

Intermediate Forebay Location Analysis

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3H.1 Introduction

The purpose of this appendix is to describe the process(es) and steps utilized to identify and refine potential locations of an Intermediate Forebay (IF) for analysis in the Bay Delta Conservation Plan (BDCP)/California WaterFix Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Modified Pipeline/Tunnel Option (MPTO). This appendix also describes options considered for the main Forebay (MF)¹.

The EIR/EIS is presently considering several conveyance options to divert water from the north Delta to the state and federal export facilities in the southern Delta. Among these many options, a pipeline/tunnel option would include new conveyance for moving Sacramento River water through several screened intakes into pipeline/tunnels. The diverted water would be collected in an IF and then flow by gravity or pumped through two large tunnels to the MF.

The primary purpose of the proposed IF is to provide a hydraulic break in the conveyance system for operational flexibility and safety. Breaking the system into two hydraulic units, the first between the intakes and the IF, and the second between the IF and MF, will reduce the range of Total Dynamic Head (TDH) of intake pumping plants. Under the various operational criteria, the Sacramento River facilities would be operated considering tidal variations and regulatory restrictions. The IF provides holding volume that can be used as a buffer to balance the mismatch between the ability to divert water from the Sacramento River and ability to send water to MF efficiently—either using gravity or shifting the pumping times during the off-peak hours of the day. In addition, the holding volume at the IF provides flexibility during start-up and shut-down of the pumps to accommodate overall operations.

From an engineering perspective the optimal location for the IF depends not only on acceptable geological foundation conditions but also on the location of the intakes on the Sacramento River. The IF would need to be in the vicinity of the intakes in order to minimize construction impacts to surrounding areas and aid in the efficient movement of water from the intakes to the IF and then from the IF to the MF.

¹ Currently Clifton Court Forebay (CCF) holds water that is pumped via Banks Pumping Plant into the canal for export. Several of the conveyance options include evaluation of a new forebay location by CCF known as the Byron Tract Forebay (BTF). The Modified Pipeline/Tunnel Option (Alternative 4) evaluates an expanded CCF. The Conceptual Engineering Reports provide further details for the additional forebay location in Tracy, California.

3H.2 Intermediate Forebay Location Considerations

3H.2.1 Intermediate Forebay Requirements Considered in Selection of Locations for Analysis

Prior to selecting potential forebay location sites, environmental, engineering, and site considerations were evaluated. Some of the considerations used in determining potential IF locations included:

- Minimizing environmental impacts.
- Locating the IF in an area of competent soil – locations consisting of deep peat soils would require costly and environmentally prohibitive ground improvements, including removal and replacement of materials necessary for construction.
- Optimizing the location of the IF for connection of the intakes and the tunnels to MF in order to reduce the construction costs, operation costs and reduce greenhouse gas (GHG) emissions.
- Minimizing local flood and drainage control impacts.
- Minimizing groundwater impacts.

In addition to the above considerations, design parameters were also evaluated and considered in refining appropriate sites for locating the IF. These required parameters include operational storage capacity, operational water surface elevations, required IF spillway facilities, total footprint area, maximum water surface area and the use of an above ground design to allow transfer of water using gravity. Based on a diversion capacity of 15,000 cubic feet per second (cfs), the operational storage capacity for the IF was estimated at 5,200 acre-feet, the approximate equivalent of up to 10,400 cfs flow for a period of six hours or 15,000 cfs for a period of four hours. Operational water surface elevations would range between +10 to +25 feet. Based on the operational holding capacity and range, the maximum water surface area for the IF was determined to be 750 acres. This results in a total maximum footprint area of approximately 1,200 acres (including the embankments, spillway facilities, intermediate pumping plant and other appurtenant facilities). For alternatives with a diversion capacity less than 15,000 cfs, the required storage capacity of the IF may be smaller, requiring a smaller total footprint.

Further refinements considered in locating sites include an evaluation of the water holding capacity and size, operational flexibility, flood safety, and other safety issues that are underway. An intermediate pumping plant may or may not be necessary depending on the size of the forebay, tunnel and operating criteria. Design considerations for the forebay embankments will comply with current DWR State Water Project seismic criteria and will comply with requirements from Title 23 of the California Code of Regulations and Division 3 of the California Water Code. Design loading parameters will also be compared with and could include USACE standards for seismic loading conditions.

Seepage issues were also considered in evaluating potential sites. Seepage control would be addressed by locating, designing and constructing features in the embankments to minimize seepage impacts. Sub-surface explorations are planned to evaluate the foundation soils and also to determine the suitability of using on-site materials for embankment construction. Based on these engineering analyses, seepage control features such as an impervious core, cut-off trenches, slurry

1 walls, and toe drains would likely be utilized to control seepage under and through the embankment
2 long-term

3 **3H.2.2 Initial Proposed Locations for Intermediate Forebay**

4 In 2009, four locations were selected and evaluated as potential sites for the IF: (Site 1) East of
5 Snodgrass Slough near the town of Hood, (Site 2) at Pearson Tract, (Site 3) at Tyler Island and (Site
6 4) east side of Interstate 5 (I-5), south of Lambert Road (sites 1–4 in Figure 3H-1).

7 On December 8, 2009, representatives from DWR and the Natural Resources Agency met with
8 representatives from the Stone Lakes National Wildlife Refuge (SLNWR) to discuss comments on the
9 preliminary IF locations. Subsequent to that meeting, further analysis and evaluation was conducted
10 by DWR staff and consultants, which resulted in identification of sites 1 and 2 as preferred, and sites
11 3 and 4 as not suitable because of soil conditions, distance from the proposed intakes and footprint
12 impacts.

13 Site 1 was found to be the preferred location based on the geological conditions and its proximity to
14 the intake facilities. However, this site presented problems because of its proximity to the town of
15 Hood, SLNWR and Giant Garter Snake habitat. Site 2, at Pearson Tract was also a preferred location
16 but was not as ideally situated in location to the intake facilities, problems due to its proximity to the
17 town of Courtland, adverse impacts to agricultural drainage conditions, and presence of organic, soft
18 and loose soils from near surface to greater depths. Site 3 at Tyler Island was found to have deep
19 peat deposits which would be problematic during construction; in addition, known Greater Sandhill
20 Crane roosting sites were identified adjacent to this location. Site 4, east of I-5, posed complicated
21 hydraulic problems; and the distance from the intake locations further make the site economically
22 challenging.

23 Sites 1 and 2 were carried forward for further analysis as discussed in the next section.

24 **3H.2.3 Locations Further Analyzed for Intermediate Forebay**

25 As noted above, for IF sites were initially proposed, but only Sites 1 and 2 were carried forward for
26 further analysis. Initially, Site 1 was determined to be the preferred location over Site 2. However
27 due to concerns of the proximity of this location to the town of Hood, SLNWR and Giant Garter Snake
28 habitat, the second preferred alternative (Site 2) at Pearson Tract was moved forward for analysis in
29 the first draft of the Conceptual Engineering Report (CER) (California Department of Water
30 Resources 2009). Subsequent to completion of the CERs and after meetings with local reclamation
31 district engineers in the vicinity of Pearson Tract focus was shifted back to the original Site 1
32 location, with modifications to address concerns of SLNWR. Some factors considered for focusing
33 back on Site 1 were the conditions at the Site 2 including poorer geological conditions (greater
34 depths of poor soil conditions), a shallow groundwater table, a higher pumping head from Intakes 1
35 through 5, lower elevation requiring extensive modifications to the existing drainage system and
36 more impacted land owners adjacent to the Site 2. A summary of Site 2, Site 1, and Site 3
37 considerations follows.

3H.2.3.1 Proposed Pearson Tract Intermediate Forebay (Site 2)

The proposed Pearson Tract location and size were based upon the initial analysis reported in the CER. The IF would be located on the Pearson Tract, south of the town of Hood (Figure 3H-1). Some of the considerations for choosing this location were:

- Minimizing environmental impacts on SLNWR.
- Locating the IF in an area with minimal peat and other soft soils.
- Minimizing impacts on the town of Hood during the construction and operation of the IF- the current location minimizes the need to relocate residences and businesses.
- Optimizing the location of the IF for connection of the intakes and the tunnels to MF in order to reduce the construction cost, operation costs and reduction in greenhouse gas (GHG) emissions.

The estimated footprint of the Pearson Tract IF covers approximately 1,200 acres of the agricultural land of Pearson Tract. This footprint included an intermediate pumping plant, other appurtenant facilities, and the forebay itself. The Pearson Tract IF's maximum water surface area is 750 acres. The above ground design for the forebay would include perimeter embankments and would allow for the movement of water using gravity. This location was favored because of its proximity to the Sacramento River, the desire to minimize impacts to SLNWR, and to minimize construction and operation costs.

3H.2.3.2 Proposed Hood Intermediate Forebay (Site 1)

The proposed Hood IF is located just south of the town of Hood and northeast of Pearson Tract (Figure 3H-1).

The total footprint of the Hood IF covers approximately the same land area (1,200 acres) as the Proposed Pearson Tract IF. As with Pearson Tract, this land is primarily in agricultural use². This footprint also included an intermediate pumping plant and other appurtenant facilities in addition to the forebay itself. The Hood IF's maximum water surface area is 750 acres. The above ground design for the forebay would include a perimeter embankment and allow for movement of water using gravity.

This location was ultimately determined to be preferred over the Pearson Tract location and included for analysis in the addendum to the ATO CER. Some of the reasons for this preference include:

- Better geological conditions than Pearson Tract
- Depth of soft/loose soils limited to 5-10 feet below surface
- Minimal dewatering anticipated as the depth to groundwater is at about 10 feet
- Minimizes pumping head from Intakes 1-5
- Less impacts to local drainage collection systems
- Fewer land owners would be impacted (6 compared to 8 with Pearson Tract)

² The total agricultural land impacts from the footprint of the Hood IF are approximately 59% row crops, 39% vineyards and 2% non-irrigated/semi-agricultural uses.

1 A further analysis of the Hood location as the preferred option over Pearson Tract resulted in
 2 several additional modifications in order to address the original concerns. These changes included
 3 shifting the forebay location slightly to the west to provide additional space between the IF and
 4 SLNWR and relocating the emergency spillway to spill to the south of the IF, rather than southeast
 5 and into SLNWR.

6 **3H.2.3.3 Proposed Glannvale Tract Intermediate Forebay (Site 5)**

7 In 2012, BDCP proponents (California Natural Resources Agency and DWR) and fish and wildlife
 8 agencies' staff met with representatives from SLNWR to discuss IF impacts. As a result of these
 9 meetings, SLNWR staff and other representatives of local interests suggested DWR evaluate another
 10 site location near I-5, herein labeled Glannvale Tract, Site 5 (Figure 3H-1). This location was
 11 evaluated based on a footprint of approximately 1,200 acres. Based on the 1,200 acre footprint, Site
 12 1 was still considered the preferred location. This was partly due to the increased distance of the
 13 site from the intakes, resulting in higher power demands and thus increased GHG emissions over the
 14 life of the project.

15 **3H.2.4 Pipeline/Tunnel Option of No-Forebay Option**

16 In order to minimize the impacts of the IF, DWR evaluated an option that would eliminate the IF and
 17 convey water directly from the five north Delta intakes to the MF using a series of pipelines and
 18 tunnels. Although this option reduced land use impacts associated with IF, it has significant
 19 operational limitations and safety risks. First, this alternative would require longer tunnels to
 20 convey water directly from five intakes to the MF, thus requiring larger pumps and larger surge
 21 protection towers at each intake, which would increase the intake footprint, energy consumption,
 22 and GHG emissions.

23 Although this option was found to provide some cost savings related to construction and mitigation
 24 associated with building the IF, it had additional safety risks associated with increased length of
 25 pressurized pipelines and tunnels, increased operational costs due to elimination of the gravity
 26 conveyance option, required an additional steel liner for tunnels, increased the number of pumps at
 27 the intakes due to increased TDH, increased energy requirements and GHG emissions, and increased
 28 complexity of operating intakes and coordinating pumping operations between the intakes, MF, and
 29 the Banks and Jones pumping plants.

30 **3H.2.5 Optimized (MPTO) Intermediate Forebay (Site 5)**

31 In 2013 a process was initiated to further refine the alignment and facilities based on public input,
 32 engineering refinements, and cost estimates. During development of the Proposed Project (MPTO)
 33 both the size and location of the IF were evaluated further. By going to a gravity-only system with no
 34 intermediate pumping plant, the IF became mainly a pass-through facility and with very little daily
 35 storage requirement. The surface area of the IF was revised to 40 acres, with a total footprint of 250
 36 acres. This provided more flexibility in sizing and locating the facility.

37 The IF sites were reevaluated based on consideration of geological conditions, local drainage
 38 collection system impacts, land use impacts, construction costs, and long-term operating costs. After
 39 meetings with Hood area landowners, SLNWR managers, and Reclamation District's, moving the IF
 40 further to the east and south of Site 1 would further reduce impacts to farm operations, drainage
 41 and irrigation systems, and foraging areas. The Glannvale Tract IF site was determined to be the

1 preferred location (Figure 3H-1, Site 5³). The total footprint of the Glannvale Tract IF is 250 acres
 2 which includes 125 acres needed for an emergency spill retention basin. The water surface area of
 3 the IF is about 40 acres.

4 The Glannvale Tract location also provides other benefits to the project including:

- 5 • Closer proximity to DWR-owned property for disposal of reusable tunnel material and source
 6 for borrow material.
- 7 • Closer proximity to I-5 which would help to reduce construction traffic in the nearby Delta
 8 communities.
- 9 • Moves the tunnel alignment away from active gas wells.
- 10 • Locates the IF in an area with less Greater Sandhill Crane foraging habitat.

11 **3H.2.6 Main Forebay Options**

12 The engineering team determined that relocation of the IF to Glannvale Tract would increase the
 13 size of the intake tunnels and main tunnels by several miles, which would substantially increase the
 14 project cost. To keep the project cost from increasing, the engineering team proposed that Clifton
 15 Court Forebay (CCF) be incorporated into the project. Connecting the main tunnels to the north end
 16 of CCF rather than extending to the proposed Byron Tract Forebay would reduce the tunnel length
 17 by two miles. This would help to offset the additional cost of moving the IF to the Glannvale Tract.

18 Incorporating and expanding CCF however would create several additional problems. First, CCF
 19 would have to be partitioned to prevent fish-free water flowing from the North Delta diversions
 20 from mixing with the water coming from the existing South Delta diversion. Second, encroaching
 21 into CCF would require modifying the existing CCF embankment, which is considered a
 22 jurisdictional dam and regulated by DWR's Safety of Dams. Modification of a portion of the
 23 embankment would require a re-evaluation of the whole embankment to determine if it meets
 24 current flood protection and seismic design standards. Since CCF was constructed in the 1960's it is
 25 likely that the embankment does not meet current standards and would need to be completely
 26 rehabilitated. Third, the South Delta diversions will need to continue unimpaired operations both
 27 during and after construction.

28 To address these problems the engineering team proposed expanding CCF to the south by
 29 incorporating the property originally proposed for BTF, and then divide the expanded CCF into two
 30 cells. The existing CCF would also need to be dredged to restore its original storage capacity. New
 31 embankments would be constructed around the perimeter of the expanded CCF and in the interior
 32 to form the two cells. The north cell would receive water pumped from the north Delta through the
 33 proposed tunnels, while the south cell would receive water conveyed through the existing CCF
 34 intake. The north cell water surface area would be approximately 800 acres, while the south cell
 35 would have a water surface area of about 1,900 acres. The south cell would continue to utilize the
 36 existing Skinner Fish Facility to collect and remove fish.

³ The map depicts the initial size of the Forebay, approximately 1,200 acres. The MPTO IF (250 acres) is located in the southwest portion of the identified area.

3H.3 Ongoing Intermediate Forebay Refinements and Analysis

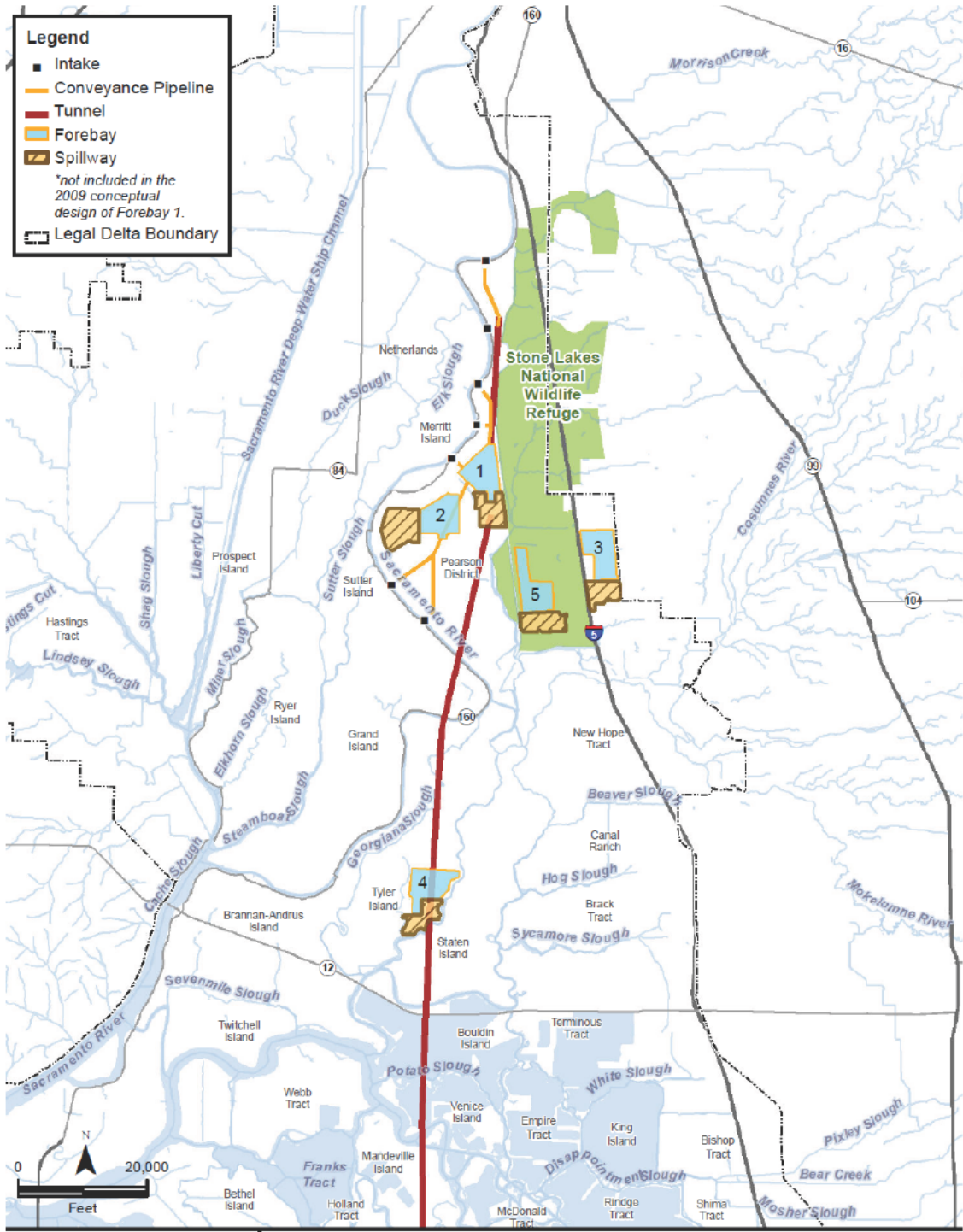
The above summary identifies the locations analyzed for the EIR/EIS and considers the maximum impacts based on a tunnel alignment and an IF located between I-5 and Highway 160 near the intake locations considered.

An overall comparison of the preferred location, Site 5 Glannvale Tract IF, to the four other options included consideration of geological conditions, local drainage collection system impacts, land use impacts, construction costs and long-term operating costs. Cost of mitigation was not a considered factor as it was determined to be too speculative as to impacts to natural habitat communities and available offsets in the BDCP conservation measures. In addition to natural community impacts, considerations of impacts to agriculture and infrastructure were evaluated.

Consistent with the efforts to date, the Project Proponents intend to continue meeting with local representatives to ensure the best possible data and information is used in evaluating locations for and impacts of the IF as the project moves forward and project design is refined. Efforts toward optimizing the IF location and size will continue with consideration of further technical studies, public review/comments and/or changes to the proposed BDCP projects and project alternatives.

3H.4 References

California Department of Water Resources. 2009. *Conceptual Engineering Report, Isolated Conveyance Facility All Tunnel Option*. DRAFT – Revision A. November 6.



**Pipeline/Tunnel Option: Potential Forebay Sites
December 2012**

California Department of Water Resources
 Advancing the Bay-Delta Conservation Plan
 Delta Habitat Conservation & Connectivity Program

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**Figure 3H-1
Intermediate Forebay Proposed Locations 2009**