22	25-Jul-22																			
13760	Demo Charlie Creek Bridge	40	15-Aug-22*	10-Oct-22																			

█ Remaining Level of Effort
 █ Actual Work
 █ Critical Remaining Work
█ Actual Level of Effort
 █ Remaining Work
 ◆ Milestone

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