San Diego County Water Authority

February 7, 2014

Attention: Imported Water Committee

Bay-Delta Conservation Plan: Infrastructure Review. (Discussion)

Purpose
The purpose of this memo is to provide an assessment of the Bay-Delta Conservation Plan (BDCP) facilities to the Committee.

Background

Over the past several months, staff has been providing the Board with background information on key issues relating to the BDCP. This memorandum provides comment on the proposed facilities associated with the preferred alternative included in the BDCP's EIR/EIS document.

Key documents reviewed by staff are the Final Draft Delta Habitat Conservation and Conveyance Program Conceptual Engineering Report, dated October 1, 2013, and the draft Geotechnical Data Report, dated April 2013. Additional cost information is provided in the BDCP.

At the Special Imported Water Committee meeting on January 9, 2014, staff reviewed the status of the BDCP design as well as the Water Authority's methodology for the construction cost review. The objective of staff's review is to indicate the areas we believe the BDCP engineering team needs to focus on as they move forward with the next phases of the project's design. The areas noted have the potential to impact the project schedule and cost and are typically addressed in a risk registry. Uncertainty should be reflected in the project's contingency and schedule and as the project becomes better defined, risks are addressed and contingency can be reduced. This assessment is consistent with the Water Authority's internal Gate Process, by which senior management tracks and reviews ongoing Capital Improvement Program projects.

Discussion

Description of BDCP Proposed Facilities[1]
The Conceptual Engineering Report (CER) describes the Modified Pipeline/Tunnel Option or EIR/EIS preferred alternative to include:

- Three Intake Facilities (including fish-screened on-bank intake structures and pumping plants)
- An intermediate forebay to receive flow from each Intake Facility
- Approximately 14 miles of intake tunnels
- 60 miles of dual main tunnels (2 x 30 miles)

[1] Delta Habitat Construction and Conveyance Program, Conceptual Engineering Report, Volume 1, October 1, 2013, Executive Summary, pgs ES-1 through ES-2.

- Existing Clifton Court Forebay modifications (dividing into two parts; one for existing State Water Project water that will continue to be delivered through the Delta, and one receiving the water from the proposed tunnels)

Figure ES-1 showing the proposed tunnel location is attached. The preferred alternative is sized to deliver 9,000 cubic feet per second from the Sacramento River in the North Delta to the South Delta pumping plants. The Conceptual Engineering Report states the preferred alternative will be engineered to protect against a 200-year flood event with sea level rise predicted from climate change, and use gravity to flow through the main tunnels. CER Figure ES-2 identifies the Conveyance Schematic for the preferred alternative.

Description of Gate Process – Lens of Review
Using the Water Authority's Gate Process as a guide to review the BDCP, staff focused on potential risk areas. For example, what elements would we be looking at to form a risk registry as part of an overall risk management plan? Based on our review of the subject documents, we have identified them below.

Construction Scheduling[2] [3]
The CER identifies a nine-year equipment procurement and construction schedule beginning in 2017. However, a conceptual level schedule, included as an appendix to the document, shows start up and commissioning activities for the main tunnels ending in December 2028. Scheduling disconnects such as this need to be confirmed and corrected.

Property Acquisition
The detailed project schedule included in the CER, Appendix C, indicates right of way acquisition will occur over an approximately five-year period, beginning a few months after 30 percent design has been completed. Given the sheer number of anticipated acquisitions, a five-year duration seems reasonable for this activity. Also, initiating the acquisition process after completion of the 30 percent design is a reasonable approach given the majority of acquisitions will be for below grade tunnels (74 miles) and tunnel muck and forebay dredging disposal sites (3,200 acres). However, there are several issues that require further attention as they could dramatically impact the project's schedule.

- A detailed property acquisition plan for all phases and elements of the project should be produced in conjunction with the design and construction portion of the project's schedule. This plan is essential to make sure all necessary property interests are acquired, either through negotiations or the eminent domain process, prior to advertising construction contracts. Should this project become a Design-Build project, a property acquisition plan becomes even more important due to the compressed schedule.
- Acquisition of right of way for the project is expected to be a highly contentious process, probably resulting in a higher than average number of condemnation lawsuits. The property acquisition plan should address the potential delays in receiving Orders of Immediate Possession as a result a significant number of right to take challenges, potentially further impacted by already busy courts.

---

[2] DHCCP, Conceptual Engineering Report, Volume 1, October 1, 2013, Table ES-3, p. ES-12.
[3] Ibid; Appendix C, MPTO Conceptual Construction Schedule, p. C-14.

- The number of acquisitions may severely stretch the ability to appraise and make offers in a timely manner. There simply may not be enough appraisers or right of way professionals with appropriate experience to handle the variety of appraisal assignments generated by the project.
- A plan must be developed to secure rights to enter private property to conduct environmental, geotechnical, and other studies that will allow the project to proceed to the Preliminary Engineering phase. This plan, and its accompanying schedule, should be incorporated into the project's master schedule.

Tunnel Methodology

Tunnel material removal requires deciding how to remove the tunnel material from the excavation face. Examples of options are fuel driven cars or a conveyor system. Both options present challenges and need to be coordinated with shaft locations and disposal sites.

Once removed, the designers need to make sure sufficient space is available for tunnel material disposal. Site locations will affect transportation and handling costs. Examples may include trucking to a nearby property versus disposal at sea – each with different risks and costs. The BDCP identifies approximately 3,200 acres of disposal area along the tunnel alignment. During design, calculations will need to be done to confirm if the identified sites can accommodate the anticipated volume of material removed.

Ventilation system design is another cost element that will be finalized during design development, and is a function of the number of shafts and locations as well as the tunnel material removal method. For example, using fuel driven removal cars will create fumes that will require removal using the ventilation system. Alternately, a conveyor system or other electrical means would not create fumes, but require additional electrical power.

Careful consideration and research needs to be done to confirm there is sufficient capacity to manufacture the 10-11 tunnel boring machines shown to be required. Designers should consider sequencing and available manufacturers, as well as identifying what other projects may be scheduled for the same time period, to fully understand the extent of strain this project will place on the industry. The affects will play out in manufacturing time and cost. Also, in the years leading up to construction, labor requirements will need to be examined to ensure sufficient labor is available to perform the work. For example, having sufficient tunnel boring machine operators fully trained to meet the aggressive construction schedule.

Power Requirements[4]

Temporary power is a critical element of the project. Major electrical infrastructure needs to be designed and constructed to allow for project construction. Reliable power needs to be available at shaft locations for the duration of the project.

Permanent power provisions also need to be made for the pumping facilities. The CER recognizes additional studies, such as system evaluation analyses, are needed to assess potential electrical infrastructure upgrades to address grid reliability. Also, examining proposed construction methods associated with any upgrades to electrical transmission lines is necessary.

---

[4] DHCCP, Conceptual Engineering Report, Volume 1, Section 19.0, Power Supply and Grid Connections, p 19-1.

Access and Utility Conflicts[5]

Relocation of Roads and Utilities: Much of the tunnel alignment is deep; therefore, the report identifies access and utility conflict risk as low. The CER identifies two portions of highways SR-12 and SR-160 that are to be temporarily relocated, as well as the addition of an interchange to accommodate construction traffic.

The tunnel alignment extends through natural gas well fields, which are well below the tunnel alignment. The report indicates plugged and abandoned natural gas and oil wells in the conveyance footprint and within borrow and spoil areas. Figure 13-1 from the Conceptual Engineering Report shows Known Gas Wells and Fields in the Delta Region. The report states that abandoned wells within the alignment will require testing and, should they be found to be improperly abandoned, they would need to be improved to meet current California Department of Conservation well abandonment standards.

Geotechnical Issues

The Draft Geotechnical Report relies on historical data as well as field explorations performed between 2009-2012 such as borings, cone penetration tests, geophysical surveys, and associated laboratory testing. Many of the tests and borings are not located on the current proposed alignment. Some are more than a mile away due to alignment changes. Even borings that are located directly on the alignment only provide information for that exact location. Long tunnels are inherently risky due to unknown subsurface conditions. Issues such as groundwater, changing ground conditions, cobbles, or boulders can lead to schedule delay and additional costs.

Section 11 of the CER addresses tunnel construction and Section 11.2 sums up the concern regarding the minimal geotechnical information collected to date:

The compatibility of the tunneling excavation method with anticipated ground conditions is critical in minimizing risk, optimizing tunnel advancement rate, and design of the tunnel support system. Currently, geotechnical information is limited. Once adequate geotechnical investigations have been performed, preliminary design evaluations will refine the recommendations for tunnel excavation and support methods.

The lack of adequate geotechnical information is also noted in the sections of the CER that discuss the other major project elements such as intakes, temporary construction areas, access shafts, muck disposal areas, and the forebays. For example, the Draft Geotechnical Data Report states groundwater is present as shallow as five-feet below grade throughout much of the delta. At facility locations and along the tunnel alignment, provisions need to be made to control and remove groundwater during construction, as well as after the facilities are completed in accordance with project permits.

The BDCP project team anticipates an extensive geotechnical study for the tunnels, borrow areas, intakes, and other facilities. The magnitude of the study is described in Section 31.5.1.1 page 31-15 of the Draft EIR/EIS as the work required to complete the study itself may have environmental impacts. The geotechnical study is described as having "...spacing of the borings and test locations

---

[5] DHCCP, Conceptual Engineering Report, Volume 1, Section 13.0, Utility and Infrastructure Crossings, p 13-1.

likely will average about 1,000 feet along proposed canal and tunnel alignments and approximately every 100 or 200 feet at intakes, pumping plants, forebays, siphons and other hydraulic structures."

Project Delivery Methodology

Based on our conversations with the BDCP engineering team, current state law prohibits BDCP management from using the Design-Build method. Changing this condition should be explored further by the BDCP team, as cost and schedule savings and risk reduction may be realized. Maintaining a single responsible party, particularly relative to procuring equipment early, concurrent with design coordination, may reduce claim risk due to equipment delay or design coordination.

Construction contract issues, such as construction contract sizing as it relates to contractor bonding ability, project labor agreements and identification of the size of the overall labor force needed, and sequencing to determine availability of local or regional labor are considerations when selecting a project delivery method. Also, selection of a project delivery method is typically made early in the project development process to minimize unnecessary expenses and begin the transfer of risk to the designer-builder. Determining whether Design-Build is an option for the construction of BDCP facilities is probably an early critical path item for the project team.

Available Resources

The proposed BDCP infrastructure is a world class level project that will require a broad range and significant number of specialized contractors, personnel, engineers, and a variety of technical experts.

Tunnel Boring Machines.[6] The schedule included in the CER is based upon operating 10 or 11 large diameter tunnel boring machines simultaneously. The CER acknowledges that obtaining that number of TBMs plus enough quality operators for the duration of tunneling activities is a risk.

Tunnel Steel Liners.[7] The CER notes the current pipeline manufacturers are unable to produce the tunnel's steel pipe in the diameters proposed. Additional manufacturing facilities may need to be built to meet the project's steel pipe needs.

Borrow Material.[8] The CER recognizes that sufficient borrow material has not been identified for first order of work items such as stabilizing the ground near major construction sites.

Specialized Contractors.[9] The CER also notes there may not be enough contractors to build certain elements of the project. Specifically, the report notes it may be a challenge to find contractors to build the 100 plus foot deep slurry walls for the tunnel drive and reception shafts.

Technical Experts. The design and construction oversight of this project will require a significant number of technical experts. These technical experts will likely include: engineers from a variety of disciplines (civil, structural, geotechnical, electrical, mechanical, etc), surveyors, land and farm appraisers, right of way agents, attorneys, land title officers, etc. The CER is largely silent on the availability of the technical experts needed to build the project.

---

[6] DHCCP, Conceptual Engineering Report, Volume 1, Section 11.3.2, pg 11-13
[7] Ibid, Appendix E, Section 7.0, pg E-6
[8] Ibid, Section 21.0, pg 21-1
[9] Ibid, Section 11.3.1, pg 11-12

Competing Projects. It is unknown whether the BDCP infrastructure team has reviewed potential schedule overlap that may result in a competition for labor and natural resources with other large scale infrastructure projects being constructed in the United States or worldwide.

Construction Estimate[10]

The BDCP summarizes the proposed cost of the 9,000 cfs preferred option at $14.3 billion. The cost information available is presented at a high level. For example, construction costs are provided in six major categories:

- River intakes structures
- Forebays and flow control structures
- Tunnels and pipelines
- Controls and communications
- Utilities and power delivery
- Contingency

The costs are further summarized below.

Estimated Costs Dual Tunnels	3,000 cfs	6,000 cfs	BDCP Proposed 9,000 cfs	15,000 cfs
Construction	$9.4B	$11.4B	**$12.4B**	$14.5B
Engineering, project and construction management	$1.4B	$1.7B	**$1.9B (~15%)**	$2.3B
Total	$10.8B	$13.1B	**$14.3B**	$16.8B

BDCP includes soft costs of 15 percent for engineering and project/construction management. This represents about $1.9 billion. This amount should be examined and refined for greater precision relative to overall project administration, design engineering costs, and construction management costs.

As a result of the highly complex nature of this project, there are many known risks that need to be analyzed, mitigated, and monitored throughout the life of the project – each with its own set of schedule and cost implications. As the design process moves forward, risks need to be captured in a risk registry and adjusted in the project contingency projections. Chapter 8 of the BDCP document discusses the Implementation Costs and Funding Sources. Relative to facility construction it states *"The estimate of direct construction cost is based on a 10% engineering design level and has an expected accuracy range of +50% to -25%, per the cost estimating classification system developed by the Association for the Advancement of Cost Estimating {sic} (2011)."* Presumably, the estimate

[10] Draft Bay Delta Conservation Plan, California Department of Water Resources, November 2013, Appendix 9B – Take Alternative Cost Estimation

generated by the BDCP adheres to the standards outlined by the Association for the Advancement of Cost Engineering. Currently, the estimate includes an overall contingency of 36 percent. Further applying the expected accuracy range to the $12.4 billion construction cost would yield a range, including soft costs, of $10.7 to $21.5 billion.

Summary of Greatest Risks to Schedule and Cost

In order to reduce overall project risk, major risk areas should be evaluated. We see the largest risk to be associated with unknown subsurface conditions. As a result, striving to obtain as much subsurface geotechnical information as possible is important. Further, examining alternate project delivery methods, such as Design-Build, may focus the risk factors on a single entity, leaving the least room for cracks in the responsibility matrix, finger pointing, and ambiguous cost overrun responsibilities. Developing a detailed property acquisition plan will allow for sufficient time for property acquisitions prior to key project milestones, such as beginning final geotechnical investigations and starting construction. Finally, examining the timing of required resources to ensure items such as tunnel boring machines, operators, and specialized contractors are available when needed. As an example, if any of the 10-11 boring machines is delayed in fabrication or experiences a major breakdown, an overall project delay may result.

Impacts

Because the status of the project is only 5-10 percent designed, the only place to account for risk is to add contingency to the cost or add time to the schedule.

In our opinion, at this stage of the project, the overall contingency should be greater than 36 percent. The greatest risk to any below-grade project's schedule and cost is differing site conditions. Absent detailed geotechnical information, the only way to partially mitigate that risk is to increase the project contingency to at least 50 percent. This is consistent with the American Association of Cost Engineering Level 5 estimate. There does not appear to contain much leeway in the project schedule. As a result, major milestones will have to be consistently met in order to avoid delaying the listed commissioning completion date of December 2028.

Prepared by:	Gary Bousquet, Engineering Manager
Prepared and Reviewed by:	William J. Rose, Director of Engineering
Reviewed by:	Glenn Farrel, Government Relations Manager
	Dennis Cushman, Assistant General Manager

Attachments:

1. Figure ES-1: Location of Facilities (from Conceptual Engineering Report Executive Summary)
2. Figure ES-2: Conveyance Schematic (from Conceptual Engineering Report Executive Summary)
3. Figure 13-1: Known Gas Wells and Fields in the Delta Region (from Conceptual Engineering Report)

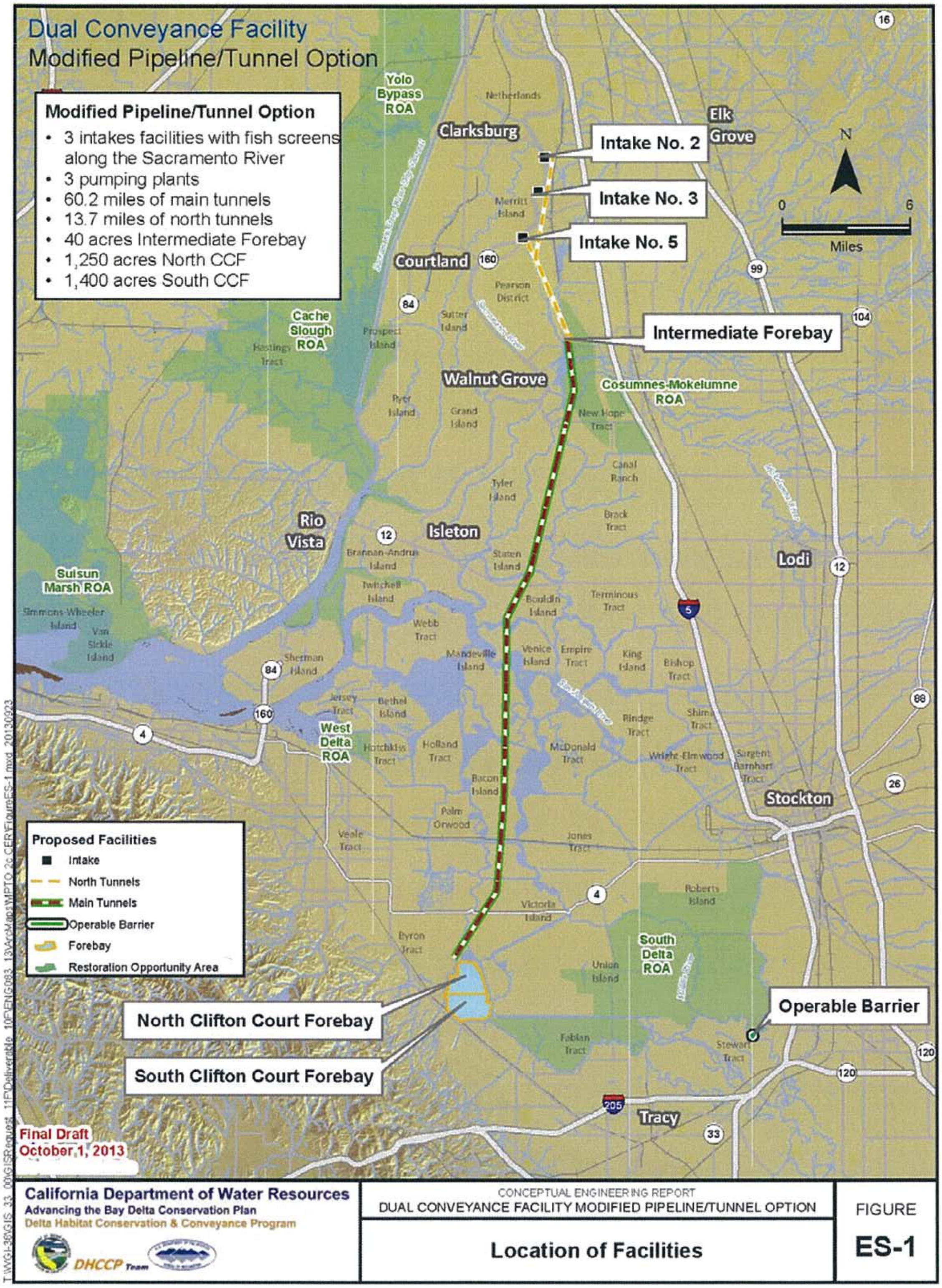

Figure ES- 1: Location of Facilities

Attachment 2

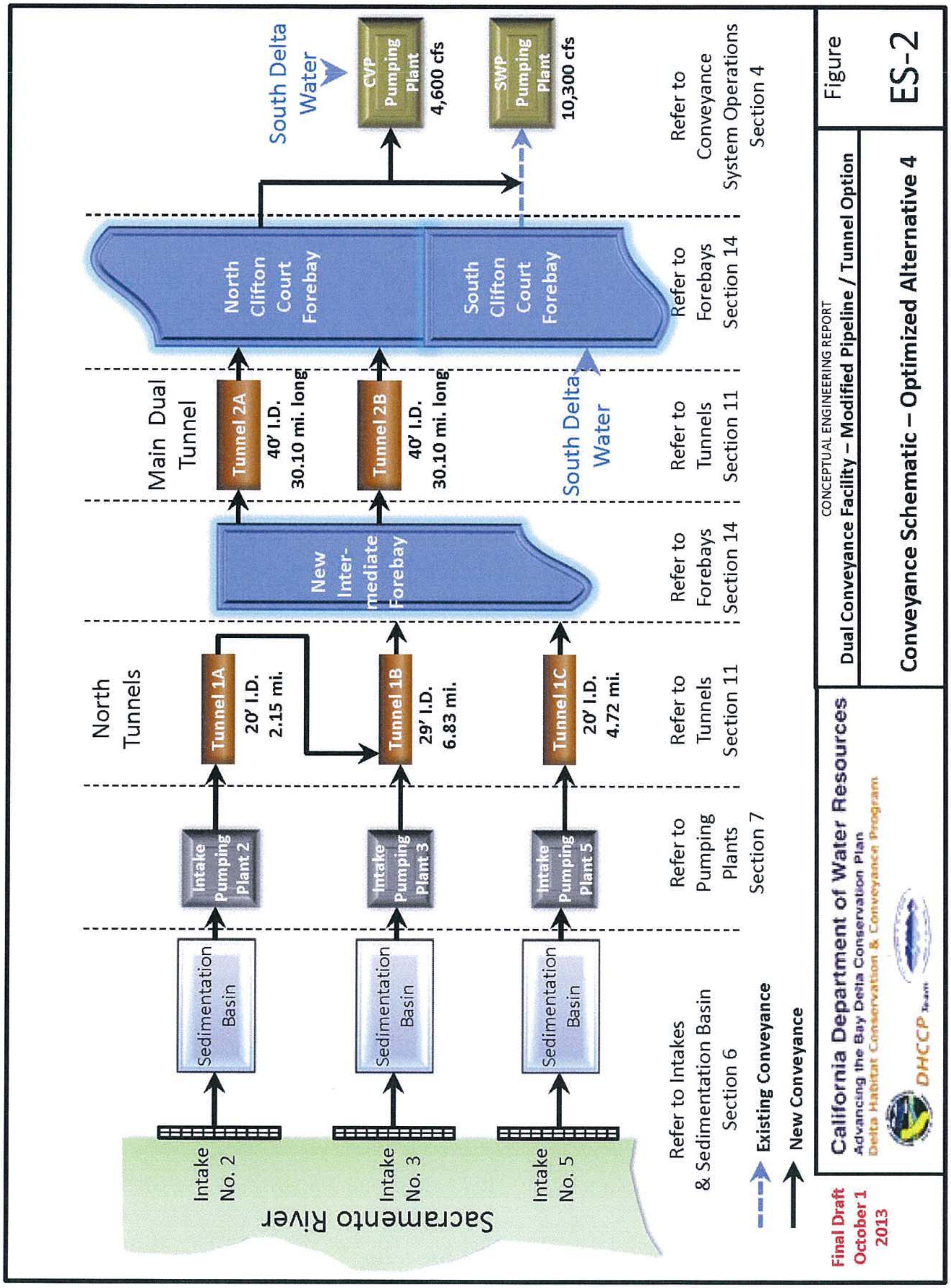

Figure ES- 2: Conveyance Schematic

Attachment 3

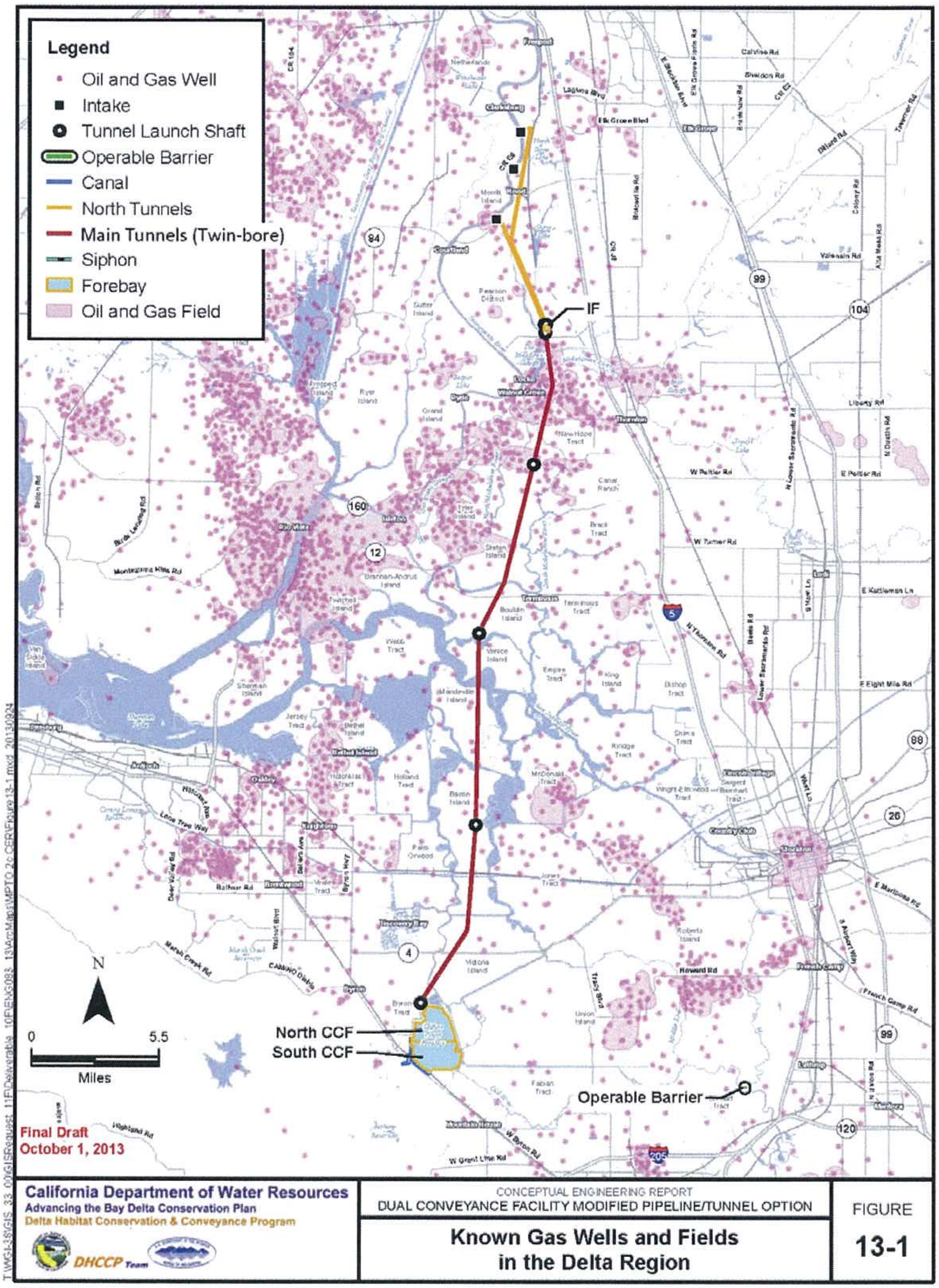

Figure 13-1: Known Gas Wells and Fields in the Delta Region