Chapter 5 Evaluation of Conveyance and Reservoir Size

The next step in the development of measures for NODOS facilities was to evaluate the many different ways of diverting water into the reservoir and releasing water to the project beneficiaries. The size of the reservoir was also evaluated. A more detailed discussion of the conveyance measures and reservoir size selection is provided in Appendix A.

Development of Conveyance Measures

Water must be delivered both to and from the offstream reservoir. As a result, the conveyance measures identified include diversion and delivery facilities (including some measures that can serve both purposes). Diversions would need to provide adequate flows into the reservoir. Deliveries of water from Sites Reservoir would need to reach the service areas and locations with water resource needs and uses.

Table 5-1 provides a list of potential conveyance measures.

Table 5-1. Conveyance Measures Considered

Conveyance Facility	Source	Capacity Description
T-C Canal	Sacramento River at Red Bluff	Existing 2,100 cfs capacity Modify to 2,700 cfs capacity Expand to 4,000 cfs capacity Expand to 5,000 cfs capacity
GCID Canal	Sacramento River at Hamilton City	Existing 1,800 cfs capacity Expand to 3,000 cfs capacity Expand to 4,000 cfs capacity Expand to 5,000 cfs capacity
Stony Creek Pipeline Diversion	Stony Creek at existing Black Butte Lake Afterbay	1,000 cfs capacity 2,100 cfs capacity
Delevan Pipeline	Sacramento River opposite Moulton Weir	1,500 cfs capacity 2,000 cfs capacity 3,000 cfs capacity 4,000 cfs capacity 5,000 cfs capacity
Colusa Basin Pipeline	Colusa Basin Drain	1,000 cfs pipeline capacity 3,000 cfs pipeline capacity

cfs =.cubic feet per second
GCID = Glenn-Colusa Irrigation District
T-C = Tehama-Colusa

The conveyance measures considered are shown on Figure 5-1.

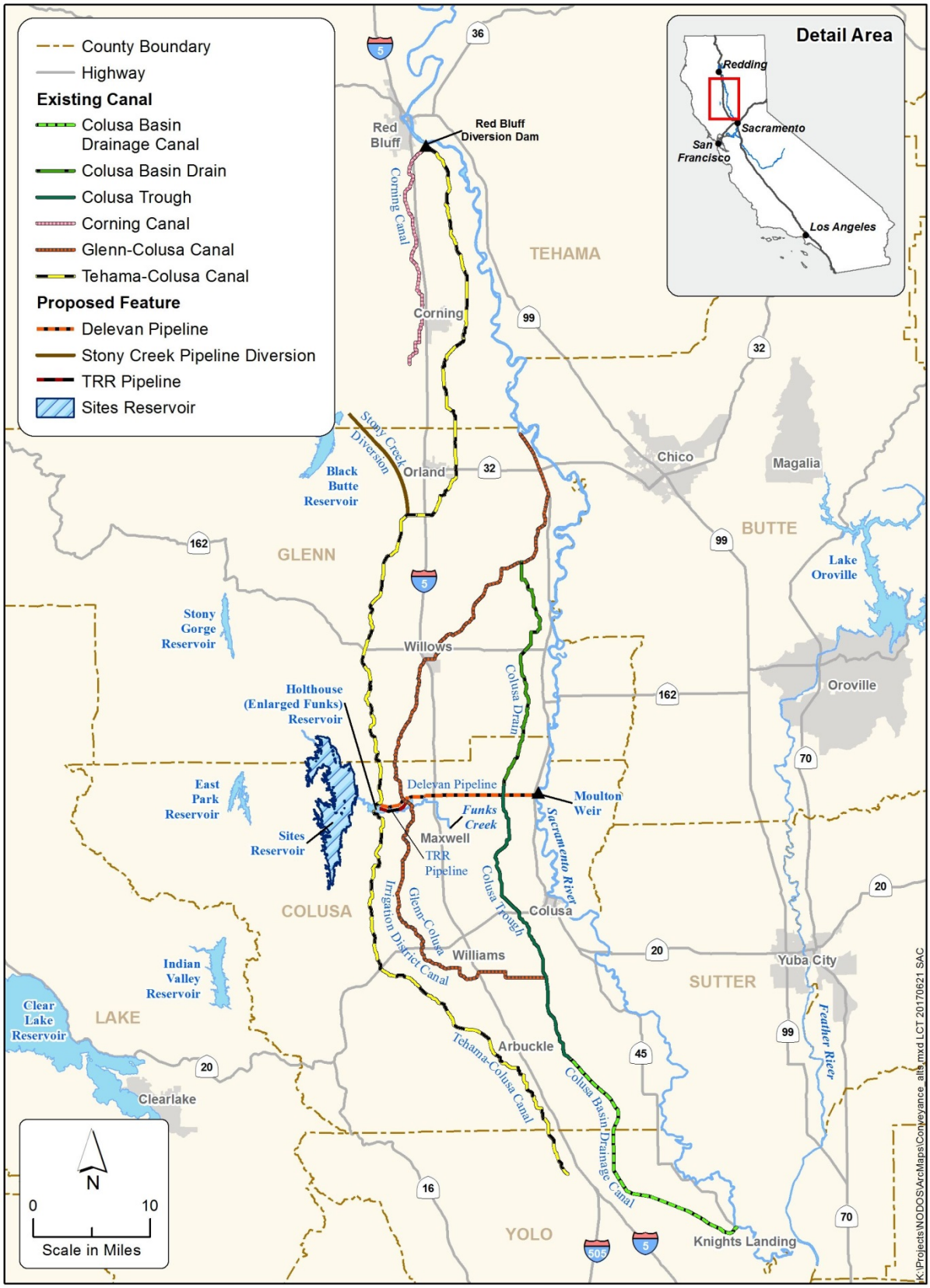

Figure 5-1. NODOS Conveyance Measures

One of the primary advantages of the Sites Reservoir location is that it provides the ability to use and incorporate the existing GCID and T-C Canals into the project. Leveraging existing infrastructure for conveyance markedly reduces both the construction costs and the construction-related environmental impacts. Preliminary operation simulations indicate that 3,000 to 6,000 cfs of total inflow capacity to the proposed Holthouse Reservoir (an expansion of the existing Funks Reservoir) on the T-C Canal are needed to fill Sites Reservoir reliably. The larger T-C Canal measures and Stony Creek Pipeline Diversion require increasing the capacity of the lower portion of the T-C Canal from Orland to the proposed Holthouse Reservoir. This increase in capacity appreciably increases the project costs and environmental impacts.

Figure 5-2 shows a conceptual flow diagram for the array of conveyance measures.

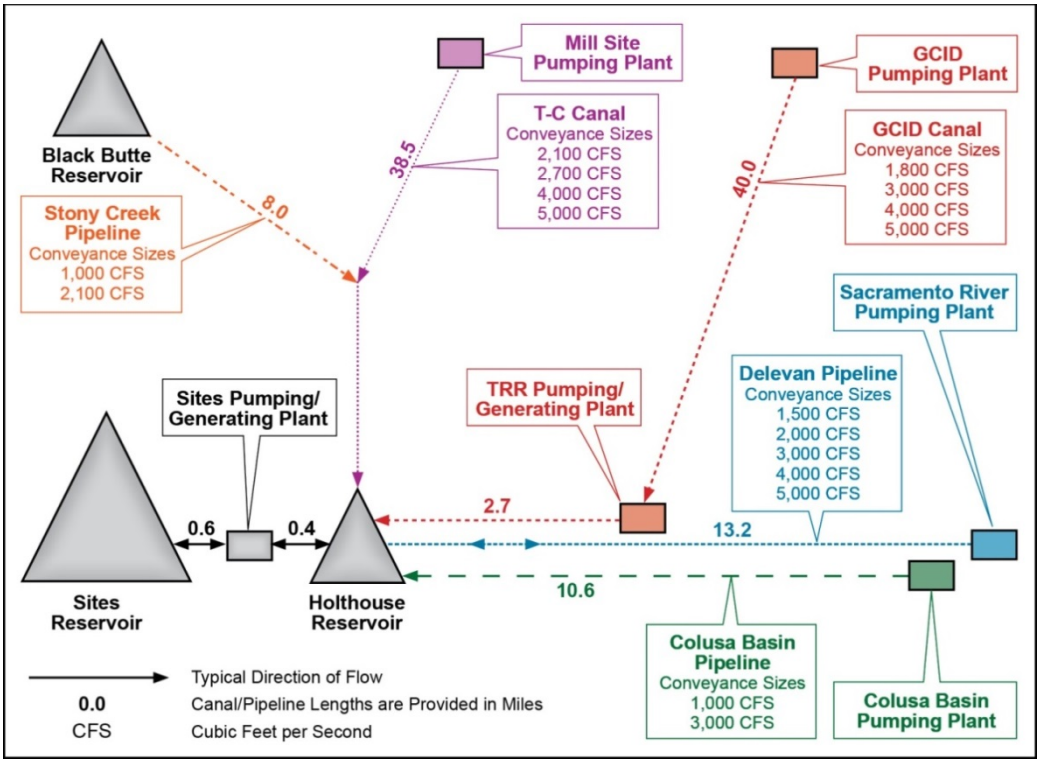

Figure 5-2. Flow Diagram for Conveyance Measures

All measures convey water to the proposed Holthouse Reservoir. Consequently, they can be compared directly to determine their relative performance in conveying water to storage. By contrast, each measure's ability to convey water from Sites Reservoir storage to areas of need or use, or directly to the Sacramento River, varies. Any conveyance system would facilitate delivery of water to a portion of the T-C service area, because Sites Reservoir uses Holthouse Reservoir on the canal as an afterbay. However, the Stony Creek Pipeline and T-C Canal measures alone do not provide conveyance to additional areas of need or use.

Conveyance from Reservoir to Service Areas or Locations with Various Water Resource Needs and Uses

Three general methods can be used to facilitate the delivery of water to areas of need and use from the proposed Sites Reservoir:

- Water can be delivered directly from Sites Reservoir to meet local needs in the vicinity of the existing GCID and T-C Canals. Needs are defined as currently unmet uses for water.
- Sites Reservoir can deliver water locally in an cooperative way (i.e., using water supply exchanges) with CVP operations, thereby facilitating an ability to meet additional needs throughout the Bay-Delta system. Any Sites Reservoir plan would be connected to Holthouse Reservoir, and therefore, to the T-C Canal. This connection would facilitate cooperative operations with the CVP, independent of the conveyance measures selected. Additional opportunity for cooperative operations with the CVP would be facilitated by the GCID Canal measures. The benefits resulting from this type of exchange operation relate directly to the amount of water served to the local area by Sites Reservoir that was previously served by the CVP's other facilities. For example, delivering water to CVP contractors in the Sacramento River Valley from Sites Reservoir in lieu of delivering water from Shasta provides additional coldwater pool storage in Shasta. This additional storage would enable the CVP to serve one of the primary objectives of this project without affecting current uses.
- The Delevan Pipeline offers the unique ability to release water into the Sacramento River directly from Sites Reservoir. Water released from the Delevan Pipeline could provide downstream benefits for Delta water quality and water supply reliability for CVP, SWP, and incremental Level 4 refuge supply. Conveyance systems that do not include the Delevan Pipeline would not provide these benefits.

Initial Evaluation of Environmental Considerations of the Conveyance Measures

The following environmental considerations are also noted for evaluating the various conveyance measures:

- **Water quality:** The CBD is the single largest source of agricultural return flows to the Sacramento River. The water from the CBD is considered to be of relatively poor quality outside of the wet season when compared to Sacramento River water, and therefore CBD water is less desirable as a primary source for diversions. Diversions would need to be restricted to periods when the CBD is primarily conveying natural runoff of higher-quality water to avoid water quality impacts to Sites Reservoir users.
- **Agricultural land:** California's desire to preserve agricultural land is reflected in the California Land Conservation Act, also known as the Williamson Act. The effectiveness of the Williamson Act is often measured by the amount of prime agricultural land (as defined in the Act) in the program. Expansion of the GCID Canal would require the acquisition of temporary and permanent rights-of-way. Similar impacts to agricultural land are associated with the expansion of the T-C Canal.
- **Environmental effects.** Measures that expand the existing canals would affect large land areas temporarily and permanently.

Table 5-2 summarizes the detailed screening of the conveyance measures. Some of the measures that are screened out as not suitable for primary diversions or releases may still be beneficial as supplemental facilities that could be added at some point in the future. Additional details regarding the screening evaluation are provided in Appendix A, Plan Formulation. Based on the screening of conveyance measures, the most favorable measures were considered to be the

Table 5-2. Summary of Conveyance Measures Screening for Primary Intakes

Option	Water Quality	Williamson Act (Impacts to Farm Land)	Biological Impacts	Release to Sacramento River	Cost-Effectiveness	Retained for Further Consideration
T-C Canal Existing	**Score: HIGH**	**Score: HIGH**	**Score: HIGH**	**Score: LOW**	**Score: HIGH**	Yes
T-C Canal Expansion	**Score: HIGH**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: LOW**	**Score: MEDIUM**	No
GCID Canal Existing	**Score: HIGH**	**Score: HIGH**	**Score: HIGH**	**Score: LOW**	**Score: HIGH**	Yes
GCID Canal Expansion	**Score: HIGH**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: LOW**	**Score: MEDIUM**	No
Delevan Pipeline < 3,000 cfs	**Score: HIGH**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: HIGH**	**Score: MEDIUM**	Yes
Delevan Pipeline > 3,000 cfs	**Score: HIGH**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: HIGH**	**Score: LOW**	No
Stony Creek Pipeline	**Score: HIGH**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: LOW**	**Score: HIGH**	No
Colusa Basin Drain	Occasionally high EC, TDS, and nutrient levels **Score: LOW**	Significant construction impact **Score: LOW**	**Score: LOW**	**Score: MEDIUM**	**Score: HIGH**	No

cfs = cubic feet per second
EC = electrical conductivity
GCID = Glenn-Colusa Irrigation District
T-C = Tehama-Colusa
TDS = total dissolved solids

existing T-C and GCID Canals, and a Delevan Pipeline with a capacity of less than 3,000 cfs. Inclusion of a conveyance facility with the ability to release water directly to the Sacramento River was considered essential to achieving the objectives of the feasibility study.

Evaluation of Various Reservoir Sizes

Four sizes of Sites Reservoir have been considered: 800 TAF, 1.27 MAF, 1.81 MAF, and 2.1 MAF. The reservoir sizes studied were chosen to reflect a range of storage values that would allow for a useful comparison of the developed cost and quantity estimates, and provide for reasonably reliable interpolation for other reservoir sizes not specifically addressed by the four selected reservoir sizes.

Table 5-3 presents a summary of each reservoir storage alternative. The table lists the total number of dams required to impound Sites Reservoir, and the total embankment volume (i.e., amount of material required to create the dams) for each of the reservoir measures.

Table 5-3. Sites Reservoir Alternative Reservoir Size Summary

Reservoir Storage (MAF)	Maximum Water Surface Elevation (feet)	Reservoir Surface Area (acres)	Total Number of Dams (main + saddle) [a]	Total Embankment Volume (CY)
0.8	440	10,200	2 + 3	6,900,000
1.27	480	12,400	2 + 6	11,600,000
1.81	520	14,200	2 + 9	22,300,000
2.1	540	15,100	2 + 7 [b]	33,800,000

[a] Total number of dams includes the main dams, Sites Dam and Golden Gate Dam, and the saddle dams.
[b] Saddle dams 7, 8, and 9 become one continuous embankment in the 2.1 MAF reservoir alternative.
CY = cubic yards
MAF = million acre-feet

After a review of the reservoir rim topography, the site geology, the presence of geologic features trending through the reservoir rim, and a cursory evaluation of the relationship between embankment volume and reservoir storage, it was determined that a 2.1 MAF reservoir may be infeasible. A review of the reservoir rim indicated that reservoir elevations at or above 540 feet would likely require more extensive grouting of the saddle areas along the relatively steep ridges of the eastern rim to ensure the structural integrity of the project. This treatment, combined with the increasing proportion of required embankment material volume and higher reservoir surface elevations, would result in larger unit costs (reservoir cost/AF of storage) for reservoir elevations above 540 feet. Therefore, the reservoir measures below elevation 540 feet were found to be more economical on a unit-cost basis. In addition, detailed geologic and geotechnical evaluations have not been performed on lower-elevation areas of the eastern rim. Therefore, a maximum elevation of 520 feet was selected to ensure that the proposed size of Sites Reservoir would be technically feasible. The maximum reservoir elevation was limited to 520 feet due to questionable conditions on the relatively steeper slopes of the eastern reservoir rim that could result in large increases in project costs during the later stages of design.

Therefore, reservoir sizes of 0.8 MAF, 1.27 MAF, and 1.81 MAF were considered further for alternative development. The larger reservoirs were prioritized for initial evaluation and preferred if the economics are favorable.

Conveyance and Reservoir Measures Considered for Further Evaluation

From the results of the initial screening of the conveyance measures and reservoir sizes described above, the following measures were further evaluated:

- Sites Reservoir size:
  - 1.27 MAF
  - 1.81 MAF
- Conveyance measures:
  - Existing T-C Canal (2,100 cfs)
  - Existing GCID Canal (1,800 cfs)
  - Delevan Pipeline
  - 1,500 cfs
  - 2,000 cfs
  - 3,000 cfs

Subsequent analysis (see Appendix A) suggested that a 2,000 cfs diversion with the Delevan Pipeline was adequate to fill the reservoir. This allows for releases to the Sacramento River of 1,500 to 2,500 cfs, depending on the design of the energy dissipation system.

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