Statement of Stephen Welch, Assistant General Manager
Contra Costa Water District

Before the
House Natural Resources Subcommittee on Water, Power and Oceans

Legislative Hearing
H.R. 6040, Contra Costa Canal Transfer Act

July 11, 2018

Chairman Lamborn, Ranking Member Huffman, and members of the Subcommittee, I am Stephen Welch, Assistant General Manager of the Contra Costa Water District (District). I wish to thank you for holding a hearing on the Contra Costa Canal Transfer Act (**H.R. 6040**). We appreciate Congressman Mark DeSaulnier for introducing the House bill. The District is an urban water agency located in the eastern part of the San Francisco Bay Area region in Northern California. It is also the oldest and largest M&I contractor within the Central Valley Project providing high quality water to approximately 500,000 residents and many large industrial customers.

As a unit of the Central Valley Project (CVP), construction of the Contra Costa Canal System began in 1937 by the U.S. Department of Interior's Bureau of Reclamation (Reclamation). The District operates and maintains this earthen canal system under agreement with Reclamation. **H.R. 6040** transfers title of ownership of the Contra Costa Canal system from Reclamation to Contra Costa Water District. The transfer of title would enable the District to invest local dollars and modernize the canal by enclosing it. Such investment will improve water supply reliability, provide significant public safety benefits and mitigate against flood risks, and maintain existing recreation opportunities for the region.

The Contra Costa Canal system is a single purpose facility making it ideal for title transfer. The District has worked closely with Reclamation to ensure that transfer remains non-controversial and seamless. In fact, we successfully completed Reclamation's administrative process for transferring title of the Contra Costa Canal system in the mid-1990s. The project met all of the criteria set forth by the "Framework for the Transfer of Title Bureau of Reclamation Projects."

It is important to our Board of Directors that the District acquire ownership of the facility before investing millions of ratepayer dollars to enclose the canal system. Our District has paid off its federal obligation for construction and is now in a position where it makes sense to move forward with modernization. We have a long, proven history of successful operation and maintenance of the canal system. The District has cultivated positive working relationships with federal, state and local regulatory agencies, and has strong financial ratings.

H.R. 6040 would improve water supply reliability and enhance public safety through facilitating enclosure of the canal system. In June 2014, the District completed a study entitled "Canal Rehabilitation Feasibility Studies," which concluded that canal enclosure best meets our objectives. Enclosure will reduce any water seepage and preserve the canal's useful life for the next 80+ years. We demonstrated the feasibility of this approach by enclosing approximately 2.5 miles of the canal to date. The open, earthen nature of the canal poses further problems for public safety. Unfortunately, our community has experienced 81 drownings (averaging 1 drowning per year) despite signs and fencing that line the canal. As local communities have grown around the canal, the risk of flood damage to surrounding property has also increased. Title transfer to the District will also relieve the United States of any risk of canal failure.

Through the development of this legislation, Reclamation requested that the District take over title and operation of the Rock Slough Fish Screen facility, which prevents the entrainment of fish at the main water intake of the Contra Costa Canal. Currently, the fish screen is in need of significant repair. **H.R. 6040** will provide for the safe and reliable operation of the Rock Slough fish screen facility by conveying the title and operation to the District based upon mutual agreement with Reclamation.

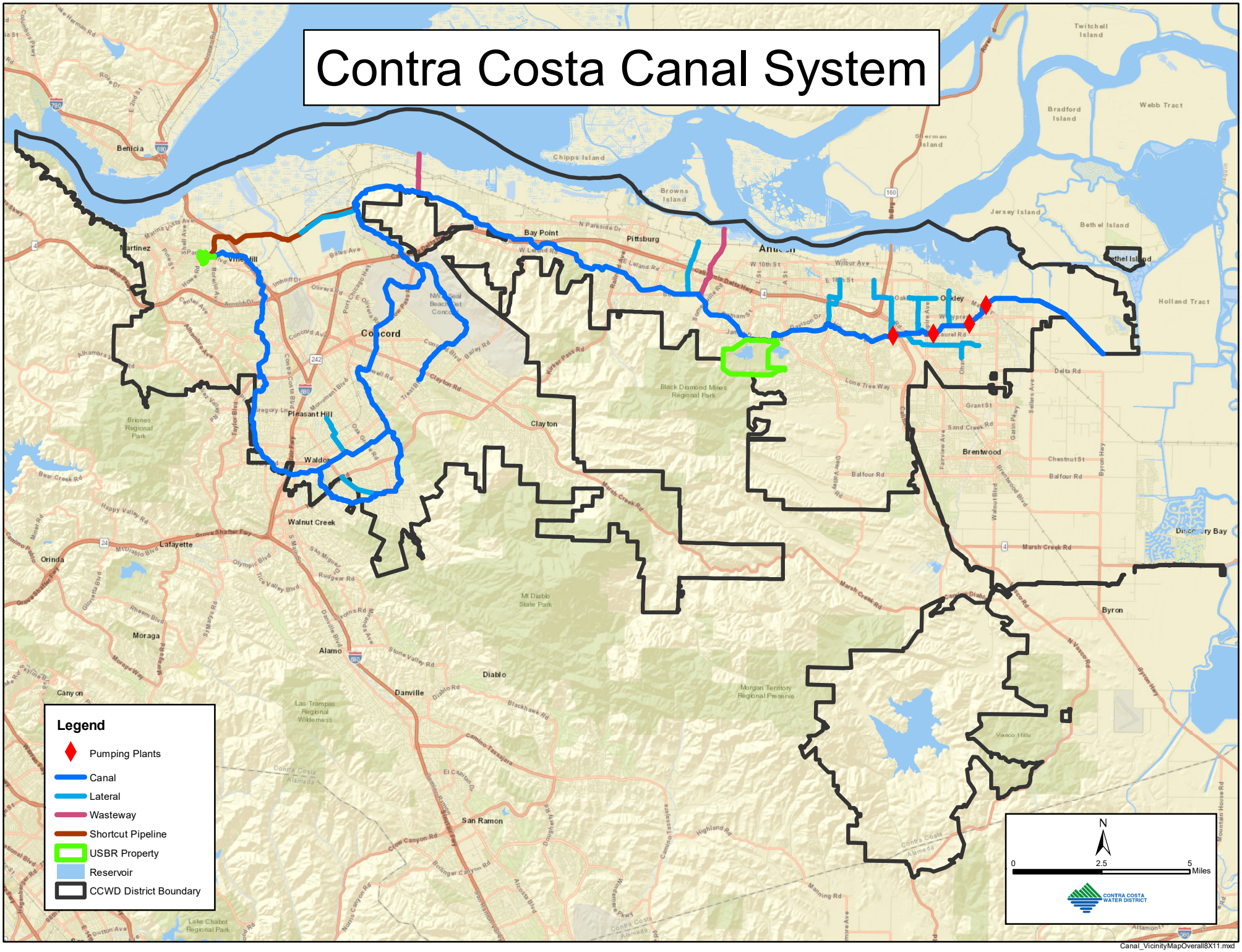
Elimination of Reclamation's coordination and oversight function would not result in any adverse impacts. In fact, **H.R. 6040** will help to lower costs and reduce administrative burden for both the District and Reclamation. Currently, work on the canal system requires varying levels of coordination and documentation with Reclamation for planning, design, project implementation, maintenance, and operation. The District's ownership of the canal system would eliminate this duplicative consultation as we do much of the same work in our oversight and review responsibilities. There are numerous third parties working within the canal system rights-of-way that include Contra Costa County, cities, local and regional agencies, recreation partners, and utilities. We will all benefit from removing duplicative federal review and bureaucratic approvals that increases costs and causes schedule delays.

Existing recreation contracts and opportunities are explicitly protected in **H.R. 6040** and the District has committed to maintain those opportunities once title is transferred. On December 20, 2017, our Board of Directors approved a signed memorandum of understanding with the East Bay Regional Park District to ensure recreation can continue once title is transferred and the canal is enclosed. District staff recently reached out to local stakeholders that include the cities of Antioch, Walnut Creek, Concord and Clayton to ensure that their interests in recreation are not affected by such a transfer.

H.R. 6040 does not affect the District's responsibilities within existing CVP contracts or exclude the District from complying with federal and state environmental laws. Before deferring our previous title transfer efforts, the District and Reclamation had worked for over two years on a transfer agreement. This included 9 public negotiation sessions, a complete environmental review and resolution of various special issue considerations. More recently, we have conducted outreach to Reclamation, local stakeholders and environmental organizations about pursuing title transfer. The response has been positive and the District is not aware of any opposition to **H.R. 6040**.

Finally, I am pleased to share that the Senate bill (S. 3001) had a legislative hearing in the Senate Energy and Natural Resources Subcommittee on Water and Power. The District supports the inclusion of an amendment to clarify that current Reclamation law, policy and our current contracts would govern the future disposition of small revenue streams, which the District collects from third party groups that utilize the canal right-of-way. The amendment was crafted with input from the Congressional Budget Office to ensure the bill does not score. I ask that the subcommittee support a similar change to **H.R. 6040**.

For the record, I am providing a map of the Contra Costa Canal system and the Canal Rehabilitation Feasibility Studies final report. Thank you for your consideration of this important legislation.



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CONTRA COSTA
WATER DISTRICT

FINAL REPORT • JUNE 2014

Canal Rehabilitation Feasibility Studies

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CONTRA COSTA WATER DISTRICT

CANAL REHABILITATION FEASIBILITY STUDIES

July 2014

INDEX OF TECHNICAL MEMORANDUMS

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CANAL REHABILITATION FEASIBILITY STUDIES

EXECUTIVE SUMMARY

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Contra Costa Water District

CANAL REHABILITATION FEASIBILITY STUDIES

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INTRODUCTION AND PURPOSE

The Contra Costa Water District's (District) untreated water facilities convey water from the Delta to its water treatment plants and customers in Eastern and Central Contra Costa County. Many of the District's untreated water facilities are more than 70 years old and require rehabilitation or replacement. As part of the Fiscal Year 2013 Update to the Untreated Water Facility Improvement Program Plan (UWFIP Plan), the District and Carollo completed a conceptual level engineering analysis to assess the viability and cost of replacing or renewing the District's Main and Loop Canals with new piped conveyance systems. The conceptual level analysis showed that a piped conveyance system is a viable alternative to the existing canals.

The conceptual level analysis included several assumptions regarding costs, operation, constructability, and other factors for the purpose of comparing alternatives. Additional engineering work is necessary to minimize uncertainty in the previous assumptions and further refine the piped conveyance design concepts. Accordingly, the purpose of the Canal Rehabilitation Feasibility Studies is to provide additional conceptual engineering of the canal renewal alternatives.

The Canal Rehabilitation Feasibility Studies is comprised of this Executive Summary and six Technical Memorandums (TMs):

- TM No. 1 – Rock Slough Renewal Alternatives.
- TM No. 2 – Main Canal Renewal Alternatives.
- TM No. 3 – Main Canal Drainage Alternatives.
- TM No. 4 – Contra Loma Alternative.
- TM No. 5 – Loop Canal Drainage Alternatives.
- TM No. 6 – Loop Canal Renewal Alternatives.

DESCRIPTION OF EXISTING FACILITIES

The District's untreated water conveyance facilities can be broadly categorized into three systems; the Main Canal, the Los Vaqueros System, and the Loop Canal.

Main Canal

The Main Canal is the District's raw water conveyance backbone, delivering untreated water from its sources in East Contra Costa County to customers in Central Contra Costa County. The Main Canal conveys untreated water from both Rock Slough and the Los

Vaqueros System. The Rock Slough Conveyance System, or the portion of the Main Canal from MP 0.00 to MP 7.05, consists of a fish screening facility, four pumping plants, and a canal. The last pumping plant in the system, Pumping Plant No. 4, discharges to the Main Canal near MP 7.05.

Untreated water is also delivered to the Main Canal from the Los Vaqueros System to the Main Canal via the Neroly Blending Facility near MP 7.05. At the Neroly Blending Facility, two sleeve valves are used to control flow into the Main Canal. A turbine is also located at this facility to allow the District to generate electricity from the excess hydraulic energy.

At MP 7.05, untreated water can be diverted to the Randall Bold Water Treatment Plant and/or conveyed to Central Contra Costa County through the Main Canal. For untreated water that will be conveyed through the Main Canal, the untreated water from Rock Slough and Los Vaqueros combine in a box culvert. Untreated water flows through the 1,500-foot long box culvert, which is connected to a 9-foot diameter siphon at MP 7.36. The untreated water then follows the meandering Main Canal 18.5 miles to MP 25.7 where the Shortcut Pipeline connects to the Main Canal. After MP 25.7, the canal continues on to the Martinez Reservoir; this portion of the canal is named the Loop Canal. The Multi-Purpose Pipeline (MPP) parallels the Main Canal from milepost (MP) 7.05 to MP 25.7 and provides additional capacity as well as some redundancy to the Main Canal.

Los Vaqueros System

The Los Vaqueros System is comprised of the Los Vaqueros Reservoir, the Old River Pump Station, the Middle River Pump Station, the Transfer Pump Station, and the pipelines connecting these facilities. The Los Vaqueros system provides the District with the ability to deliver high quality water to its customers throughout the year, regardless of water conditions or pumping restrictions in the Delta.

Loop Canal

Prior to the construction of the Shortcut Pipeline and the Multi-Purpose Pipeline, the Loop Canal was the central conveyance facility for the District. The Loop Canal stretches from MP 25.7 to the Martinez Reservoir at MP 47.7. The Loop Canal also includes the 5-mile Ygnacio Loop Canal and low lift pump station. The Loop Canal primarily serves to provide redundancy to the Shortcut Pipeline and deliver untreated water to approximately 200 customers. Of these 200 customers, only 10 use more than 10,000 gallons per day (gpd).

POTENTIAL FUTURE PROJECTS

Because the canal system is nearing the end of its useful life, upgrade and replacement alternatives were evaluated for the Main Canal, including the Rock Slough portion of the Main Canal, and the Loop Canal. The potential future projects are shown in Figure ES.1.

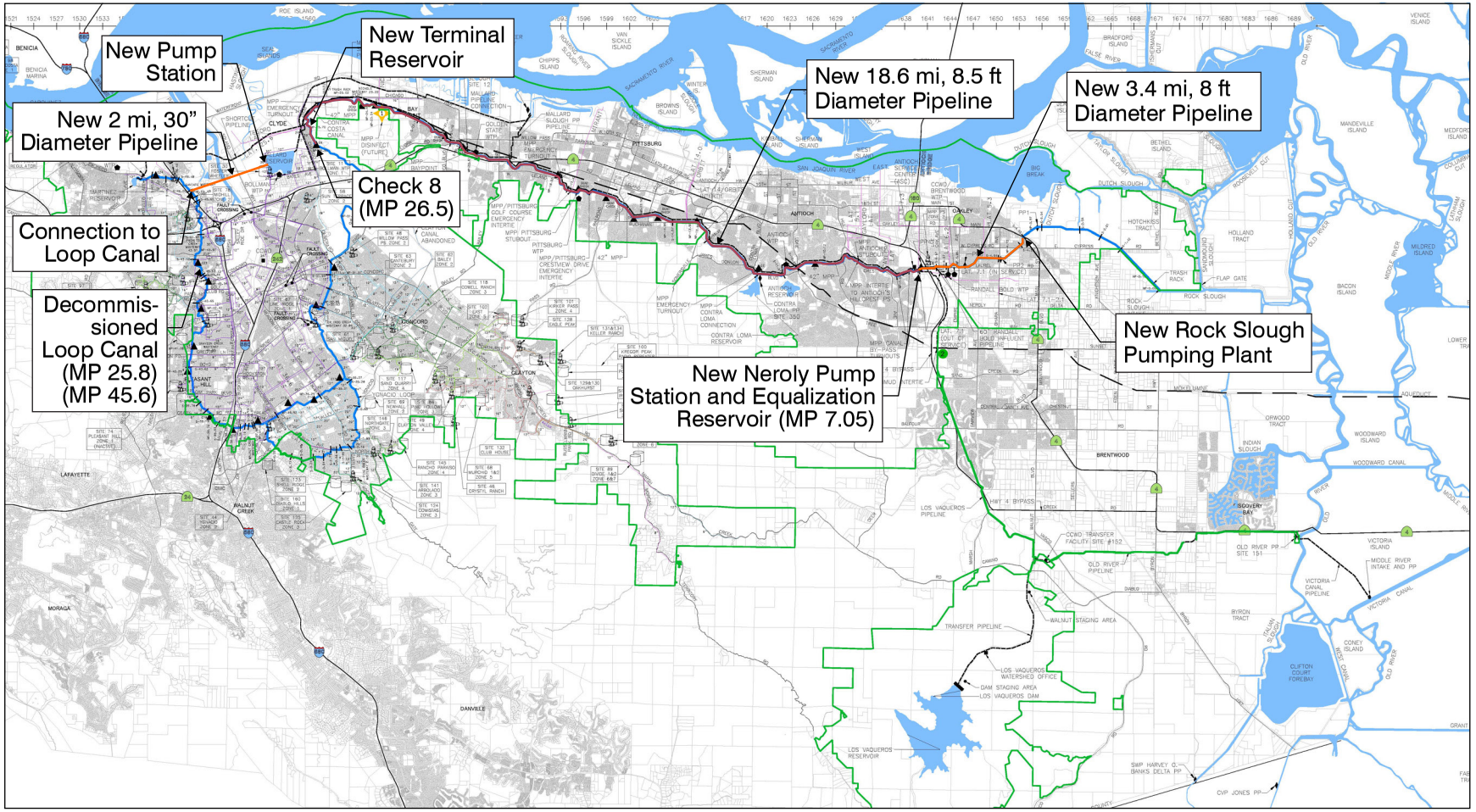

Figure ES-1
OVERVIEW OF CANAL RENEWAL PROJECTS
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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These future projects are recommended based on preliminary information and analysis performed during this study and the UWFIP. Additional studies and coordination are required to verify the viability of each alternative, preferred configuration, operation constraints, and constructability. Therefore, the following recommendations should be considered to be preliminary in nature and subject to change as additional studies, including environmental documentation, are prepared and public outreach is performed.

Main Canal Renewal

Renewal of the Main Canal was divided into two components, the Rock Slough Conveyance System, including the four existing pumping plants and the Main Canal from MP 0.0 to MP 7.05, and the portion of the Main Canal from 7.05 to MP 25.7.

Rock Slough Renewal Alternative

The selected Rock Slough Renewal Alternative is comprised of a single, new pump station at the current location of the existing Pumping Plant No. 1. As described in TM No. 1, the new pump station will discharge to a new 8-foot diameter welded steel pipe. The 8-foot diameter pipe would discharge to the existing box culvert that encloses the Main Canal at MP 7.05.

The new pump station would have a total capacity of 380 cubic feet per second (cfs). The pump station would be a trench-style pump station. The variable frequency drive (VFD) driven pumps, comprised of four large and two small pumps, would accommodate a broad range of flow rates.

Where the pipeline transitions to a siphon, the siphons would be lined with welded steel pipe. The welded steel pipe would allow the siphons to be pressurized and used as integral components of the new pipeline. Customer laterals would be modified, or replaced, with smaller diameter laterals with altitude valves or PLC controlled throttling valves.

Depending on whether the Rock Slough Conveyance System can be shut down for an extended period of time, the new pump station would be constructed either within the existing Pumping Plant No. 1 forebay or just to the east of the existing forebay. Similarly, depending on the allowed shutdown period, the pipeline could either be installed next to the existing canal in an open trench or along the centerline of the existing canal. The hydraulic grade line (HGL) for the new Rock Slough pump station and pipeline is shown in Figure ES.2. In addition, the HGL for the Main Canal Renewal Alternative is shown in Figure ES.2. Both HGLs are shown during a maximum flow rate condition.

The cost estimate for this Rock Slough Renewal project is $94.6 million in April 2014 dollars.

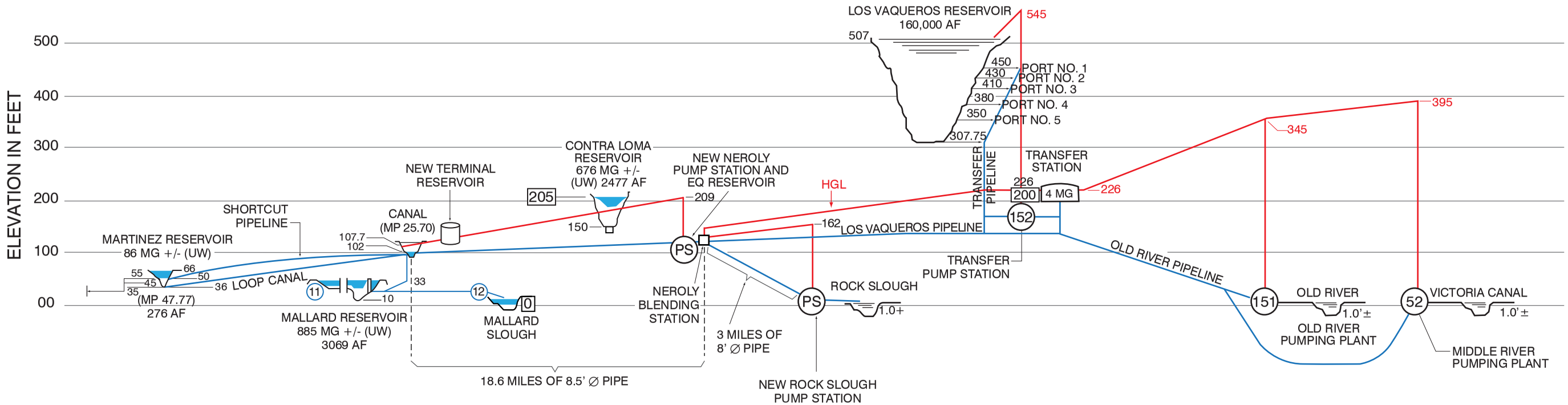

Figure ES-2
HYDRAULIC GRADE LINE (HGL) FOR
PREFERRED MAIN CANAL ALTERNATIVES
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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Main Canal Renewal Alternatives

Of the five conveyance alternatives developed as part of the UWFIP Plan, two alternatives were selected for further evaluation. Alternative 4, Replacement of the Main Canal with an 8-foot diameter Pipeline and new Neroly Pump Station was attractive because of its relatively low net present value, increased water conveyance reliability, and several additional tangible benefits to the District. In addition, Alternative 5, Replacement of the Main Canal with a Pipeline and new Contra Loma Pump Station, was also selected for further consideration, based on feedback from the District's User Group.

New Neroly Pump Station and 8.5-foot Diameter Pipeline

TM No. 2, Main Canal Renewal Alternatives, builds on the UWFIP Plan by expanding the conceptual engineering of the new large diameter pipeline and Neroly Pump Station beyond what was presented in the UWFIP Plan. TM No. 2 provides additional figures, schematics, concepts, and costs for the pipeline, pump station, equalization reservoirs and, perhaps most importantly, construction sequencing. Key refinements include an increase in pipe diameter from 8 feet to 8.5 feet and the ability to operate the pipeline in gravity mode for flows up to 120 cfs.

The Neroly Pump Station would be located near the existing Neroly Blending Facility to the east of the discharge of Pumping Plant No. 4 at MP 7.05. The pump station would be co-located with an equalization reservoir. The pump station would discharge to a 8.5-foot diameter pipeline, installed in the centerline of the existing Main Canal, from MP 7.05 to MP 25.7. A terminal reservoir would be located near MP 25.7. A schematic of the pump station, reservoirs, and pipeline is shown in Figure ES.3.

The pump station would be located on top of a buried concrete reservoir in the District owned laydown area located east of the Antioch Service Center and just to the north of the existing box culvert which houses the Main Canal. The reservoir would be trapezoidal shaped to fit the site and would have a nominal sidewater depth of approximately 26 feet (104 to 130 feet). The upper portion of the reservoir (122 to 130 feet) would be used for equalization storage when the new pipeline operates in gravity mode (during low demand periods) and the lower portion (104 to 122 feet) would be used when the pipeline is pressurized by the new Neroly Pump Station (during high demand periods). The reservoir would be tied into the existing box culvert. A gate would be installed in the reservoir between the box culvert and the reservoir to allow the reservoir to be isolated from the existing box culvert.

The pump station would be located on top of the reservoir. The 370 cfs pump station would be composed of a set of five high head vertical turbine pumps and a set of four lower head vertical turbine pumps. The pumps are only necessary if flows are higher than 120 cfs. The new pumping plant will pump the untreated water from the Neroly Equalization Reservoir into a new 8.5-foot diameter pipeline. The welded steel pipeline will be installed within the existing canal alignment. Where the canal transitions to a siphon, the siphons will either be

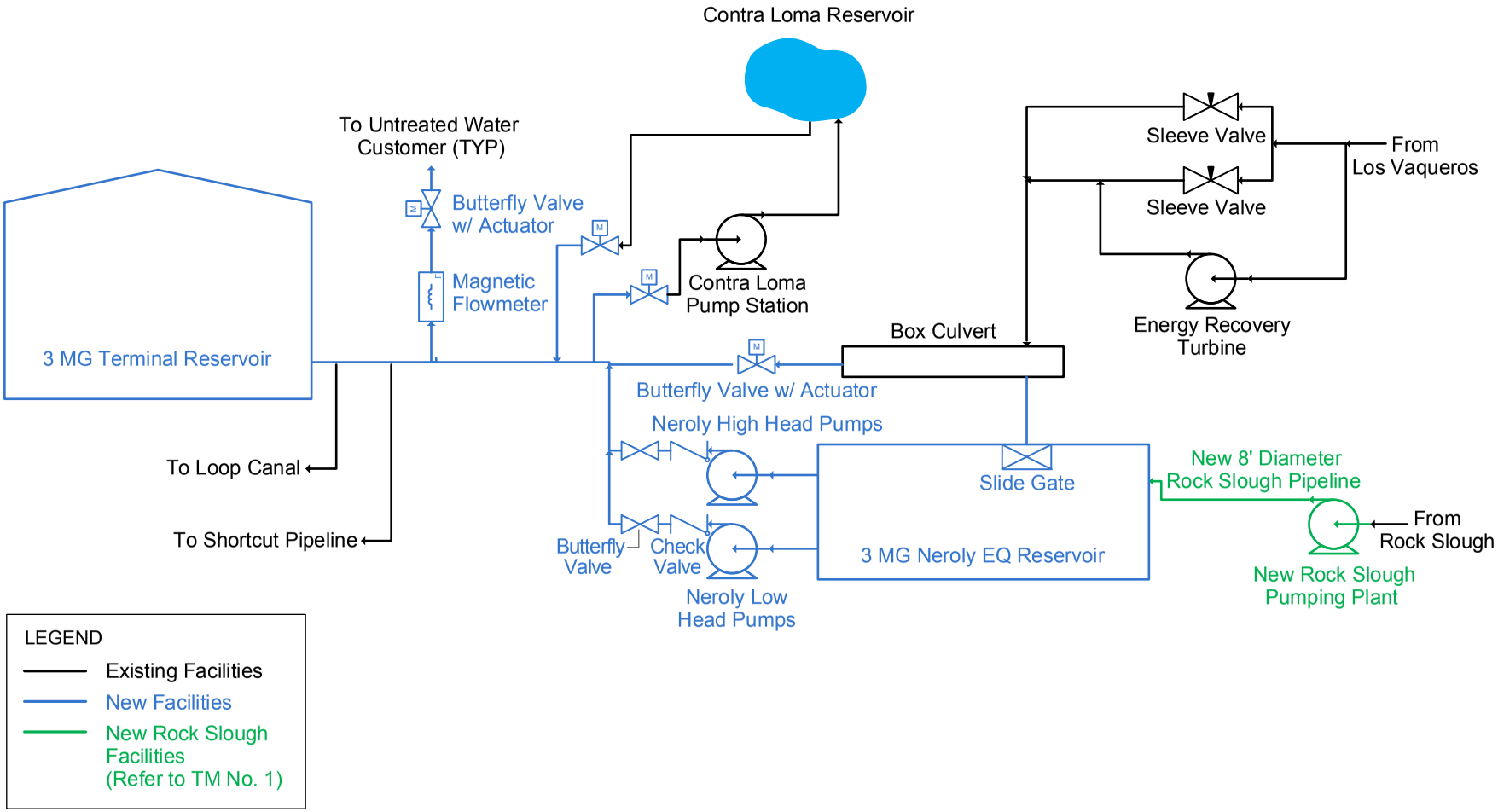

Figure ES-3
SCHEMATIC OF NEW PIPELINE, NEROLY PUMP STATION, RESERVOIRS NECESSARY TO REPLACE MAIN CANAL
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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lined with welded steel pipe or the pipeline will be installed in a new tunnel parallel to the siphon. Similarly, where vehicle and utility bridges pass over the canal, the new pipeline will either be routed within the canal alignment or will be tunneled under, or trenched through, the roadways.

The construction of the pipeline will be challenging because the pipeline will be constructed in the existing canal alignment. For this reason, a temporary bypass of the canal is required. The bypass will occur in 2-mile segments and will be capable of providing up to 210 cfs of flow. Some of the bypass pipeline segments will require tunneling under obstacles such as high traffic highways or railroad tracks. Two 2-mile segments of the canal will be replaced with a pipeline each year, for a total construction period of 5 years.

The 3-MG terminal reservoir will be likely be a buried, prestressed concrete, cylindrical type reservoir. It will provide equalization storage for the new Neroly pump station and pipeline system.

The cost estimate for this alternative is $320 million in April 2014 dollars.

New Contra Loma Pump Station Alternative

TM No. 4, Contra Loma Alternative, builds on the UWFIP Plan by expanding the conceptual engineering of the Contra Loma Pump Station Alternative, Alternative 5. TM No. 4 provides additional figures, concepts, and costs for this alternative. This alternative was selected for further analysis for two reasons:

- There is a limited amount of available property at the Neroly Blending Facility and Pumping Plant No. 4 to locate the new Neroly Pump Station and Equalization Reservoir.
- This alternative limits the number of new facilities that must be constructed. The existing Contra Loma Reservoir is used in place of a new terminal reservoir at MP 25.7.

The Contra Loma Pump Station alternative is comprised of the following components:

- A 10-foot diameter pipeline from Neroly to Contra Loma. The pipeline would be installed in the Main Canal as described in the Neroly Pump Station Alternative.
- A new pump station and equalization reservoir at Contra Loma that will lift untreated water into the existing Contra Loma Reservoir when untreated water demands are higher than 90 cfs. During periods when demands are lower than 90 cfs, the pipeline would continue to flow by gravity. The new pump station would be located on top of a new equalization reservoir located in the northwest corner of the existing Contra Loma Pump Station site. The new pump station would replace the existing Contra Loma Pump Station.

- The Contra Loma Reservoir would be hydraulically connected to the new 6.5-foot diameter pipeline and would serve as the regulating reservoir for the segment of the new pipeline from Contra Loma to MP 25.8. The new Contra Loma Pump Station would be designed to maintain a constant level of 205 feet in the existing Contra Loma Reservoir.

- The discharge of the new pump station would be connected to the existing 6 foot diameter drain/fill pipeline that passes through the existing Contra Loma Dam. The pump station discharge would also be connected to the new 6.5-foot diameter pipeline that would replace the canal between Contra Loma and MP 25.8.

The cost estimate for this alternative is $303 million in April 2014 dollars.

Comparison of Neroly and Contra Loma Pump Station Alternatives.

The Neroly Pump Station Alternative was determined to be preferable to the Contra Loma Pump Station Alternative for the following reasons:

- The Contra Loma Alternative is dependent on the implementation of the Rock Slough upgrades described in TM No. 1 (the pipeline from Neroly to Contra Loma to be pressurized by the new Rock Slough Pump Station and Pipeline). This would require the District to implement both projects at the same time.

- While the capital/project cost of the two alternatives is similar (excluding the cost of the required Rock Slough upgrades), the annual electricity costs of the Neroly alternative are approximately half of the costs of the Contra Loma Alternative. Therefore, the net present value of this alternative is approximately $28 M lower than the Contra Loma alternative.

- Modifications to Contra Loma Dam and Pump Station would not be required.

These advantages outweighed the following advantages of the Contra Loma Alternative:

- The project is easier to construct than the Neroly alternative and construction will have less impact on existing facilities and operations. In addition, the location of the untreated water blending facility at Neroly will not be affected.

- Because the existing Contra Loma Reservoir will be utilized as a key feature of the Contra Loma alternative, a terminal reservoir is not required.

- The large, existing Contra Loma Reservoir enables the use of a simple and reliable control scheme for the new Contra Loma Pump Station.

Loop Canal Renewal

Prior to the construction of the Shortcut Pipeline and the Multi-Purpose Pipeline, the Loop Canal was the central conveyance facility for the District. However, in 2014, it primarily provides redundancy to the Shortcut Pipeline, as well as delivering untreated water to approximately 40 relatively low volume, metered customers and approximately 180 unmetered residential customers. Maintaining 25 miles of the Loop Canal requires approximately $700,000 manpower alone, on an annual basis.

The UWFIP Plan presented an assessment of the upgrade and replacement alternatives for the Loop Canal. The UWFIP Plan presented eight renewal alternatives and sub-alternatives. Four of those alternatives were selected for further study:

- Alternative 2 – Decommission Canal and Provide Redundancy to Shortcut Pipeline.
- Alternative 3 – Convert Loop Canal to Untreated Water Pipeline (from Check 8 to MP 42.0).
- Alternative 3A – Convert Loop Canal to Untreated Water Pipeline (from Check 8 to Martinez Reservoir).
- Alternative 5A – Convert Loop Canal to Recycled Water Pipeline (from CCCSD near MP 45.5 to Lime Ridge Open Space).

A key constraint for this study was that the selected renewal alternative must provide redundancy to the Shortcut Pipeline, as the Loop Canal does now. Accordingly, all of the alternatives include measures to provide 27.5 cfs of untreated water to the Shell Refinery, via Martinez Reservoir. This assumes that the City of Martinez would be supplied with treated water from the District's treated water distribution system.

For each of the four alternatives, additional conceptual engineering was performed, as described in TM No. 6, Loop Canal Renewal Alternatives. The conceptual engineering included refinement of system hydraulics, evaluation of storage tank locations, development of pipeline installation sections, and analysis of potential impacts on the treated water distribution system. In addition, the Shortcut Pipeline redundancy alternatives were also updated.

Currently, if the Shortcut Pipeline is taken out of service for planned or unplanned maintenance or if additional conveyance capacity is required, the District is capable of providing untreated water to its customers that draw from the Martinez Reservoir by conveying water through the Loop Canal. Three alternatives were developed in the 2013 UWFIP and carried through to this study.

- Upgrade the existing unused recycled water pipe network to the northeast of Mallard Reservoir to convey untreated water to Shell.

- Construct a new pump station at Mallard Reservoir and convey untreated water to the western end of the Loop Canal via a new 2-mile pipeline.
- Design a new pipeline and pump station to convey untreated water from MP 25.8 to the Martinez Reservoir (same as Loop Canal Renewal Alternative 3A).

Table ES.1 shows a summary of the four Loop Canal Renewal alternatives, paired with the selected Shortcut Pipeline Redundancy Alternative.

Table ES.1 Summary of Loop Canal Conveyance Alternatives
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Alternative	Capital Costs[(1)(2)] ($M)
2 Decommission Canal and Provide Redundancy to Shortcut Pipeline via Alternative B	41.1
3 Convert Loop Canal to Untreated Water Pipeline and Provide Redundancy to Shortcut Pipeline via Alternative B	72.8
3A Convert Loop Canal to Untreated Water Pipeline (from Check 8 to Martinez Reservoir)	102.6
5A Convert Loop Canal to Recycled Water Pipeline Using Existing Recycled Water Pipelines. Provide Redundancy to Shortcut Pipeline via Alternative B	63.1

Notes:
(1) The costs above do not include the $18.1 M required to provide stormwater conveyance facilities when the canal is removed. Refer to TM No. 5.
(2) Based on April 2014 dollars; ENRCCI=10,895.

The most viable alternative appears to be Alternative 2. Alternative 2 consists of a decommissioning the Loop Canal and converting the existing Loop Canal untreated water customers to the treated water distribution system. Alternative 2 would be paired with Shortcut Pipeline Alternative B. This alternative pairing appears most viable for the following reasons:

- The project cost is approximately 1/3 less than the next lowest alternative.
- The use of the District's existing treated water distribution system is maximized.
- The Shortcut Pipeline Redundancy Alternative does not rely on an aging, unused pipeline network.
- O&M and maintenance costs for the Loop Canal and Loop Canal ROW, as well as future capital costs for canal upgrades, are eliminated. In addition, District resources will not be required to operate and maintain a lengthy loop canal pipeline.

Figure ES.4 shows Loop Canal Alternative 2. Figure ES.5 shows a larger scale view of Shortcut Pipeline Redundancy Alternative B. The conceptual routing for the pipeline shown in Figure ES.5 is preliminary and does pass through some environmentally sensitive areas. A follow up study should be performed to confirm the preferred pipeline route. To the maximum extent possible, the pipeline should avoid environmentally sensitive areas. The cost estimate for this project is $41.1 million in April 2014 dollars.

Stormwater Drainage Studies

In addition to conveying untreated water from the California Delta to customers and District facilities, the Main and Loop Canals collect and convey stormwater runoff. Stormwater from the United State Bureau of Reclamation (USBR) canal property drains into the canal. In addition, there are off-site properties on the upstream side of the canal that drain into the canal.

If the District replaces the Main and Loop Canals, the canals will no longer be available to collect and convey stormwater runoff. Accordingly, TM No's. 3 and No. 5 were prepared to quantify the stormwater runoff into the Main and Loop Canals, respectively. The TMs also present approaches for handling the stormwater after the existing canal is removed from service. The summary and conclusions from the TMs are as follows:

- There are relatively few sources of off-site stormwater runoff to the Main Canal, with the exception of Concord Naval Weapons Station (CNWS). The CNWS accounts for 84 percent of the total off-site property that drains to the Main Canal. A storm with a high intensity and long duration has a potential to contribute as much as 68 cfs to the Main Canal, based on a wet weather event with 100-year recurrence interval and 24-hour duration.

- The Loop Canal receives stormwater runoff from more off-site properties than the Main Canal. The Concord Naval Weapons Station (CNWS) and Lime Ridge Open Space account for approximately 46 percent and 31 percent, respectively, of the total off-site area that drains to the Loop Canal. A storm with a high intensity and long duration has a potential to contribute as much as 256 cfs to the Loop Canal, based on a wet weather event with 100-year recurrence interval and a 24-hour duration.

- Redirecting stormwater to existing stormwater collection systems and natural drainage features (e.g. creeks) appear feasible, except for some locations along the Loop Canal. Because the capacities of the existing collection systems and creeks are unknown, it was assumed that detention basins, sufficient to contain runoff from wet weather event with a 100-year recurrence interval and a 24-hour duration, would be constructed, where feasible, to minimize the hydraulic impacts on the existing collection systems.

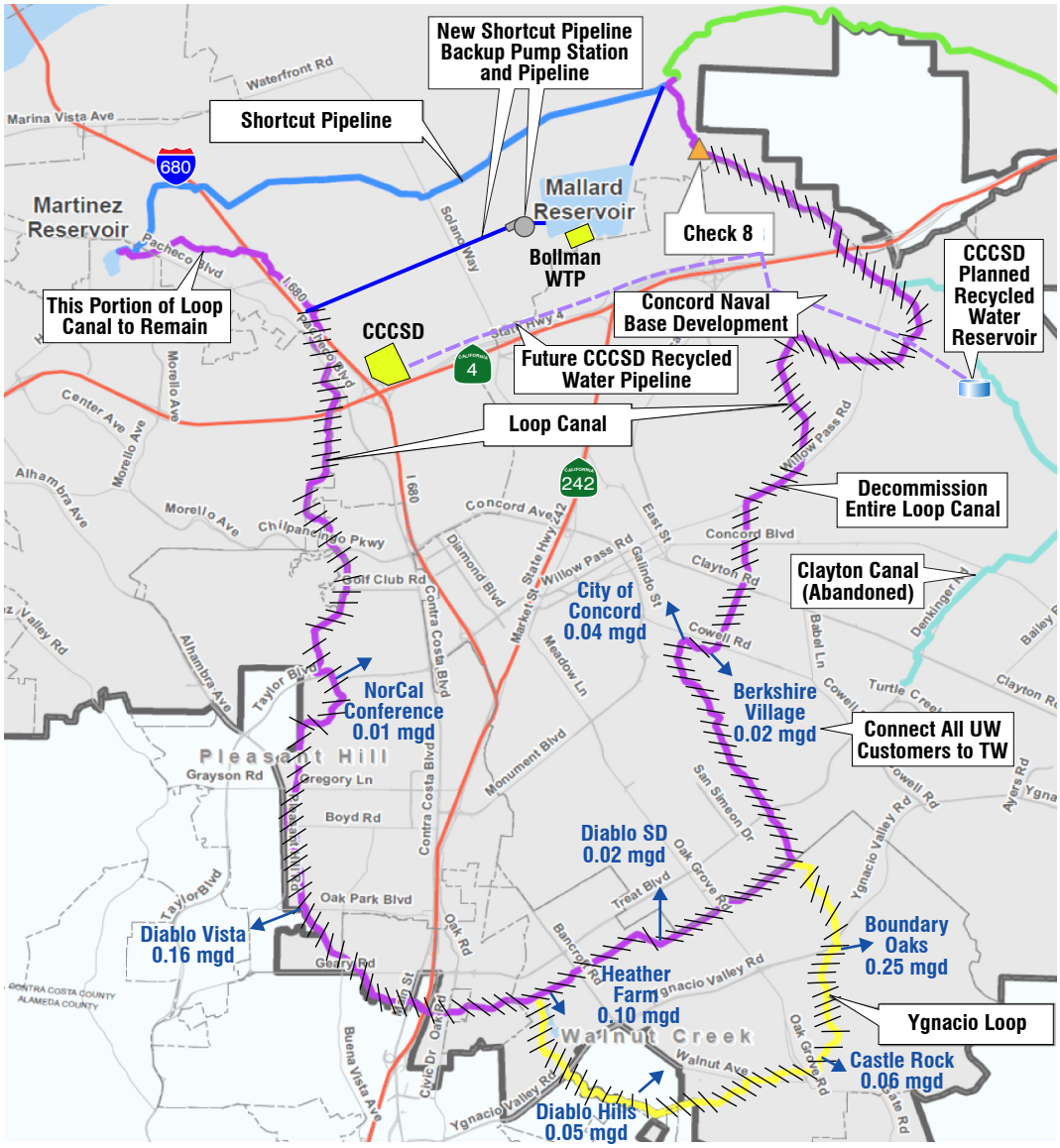

Figure ES-4
LOOP CANAL RENEWAL ALTERNATIVE 2
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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Figure ES-5
SHORTCUT PIPELINE REDUNDANCY ALTERNATIVE
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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- On the Main Canal, the majority of the detention basins can be placed within existing canal property, with the exception of the detention basins for the portion of the Main Canal that passes through the CNWS. These detention basins will require acquisition of property or easements from the CNWS. However, these detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure is capable of handling the increased stormwater runoff flows.

- Because the Loop Canal is located in an urban, developed area, construction of detention basins does not appear feasible at many locations. Without detention basins, more emphasis on the capacity of the existing stormwater collection systems and creeks is required, especially in areas with existing flooding issues (e.g. Grayson Creek). These collection systems and creeks need to be studied in depth during the next phase of this project. If the proposed discharge locations do not have capacity to receive additional stormwater flows, then it is likely that stormwater can be conveyed further down the Loop Canal alignment to another location.

- For the portion of the Loop Canal that passes through the CNWS, construction of detention basins will require acquisition of property and/or easements from the CNWS. Similar to the Main Canal, close coordination with the Navy, the City of Concord, and the CNWS developer will be required, as the Loop Canal detention basins will be located in areas of the CNWS that are planned to be developed. These detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure are capable of handling the increased stormwater runoff flows.

- Within the canal property, concrete lined ditches will be constructed to convey stormwater to the detention basins. The ditches will discharge to grass lined swales upstream of the detention basins, or drainage connections, to provide stormwater treatment.

- Additional investigations and modeling should be performed to analyze the capacity of the existing stormwater collection systems and natural drainage features.

- If the Main Canal is replaced by a pipeline, managing stormwater drainage from the canal property and off-site properties that drain to the canal appears feasible. The estimated cost of the stormwater facilities is $15.8 M.

- If the Loop Canal is decommissioned or replaced by a pipeline, managing stormwater drainage from the canal property and off-site properties that drain to the canal appears feasible. However, the stormwater facilities will be more difficult to implement than on the Main Canal. The estimated cost of the stormwater facilities is $18.1 M.

ITEMS TO BE ADDRESSED IN THE NEXT PHASE OF THE PROJECT

Each of the three renewal projects, Main Canal, Rock Slough System, Loop Canal, in their own right, are significant and complex infrastructure improvement projects with long term implications on the District. Accordingly, making the right decisions during the planning, conceptual design, and preliminary design phases of these projects is critical to maximizing the benefits of these projects. While the Canal Renewal Feasibility Studies and the previous update to the UWFIP investigated many of the issues and topics that need to be addressed before proceeding with final design, several components of the project need to be explored prior to implementing these projects. These issues that require further study are discussed in the following subsections.

Main Canal Renewal Project

- The configuration and operation of the preferred Main Canal Renewal Alternative should be confirmed.
  - The hydraulics should be analyzed in further detail. The analysis should include an evaluation of operating the pipeline at Los Vaqueros system head (e.g. after minor and friction losses in the existing pipeline at 400 cfs, or a lower design flow rate), Contra Loma Reservoir head, and the current hydraulic concept. Hydraulics should be peer reviewed to ensure all anticipated operating and hydraulic conditions are evaluated and accommodated.
  - Since replacement of the main canal requires two new reservoirs and a pump station, it may be beneficial to increase the discharge pressure of the new Rock Slough Pump Station and raise the HGL of the LV system to pressurize the entire system. This may reduce the required facilities for this project. Drawbacks for this option include the following:
    * Because the diameter of the Los Vaqueros pipeline is fixed, friction and minor losses at the maximum flow rate are fixed, therefore significant upgrades would be required to raise the HGL.
    * Operation of the energy recovery turbine at Neroly would be significantly impacted.
  - The system must be designed to handle pipeline startup and flushing, as well as overflow from the Randall Bold WTP, which currently discharges to the Rock Slough portion of the Main Canal. Facilities to drain the new pipeline should also be included.
  - The volume of the equalization/terminal reservoirs needs to be evaluated to ensure sufficient operating capacity. The design should account for two reservoirs to accommodate maintenance while maintaining service. For the equalization basin at Neroly, the use of the existing 1.7 MG of volume within the box culvert should be maximized. Some of the volume is required to convey the

untreated water through the box culvert but a portion may be able to be used for equalization.

- Untreated water service to customers should be developed in more detail. A list of customers and options to serve each should be prepared. On a case-by-case basis, untreated water customers could be served by either a gravity or pressurized supply. Customers who would benefit from a pressurized, higher energy service, could be billed with an alternate rate structure that accounts for the cost of providing the higher pressure service.
  - The hydraulics and capacity of the existing services must be reviewed. Standard details for the customer laterals should be developed. Since all untreated water customers are unique, site specific designs are likely required for each customer. Solutions during construction of the Main Canal (particularly when customers are bypassed) will also be required.

- Bypassing the Main Canal during construction may be the most challenging component of this project. As the Main Canal is the District's primary method of transferring untreated water from Eastern Contra Costa County to Central Contra Costa County, construction sequencing and bypassing is one of the key drivers for this project. The construction sequencing and bypass requirements drive the project costs, schedule, and design. A conceptual scheme was presented in TM No. 2 for bypassing the canal with portable pumps and HDPE pipe in segments. The construction plan should be flushed out in the next phase of the project.
  - The District may not be allowed to close any roads, even less traveled local roads during construction. If this is the case, the bypass pipe will need to be tunneled under roads and construction costs of the project will increase significantly. During the next phase of the study, the ability of the District to shutdown local roads temporarily during construction should be investigated.
  - An assessment of backup/emergency untreated water and treated water alternatives during construction should be performed. For example, it may be possible to rent Mokelumne Aqueduct #3 to offset untreated water demands in lieu of, or in addition to, bypass pumping.
  - The need for rehabilitation of Mallard Pipeline should be evaluated. The Mallard Slough Pump Station and Pipeline could provide temporary flows or other benefits during construction. In addition, the new pipeline will need to be connected to the Mallard Slough Pump Station discharge pipeline. The existing pumps at Mallard Slough may need to be upgraded to pump into the new pressurized pipeline.
  - In addition, the existing interties between the Main Canal and the Multi-Purpose Pipeline (MPP) should be reconnected to the new pipeline. The interties may need to be upgraded and valves installed within new valve vaults.

- Design options and issues for each canal crossing (with specific emphasis on bypass piping requirements) should be developed. The issues should include a summary of the jurisdictional/stakeholder coordination requirements for each crossing.

- Constructability reviews should be performed as part of preliminary and final design, particularly related to bypass pumping. Contractor peer review and value engineering should be included.

- Potential utility conflicts and/or coordination requirements (i.e., gas lines, electric utilities, cable/communications, etc.) need to be investigated in detail. In addition, WAPA coordination and power delivery requirements will be required.

- Additional engineering is required to further refine the costs for the Main Canal and the other projects. Further investigation is required in the following areas:
  - Geotechnical.
  - Tunneling.
  - Stormwater connection fees and mitigation measures (if required).
  - Construction sequencing/bypassing (as discussed above).
  - Welded steel pipe costs (as pipe costs can be highly variable).

- Options for alternative pipe routing through/around the Concord Naval Weapons Station (CNWS) to avoid potential lengthy coordination related to storm water re-routing should be explored.

- The advantages and disadvantages of the District owning the Canal Right -of-Way (rather than USBR) should be evaluated. Possible disadvantages include a possible electrical rate increase if the District acquires ownership of the facilities.

- The extent of mitigation for wetlands elimination should be determined. Future cost estimates should include a separate line item for mitigation requirements. While mitigation requirements for wetlands elimination or other elements are not likely to be significant, costs for mitigation should be identified as single line item as opposed to inclusion in the design contingency.

- The Neroly PS would be constructed to accommodate all nine pumps (low and high capacity pumps), but only the low capacity pumps (mechanical and electrical) could be constructed with the original pump station. This would allow the District to reduce upfront costs and provide flexibility to easily meet future demands.

Rock Slough System

- The firm and total flowrates for the Rock Slough system, and future Rock Slough Pump Station, should be confirmed. As part of the upcoming Future Water Supply Study (FWSS), the District will evaluate whether the capacity of the Rock Slough

system can be reduced. This would reduce the costs of the new pumping plant and pipeline.

  - A Rock Slough system capacity of 350 cfs is consistent with the existing District planning documents and was the basis for sizing the Canal Replacement project for the unlined portion of the Canal. Some redundancy is necessary to provide sufficient capacity for filling LV at the maximum rate of 200 cfs without impacting the ability to meet Canal demands. For example, if the 250 cfs Old River Pump Station is used to fill LV at 200 cfs, it would only have 50 cfs available to meet Canal demands. If Canal demands were higher than 50 cfs (which they regularly are), the difference would need to be met with Rock Slough and/or using a portion of Middle River Pump Station capacity (up to the allowable 320 cfs total diversion from Delta at the Middle and Old River intakes).
  - Optimizing/reducing the capacity of the upgraded Rock Slough system would allow the District to maximize the use of the newer facilities that make up the Los Vaqueros system. However, the Rock Slough system has several advantages over the Los Vaqueros system that need to be incorporated into the analysis. These include certain restrictions (OMR) on diversions for the Middle River and Old River Pump Stations due to environmental restrictions that do not apply to Rock Slough, and lower pumping costs for the Rock Slough System.

- Phased construction of the Rock Slough system upgrade should be considered. In the first phase, only a portion of the pumps and electrical gear would need to be installed. Additionally, it may be possible to phase the pipeline to reduce initial capital costs (e.g. by installing a smaller diameter pipe in the first phase and a second parallel pipe in the second phase).
  - A pipeline diameter optimization study should be performed to minimize construction costs and electricity costs.

- The pipeline design and cost estimates should be updated to incorporate the high groundwater table along the pipeline route. A geotechnical study is required to determine the groundwater table along the pipeline route. A discharge point for the groundwater should be indentified, as it is unlikely that it can be discharged to the canal and served to customers. It may be possible to discharge groundwater into the canal and deliver the groundwater to the Delta.
  - If the Rock Slough system can be shutdown for an extended period of time, the pipeline could be constructed in the centerline of the lined canal. This may reduce potential groundwater issues and reduce excavation costs.
  - The geotechnical study should include characterization of the groundwater quality, which will be required for the preparation and approval of a dewatering discharge permit.

- It may be desirable to leave the existing forebay for Pumping Plant No. 1 in place to reduce the potential for hydraulic transients in the suction pipeline and to maintain the environmental credit that is received by the District for the forebay. Additional analysis should be performed in the next phases of the project to determine if transients are an issue.

- The existing blending facility at the discharge of the Los Vaqueros flow control structure to the box culvert should be maintained to the maximum extent possible. In order to provide Randall Bold WTP with sufficient water quality, it is necessary to blend the two untreated water sources at this location. Therefore, the new Rock Slough pipeline should tie into the box culvert upstream of this location.

Loop Canal

- Several User Group and ECOM meetings took place focused on the Main Canal and the Rock Slough System. Additional meetings need to be scheduled to discuss the future of the Loop Canal, before proceeding with the next phase of the Loop Canal Renewal Project. These meeting should include discussion of the Shortcut Pipeline Redundancy Alternatives.

- In the event that Alternative 2 is selected as the preferred alternative, a treated water distribution system capacity study should be preformed to verify that the existing system is capable of accommodating the existing untreated water customers.

- If an untreated water pipeline alternative is selected, a surge analysis should be performed to verify that measures to mitigate hydraulic transients are not required.

- Discussions should be determine CCCSD's schedule for addition of nitrification and determine if there is interest in providing recycled water to customers via a Loop pipeline.

- For the Shortcut Pipeline Redundancy Alternative B, TOSCO and CCCSD should be approached to determine if acquiring an easement for a pipeline across their properties is feasible. In addition, the preferred pipeline route should be confirmed. To the maximum extent possible, the pipeline should avoid environmentally sensitive areas.

- For Shortcut Pipeline Redundancy Alternative A, the condition of unused recycled water distribution system should be investigated.

- For all Shortcut Pipeline Redundancy alternatives, the District's treated water production and distribution system should be modeled to confirm that it is capable of supplying treated water to the City of Martinez if the Shortcut Pipeline is offline.

Main and Loop Canal Drainage Studies

- While the stormwater connections are likely viable, particularly for the Main Canal, the amount of coordination and permits needed for this effort may be on the critical path. Over a dozen entities will be involved with this work and significant District staff time will be required for coordination. Significant engineering time will also be required to model the existing manmade and natural drainage systems, develop solutions, and design improvements to allow the canal to pipeline projects to proceed. Accordingly, coordination with the CNWS and the other affected entities, as well as the stormwater modeling and facility engineering should be started in the next phase of these projects.

- The coordination with the affected entities and the additional stormwater engineering will serve to better define the stormwater routing requirements and alternatives to gain better confidence in cost and/or schedule risk to project.

- The Main Canal serves as emergency conveyance facility for the Contra Loma Reservoir discharge to the Los Medanos Wasteway. This operation is not related to spillway use, it is used for emergency lowering. The spillway has a separate water course under the canal if required. Any modifications to the Main Canal in this area need to preserve the conveyance capacity for emergency discharges to the Los Medanos Wasteway.

- Near the Navy base, it may be possible to route the proposed new pipeline further to the north, parallel to the MPP. This would allow the canal to be maintained as a stormwater conveyance facility and discharge to Mallard reservoir. This configuration would be beneficial because it would avoid the need for construction of detention basins on CNWS property, if the existing drainage paths are not capable of conveying additional stormwater.

PROJECT PHASING AND IMPLEMENTATION PLAN

A proposed implementation schedule was developed for the Main Canal Project, which is likely to be the first of the three projects implemented by the District. Figure ES.6, depicts the proposed timing of the project, including preliminary design, environmental documentation, final design and construction. The schedule is preliminary and should be adjusted at regular intervals to account for available funding, resources, and District priorities.

Table ES.2 includes a cashflow for the Main Canal Renewal Project, including the Main Canal Stormwater Drainage Facilities. In the cashflow, the professional services are not escalated but the construction costs are escalated to the midpoint of construction. Figure ES.7 is a graphical depiction of the project cashflow, from preconstruction through commissioning. Figure ES.8 is a graphical depiction of just the preconstruction cashflow.

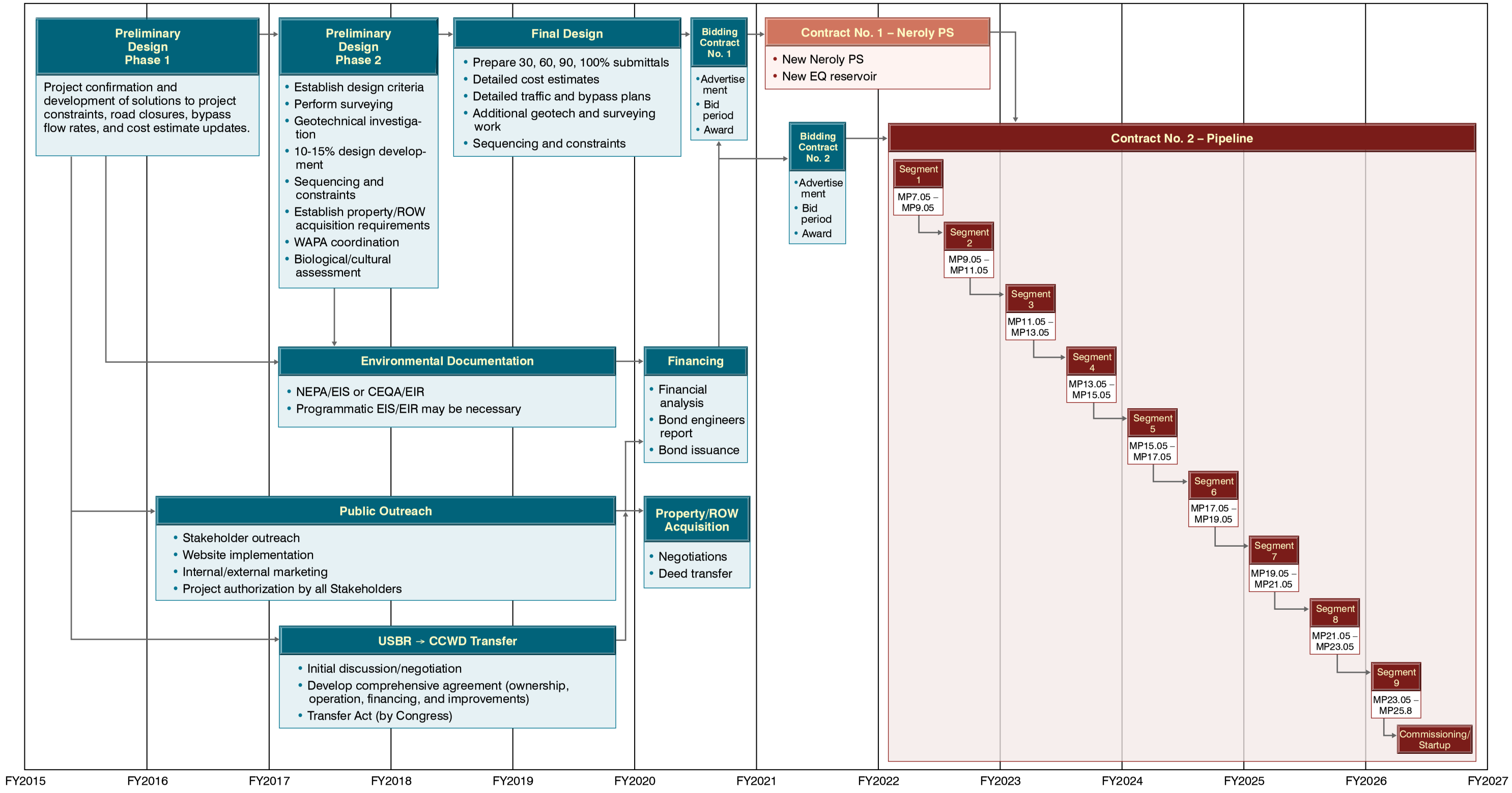

Figure ES-6
MAIN CANAL TO PIPELINE PROJECT IMPLEMENTATION PLAN
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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Table ES.2 Main Canal to Pipeline Project - Estimated Cash Flow
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Fiscal Year	Engineering Services	EIS-EIR	Public Outreach	Construction Management	Construction Contract No. 1 (CC1)	Construction Contract No. 2 (CC2)	Change Orders	Total Annual Expenditures	Total Cumulative Expenditures
2015	$188,000 Predesign Ph1							$188,000	$188,000
2016	$164,000 Predesign Ph1		$50,000 Initial Outreach					$214,000	$402,000
2017	$2,500,000 Predesign Ph2. Inc. 15% Dwgs, Surveying, Geotech Borings/Testings	$1,700,000 Initial Assessment, Env. Assessments, Notice of Intent	$200,000 EIR support					$4,400,000	$4,802,000
2018	$2,700,000 Complete Predesign/ Begin Final Design (CC1)	$1,700,000 Draft EIS/EIR	$200,000 EIR support					$4,600,000	$9,402,000
2019	$4,000,000 Final Design (CC1 & CC2)	$1,274,000 Final EIS/EIR	$150,000 EIR support					$5,424,000	$14,826,000
2020	$8,000,000 Final Design (CC1 & CC2)	$0	$150,000 Design Support					$8,150,000	$22,976,000
2021	$4,000,000 Final Design (CC2)	$0	$150,000 Design Support					$4,150,000	$27,126,000
2022	$2,400,000 DSDC (CC1)	$150,000 Bio. Monitoring	$150,000 Const. Outreach (CC1)	$3,600,000 CC1	$27,080,000			$33,380,000	$60,506,000
2023	$3,000,000 DSDC (CC1 & CC2)	$130,000 Bio. Monitoring	$150,000 Const. Outreach (CC1 &CC2)	$4,000,000 CC1 & CC2	$13,540,000	$58,305,000	$4,150,000	$83,275,000	$143,781,000
2024	$1,000,000 DSDC (CC2)	$130,000 Bio. Monitoring	$150,000 Const. Outreach (CC2)	$2,500,000 CC2		$58,305,000	$2,310,000	$64,395,000	$208,176,000
2025	$1,000,000 DSDC (CC2)	$130,000 Bio. Monitoring	$150,000 Const. Outreach (CC2)	$2,500,000 CC2		$58,305,000	$2,310,000	$64,395,000	$272,571,000
2026	$1,000,000 DSDC (CC2)	$130,000 Bio. Monitoring	$150,000 Const. Outreach (CC2)	$2,500,000 CC2		$62,230,000	$2,310,000	$68,320,000	$340,891,000
2027	$1,000,000 DSDC (CC2)	$130,000 Bio. Monitoring	$150,000 Const. Outreach (CC2)	$2,500,000 CC2		$34,550,000	$2,310,000	$40,640,000	$381,531,000
Subtotals	$30,952,000	$5,474,000	$1,800,000	$17,600,000	$40,620,000	$271,695,000	$13,390,000		

Notes:
(1) Based on cost estimates contained in draft Technical Memorandum No. 2 - Main Canal Renewal Alternatives and Technical Memorandum No. 3 - Main Canal Drainage Alternatives (Carollo 2014).

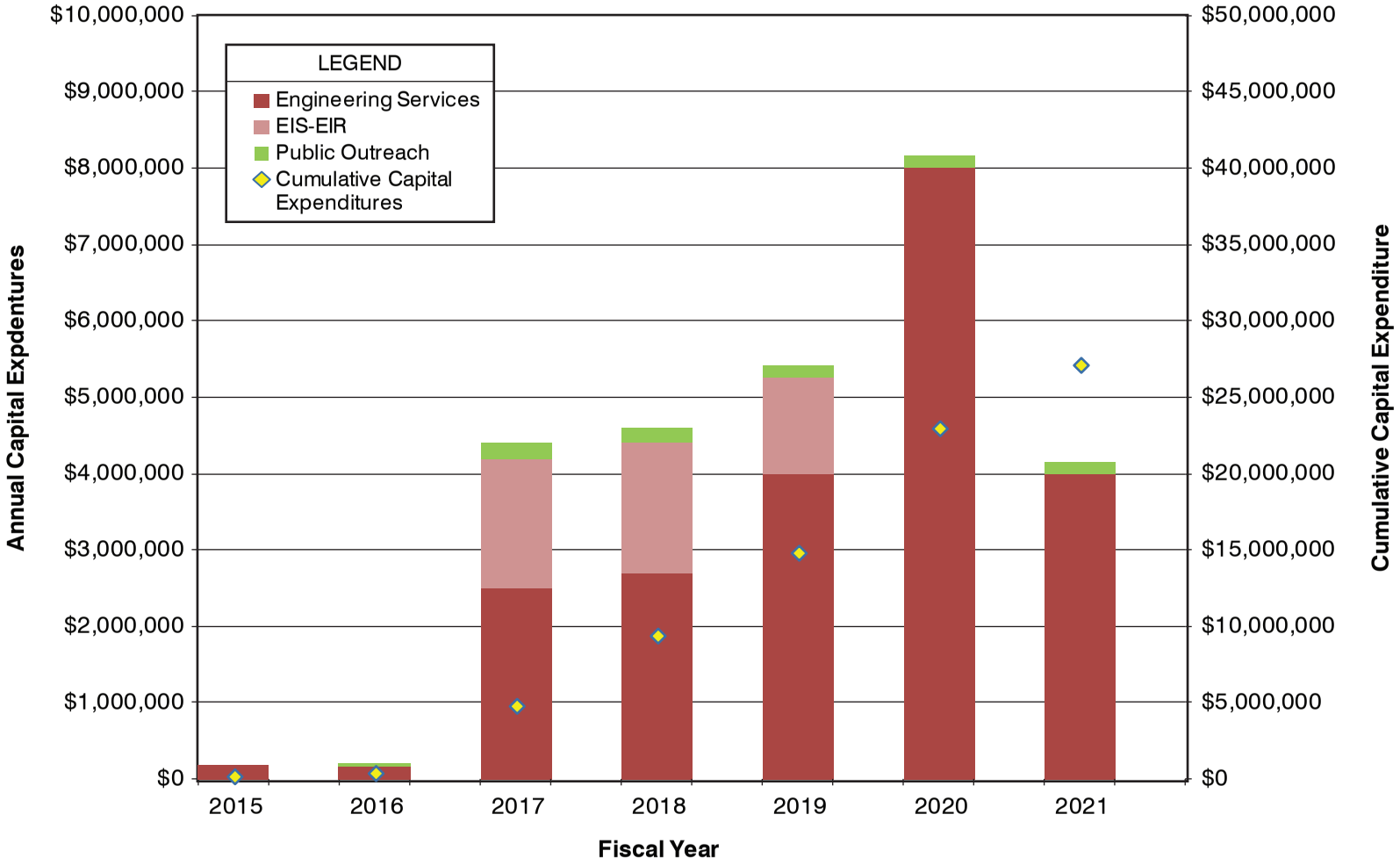

Figure ES-7
MAIN CANAL RENEWAL PROJECT:
PRE-CONSTRUCTION CASH FLOW
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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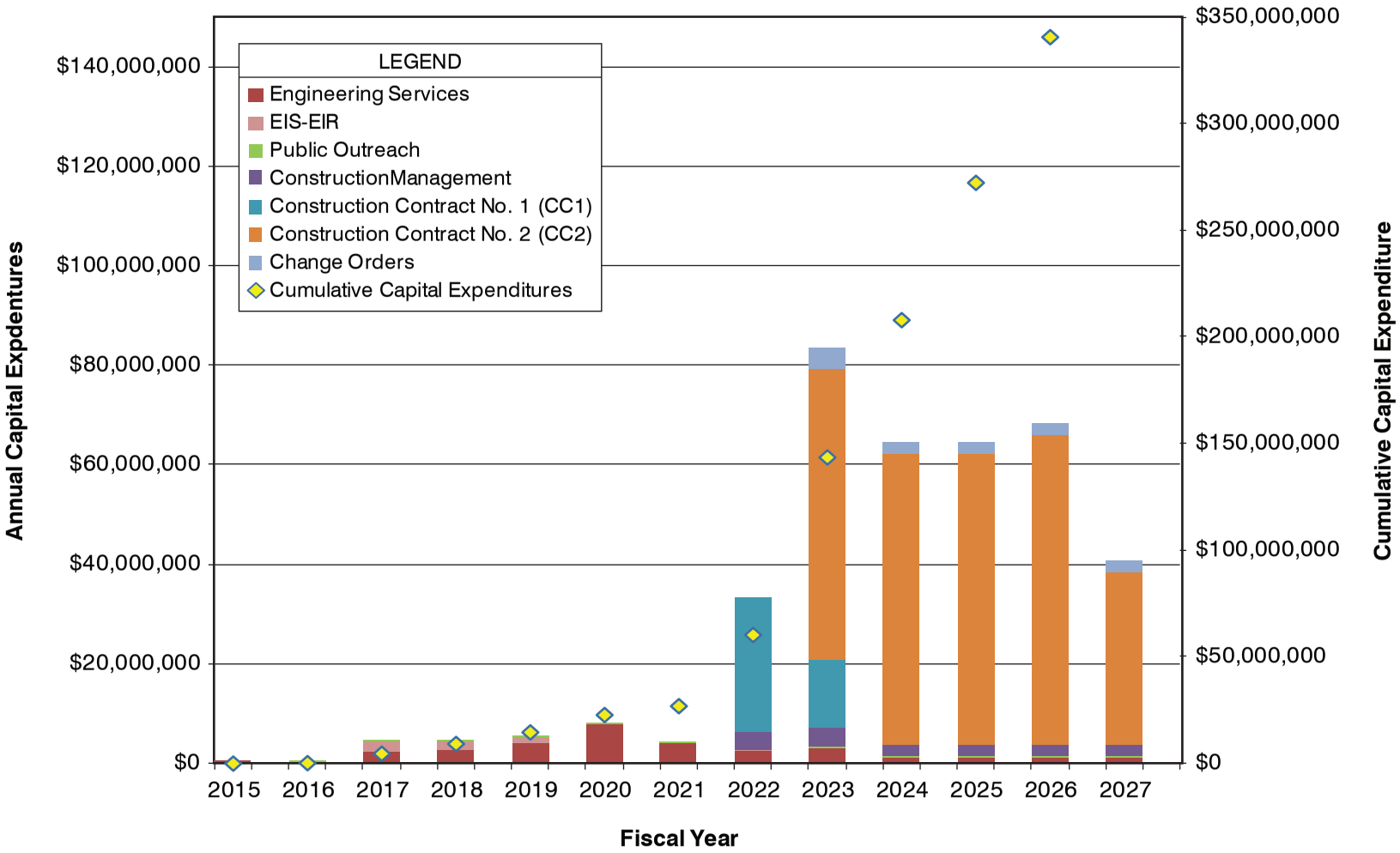

Figure ES-8
MAIN CANAL RENEWAL PROJECT:
ESTIMATED CASH FLOW
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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A project cashflow was developed based on the project cost estimate presented in the Main Canal Renewal Alternatives memorandum (TM No. 2) and the Main Canal Drainage Studies TM No. 3). For both projects, the total $335.9 M project cost estimate included a 20 percent contingency of design, legal, and administrative fees equaling $53.7 M. For the cashflow projection, the 20 percent contingency was divided into the following components, based on industry standards for projects of this size and scale:

- Preliminary Design 1.5% ($4.0 M).
- Environmental Documentation 1.0% ($2.7 M).
- Final Design 6.5% ($17.5 M).
- Design Services During Construction 3.5% ($9.4 M).
- Biological Monitoring 0.3% ($0.8 M).
- Construction Management 6.5% ($17.5 M).
- Public Outreach 0.7% (1.9 M).

These percentages were based on our understanding of project requirements, and comparison of costs from other projects of similar scale and complexity. For example, for the final design expenditures we considered the breadth and scope for the pipeline design, crossings, pump station design, traffic and utility coordination, storm water design , untreated water service design, etc. For the outreach and environmental support elements we solicited input from Data Instincts and ESA, respectively.

The cash flow was based on the following assumptions:

- The preliminary engineering and final design efforts were subdivided into discrete amounts over the next seven fiscal years. For the first two years of this seven year engineering effort, we have assumed that the predesign budget would match the funding available in the District's current budget (as defined in the recently advertised RFQ).
- The environmental documentation effort would start in earnest FY 2017. The environmental documentation work would continue through FY 2018 and wrap up in FY 2019.
- In FY 2017, predesign efforts would accelerate and include a full geotechnical investigation and topographic survey.
- In FY 2018, the predesign effort would end, and transition to final design. Final design would start on the Neroly Pump Station and reservoir (Construction Contract No. 1)

and then ramp up over the following three years to include the pipeline and stormwater facilities (Construction Contract No. 2).

- Throughout this planning and design effort, public outreach activities would take place to support the environmental and design process.

Public Outreach Approach

Significant infrastructure projects, such as the proposed Canal Renewal projects, require a well-defined purpose and need, sound engineering, and a thoughtful, yet robust public outreach effort, all carried out in close coordination. Board members, engineers, planners, and communications staff must work together from the same playbook in order to create internal and external support for a project. Accordingly, a preliminary, near term public outreach approach has been prepared for the Main Canal Renewal Project. The public outreach approach provides the District with a logical plan to successfully implement the Main Canal Renewal Project with community input and backing.

Defining the Project's Purpose and Need

Clearly defining the purpose and need for the Canal Replacement Project is critical to developing and delivering effective messages — both internally and externally — that can build support for the project. The UFWIP Update provides reasons that the pipeline alternative was identified as the most viable alternative, and provides a solid foundation for defining the purpose and need for the project. Some of the key elements necessary to develop key messages are listed below:

- The District's mission is to provide a reliable supply of high quality water.
- Canal replacement is key to providing reliable and safe water service.
- The Main Canal is 70 years old and nearing the end of its useful life and has become expensive to maintain and rehabilitate.
- Pipeline conveyance protects water quality (no chemical treatment for vegetation), and eliminates safety hazards and risks from an open canal.
- Reduced water losses from seepage, evaporation and illegal connections.
- Improved seismic safety of distribution system.

Near Term Plan for Engineering and Outreach Efforts

In this section, the overall implementation plan has been expanded to provide additional detail on the near term engineering and outreach efforts. Figure ES.9 shows the engineering and outreach efforts during the next two to three years of the project (the timeline can be extended if funding is not available immediately). These efforts will be

coordinated with each other to keep the board, staff and members of the public informed and involved during the process. The main emphasis is on defining and communicating the purpose and need for the project, and delineating the steps to effectively carry out the engineering and communications needed for a successful project.

The green shaded boxes in Figure ES.9 show the initial engineering effort in FY 2015. The engineering would begin with project confirmation, followed by a more detailed engineering analysis of the outstanding issues, as defined in the previous sections.

The gold shaded boxes show the internal and external outreach effort in FY 2015. The effort begins with a briefing of the District's Board of Directors and initial outreach to the public. A key element in the outreach effort is to keep elected officials up-to-date on the project during each step in the process. Subsequent outreach steps include informational meetings to gather input from Board members, affected agencies and special interest groups. These sessions, referred to as in-depth or one-on-one interviews, would also include members of the public and potential stakeholders.

Using the information gathered from interviews, key messages will be developed and outreach materials prepared. Additional information-gathering meetings with key agencies and special interest groups will further refine messages and update the outreach plan accordingly. Focus groups of community members will be used to test the messages and outreach materials. A dedicated web page, or suite of pages, will be placed on the District website to help introduce and keep the public informed as the project unfolds.

During FY 2016, the engineering effort would focus on preliminary project design, construction sequencing and updated cost estimates. Outreach efforts at this time will include continuing to interface with key affected agencies and special interest groups, coordination with permitting agencies. In addition, several informational Open House events will be conducted to inform and gather public input. This period will include continual briefings of the District Board on all aspects of the project and may also include an initial scoping meeting as part of the CEQA/NEPA process.

Figure ES.9 shows the engineering and outreach efforts during the next two to three years of the project (the timeline can be extended if funding is not available immediately).

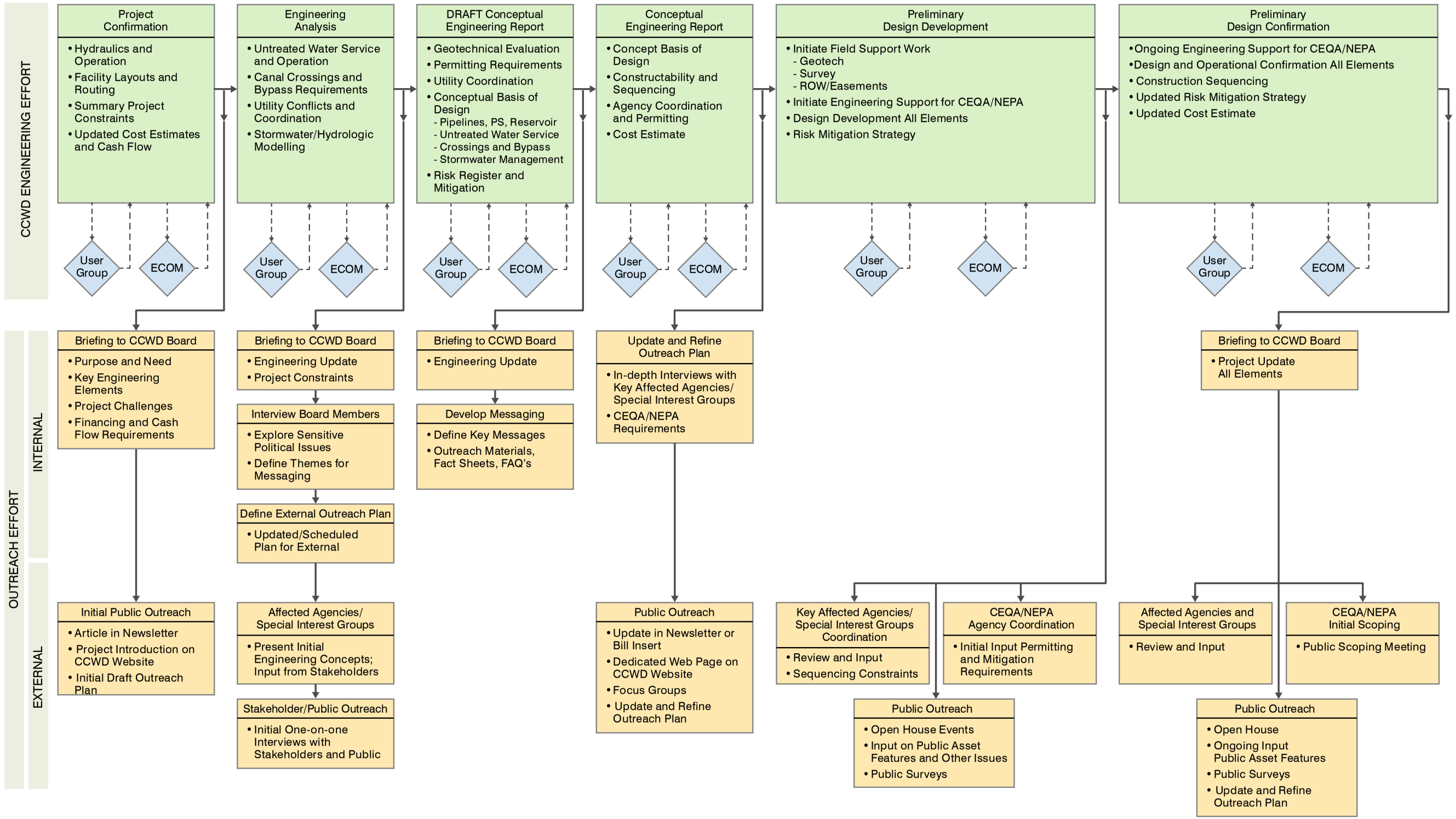

Figure ES-9
CANAL TO PIPELINE INITIAL PHASE
ENGINEERING AND OUTREACH IMPLEMENTATION PLAN
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Ken Wilkins and Todd Yamello		
Subject:	Rock Slough Pumping Plants and Canal Renewal Alternatives TM No. 1		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

The Rock Slough Pumping Plants and Canal lift untreated water from sea level up to the Main Canal where the water flows by gravity to customers and District facilities in eastern and central Contra Costa County. The Rock Slough Pumping Plants and Canal have been operational for more than 70 years and are approaching the end of their useful lives as water conveyance facilities.

The 2013 Update of the Untreated Water Facilities Improvement Program (UWFIP) presented an assessment of the upgrade and replacement alternatives for the Rock Slough Pumping Plants and Canal. The assessment concluded that the replacement of the pumping plants and canal with a single high lift pump station and a new pipeline was the most viable conveyance renewal alternative. This conclusion was based on consideration of cost, safety, operational reliability, water quality, and risk minimization.

PURPOSE

This memorandum presents refinements to the Rock Slough Pumping Plants and Canal upgrade and replacement alternatives presented in the 2013 UWFIP update.

DESCRIPTION OF EXISTING INFRASTRUCTURE

The Rock Slough Conveyance System, or the portion of the Main Canal from MP 0.00 to MP 7.05, consists of a fish screening facility, a headworks structure, four pumping plants, a canal, and a flood control structure near the fish screening facility. Untreated water from the California Delta is screened at Rock Slough Fish Screen facility. The screened, untreated water then flows by gravity through 3.2 miles of unlined canal prior to entering a 0.4-mile long, 10-foot diameter reinforced concrete pipe. The reinforced concrete pipe, constructed in 2010, conveys the untreated water to the forebay of Pumping Plant No. 1. A second one-mile segment will be constructed in 2014/2015. Additional pipe will be installed to fully encase the unlined canal segment when funding is available.

After passing through the piped portion of the canal, a series of four pumping plants lift the untreated water in stages from sea level to an elevation of 124 ft. The pump stations are connected by a concrete lined canal with a total length of 3.6 miles. The last pumping plant in the system, Pumping Plant No. 4, discharges to the Main Canal near milepost 7.05.

The Rock Slough Canal is not required to convey untreated water if untreated water is delivered from Los Vaqueros Reservoir, Old River Pump Station, and/or Middle River Pump Station. However, the Rock Slough Canal is required to convey untreated water to the City of Brentwood Water Treatment Plant and when the District is filling Los Vaqueros Reservoir. In addition, due to environmental related pumping restrictions and energy costs, supplying untreated water via Rock Slough is often preferable to supplying water from the Los Vaqueros System.

The Rock Slough Pumping Plants and Canal require significant investments of manpower and capital to meet the District's supply needs and operational/reliability objectives. The infrastructure is nearing the end of its useful life, and the annual costs to maintain service will continue to increase in the future. This is particularly true of the four pumping plants, each of which will require mechanical, structural, and electrical system upgrades in the next 5 to 10 years.

BACKGROUND ON THE CONTRA COSTA CANAL REPLACEMENT PROJECT

The District is currently in the process of replacing the portion of the Rock Slough Canal between the Fish Screen Facility and Pumping Plant No. 1 (PP1). Phase 1, which included replacement of approximately 0.4 miles of canal immediately upstream of PP1, is complete. Phase 2 is in construction and will expand the pipeline one mile to the east. In addition, a flood isolation structure will be installed downstream of the existing headworks structure. Phases 3, 4, and 5 are in design. In the future, because the friction losses will be greater in the pipeline than through the existing canal, the water elevation in the forebay of PP1 will be lower than PP1's design water surface elevation. The lower water surface elevation will adversely affect PP1. Once the canal upstream of PP1 is fully encased, it will not be possible to modify PP1 sufficiently to accommodate the lower water surface elevation. Therefore, PP1 must ultimately be replaced by a new pumping plant. Accordingly, in 2011 Brown and Caldwell prepared a technical memorandum (2011 PP1 Memo) that presented an initial design development analysis of a replacement pump station for PP1.

This memorandum incorporates many of the pump station design criteria and assumptions included in the 2011 PP1 Memo. Exceptions, refinements, and alternatives to the design criteria and assumptions presented in the 2011 PP1 Memo are noted in the following sections.

LOCATION OF ROCK SLOUGH PUMPING PLANTS AND CANAL

The location of the four existing pumping plants and concrete lined canal, which are the topic of this memorandum, are shown in Figure 1. Figure 1 also shows the location of canal siphons and vehicle/utility bridges over this section of the canal. Lastly, the figure shows a potential location for the new Rock Slough Pumping Plant and one potential pipeline route. The new Pumping Plant and pipeline would replace the four existing pumping plants and the concrete lined canal. The conceptual design for the new pumping plant and pipeline are discussed in the following sections.

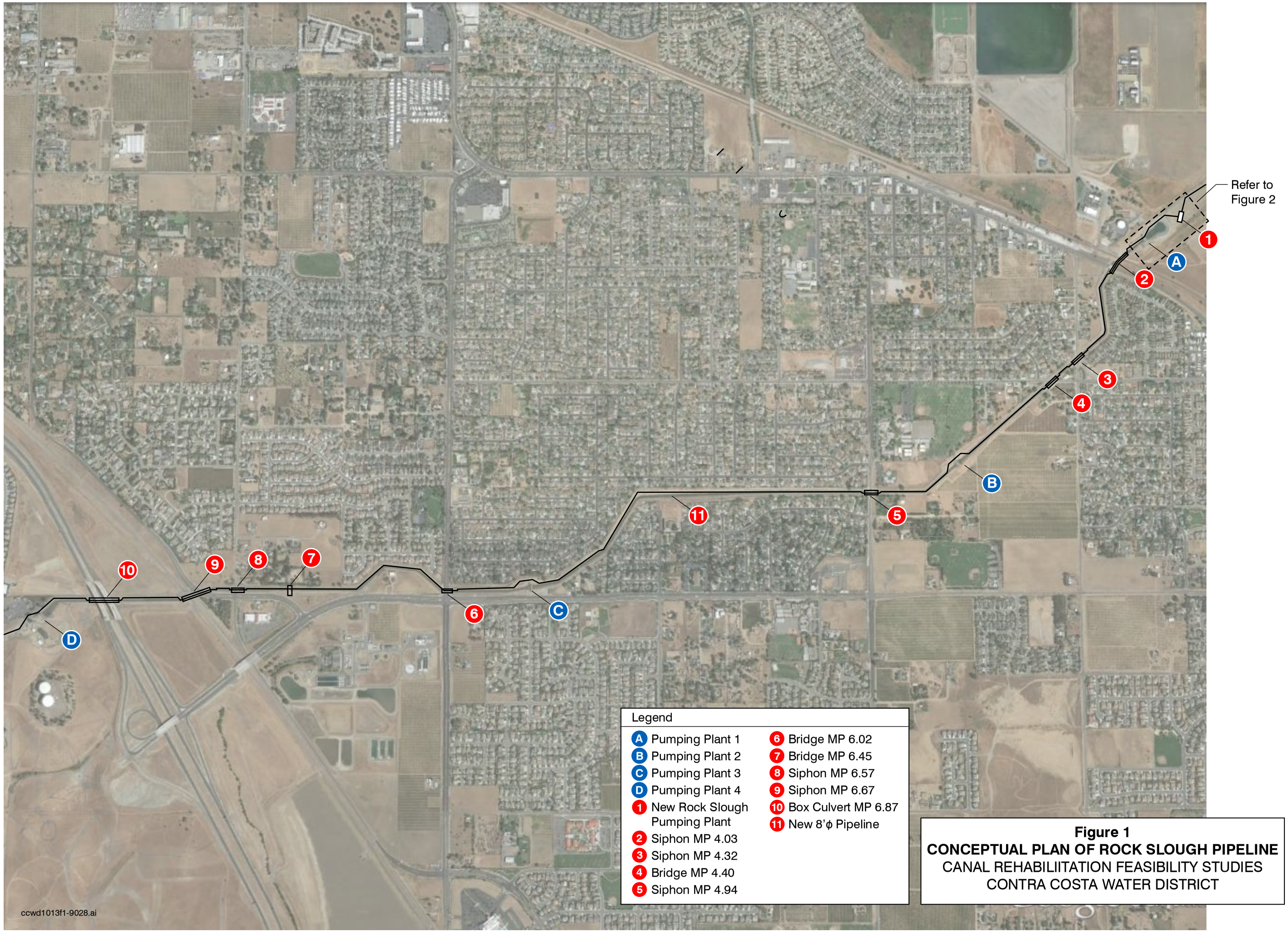

Figure 1
CONCEPTUAL PLAN OF ROCK SLOUGH PIPELINE
CANAL REHABILIITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

REQUIRED CAPACITY FOR ROCK SLOUGH PUMPING PLANT AND CANAL

In 2050, the required capacity of Rock Slough system is 350 cfs. This is based on the 2002 Future Water Supply Study's (FWSS) demand projections and assumes 73 cfs of the demand will be met through existing storage. This is also consistent with the design capacities presented in the 2011 PP1 Memo.

Per the 2011 PP1 Memo, the total and firm capacity of the new PP1 will be 380 and 300 cfs, respectively. This combination of four 80 cfs and two 30 cfs pumps allows for a broad range of pumping plant flowrates at efficient operating points on the pump curves.

The pump suction water surface levels are identical to those presented in the 2011 PP1 Memo, as no significant modifications are proposed to the reinforced concrete pipeline. The high and low water surface elevation at PP1 are +8.9 and -8.4 respectively. Because the purpose of this study is to further evaluate the potential to replace the concrete lined portion of the canal with a pipeline, the pump discharge static elevation was assumed to be 124 ft, or the water level in the Main Canal just downstream of PP4 at Neroly Blending Station. In addition, an allowance of 6 ft (for a total static water elevation of 130 ft) was added to the worst-case system curve to allow for the addition of an equalization reservoir near the Neroly Blending Station. The 3 million gallon (MG) equalization basin would have a sidewater depth of approximately 20 feet but most of the depth would be below the discharge point of the new pipeline. An equalization reservoir may be required if the Main Canal, from Neroly to the Shortcut pipeline, is converted to a pipeline. Refer to the Technical Memorandum No. 2, Main Canal Renewal Alternatives, for additional information on the equalization reservoir.

Pump Station Configuration and Location

The 2011 PP1 Memo described a variety of pump station configurations. The single wet well, trench-style pump station that is presented in the report is conservatively designed and appears to be the most cost effective configuration. Accordingly, the trench-style pump station is carried through intact to this study. The dimensions, including the length, width, and depth of the wet well, as presented in the 2011 PP1 Memo remain unchanged. Other than the pump station location, the only major changes to the pump station configuration are that the two wet well alternative was dismissed from further study because the new Rock Slough Pumping Plant will be discharging to a single, 3.4-mile long pipeline. The reason for this is that the advantages of redundant wet wells and discharge pipelines will no longer be present with a single, discharge pipeline in series with the new Rock Slough Pumping Plant. In addition, it is likely that a new surge vessel would be required. This surge vessel could be located to the east of the proposed pump station.

The 2011 PP1 Memo placed the location of the new Rock Slough Pump Station near the center of the existing PP1 forebay, as shown in Figure 2. If located in the forebay, the estimated 18-month construction period for the new pump station may necessitate year-round bypass pumping with a flowrate up to 180-cfs during the peak summer demand period. However, bypass demands will depend on water supply conditions at the time of construction and may not be necessary as the Los Vaqueros system may be able to be used to offset these demands.

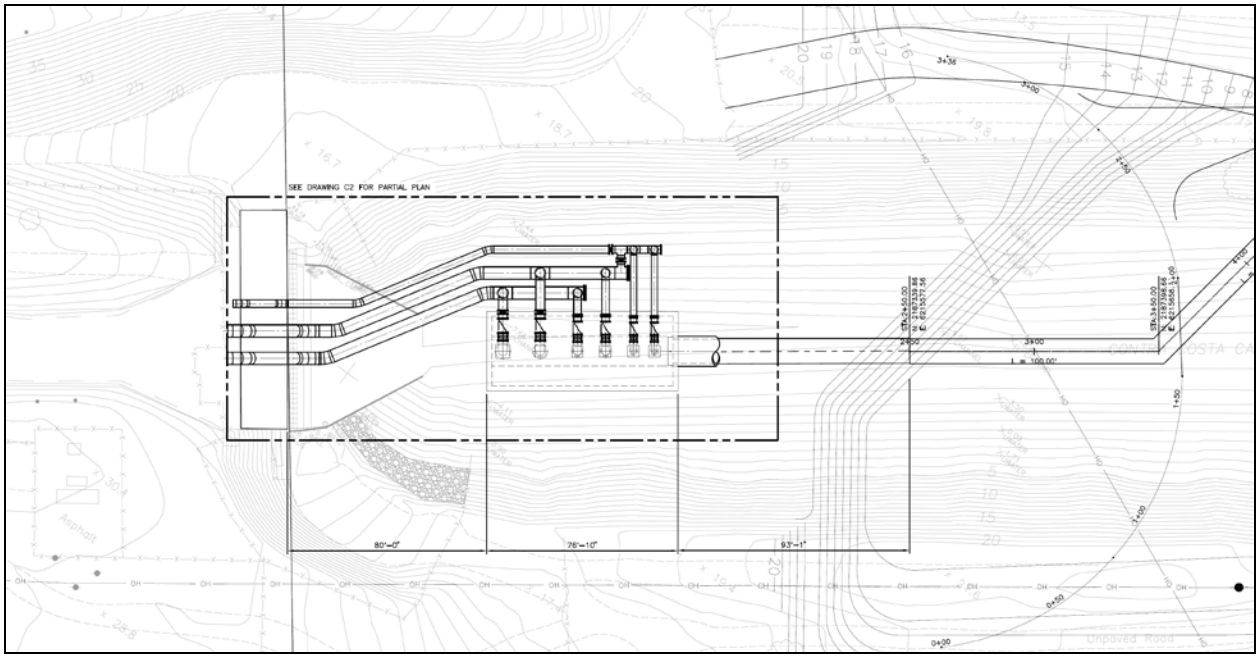

Figure 2 – New Rock Slough PP1 in Center of PP1 Forebay as proposed in 2011 PP1 Memo (B&C)

To avoid the long-term bypass, if necessary, an alternate pump station location was developed for this study. This alternative location is shown in Figure 3.

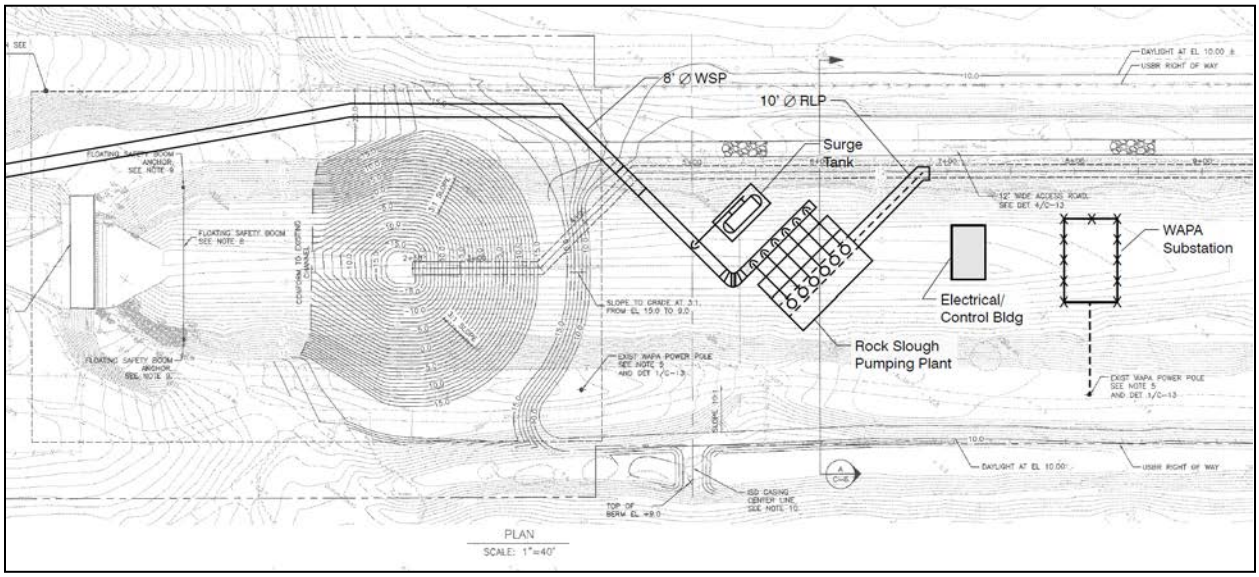

Figure 3 – Alternate Location for Rock Slough Pumping Plant No. 1

The alternative location differs from the location in the 2011 PP1 memo in several key respects:

- The pump station is located within the footprint of an abandoned portion of the existing earthen lined canal instead of in the existing forebay.

- A new WAPA substation is provided because of the increased electrical demands due to the higher required lift (the new Rock Slough Pumping Plant will be providing all the lift currently provided by PP1, PP2, PP3, and PP4).
- Because a new substation is required and due to the 600 ft distance between the new pumping plant and PP1, a new electrical building is provided (long distances between VFDs and pump motors can cause severe problems with the conductors and pump motors).
- A hydropneumatic surge vessel is included in the layout. While a surge analysis is not within the scope of work for this study, it is likely that the 3.4-mile pipeline and the relatively high static head will require the installation of a surge vessel to prevent damage from hydraulic transients after an electrical failure.
- The discharge pipeline is routed around PP1 and adjacent to the existing canal instead of through PP1 as the new Rock Slough Pumping Plant will not discharge to the canal.

The advantages and disadvantages of the two potential locations are summarized in Table 1.

Table 1 Evaluation of Pumping Plant Locations
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Pumping Plant Location	Advantages	Disadvantages
Centered in PP1 Forebay (as shown in Figure 2)	• Does not require a new electrical building, as PP1 can be used to house the electrical gear. • Less shoring and excavation is required as existing forebay is already surrounded by a sheetpile wall. • Reduced shoring costs and reuse of PP1 to house electrical equipment (Savings = $1.6M in shoring and $0.4M for the electrical building)	• Requires at least 18-month shutdown of PP1. Under a worst case scenario, a year-round bypass with a maximum capacity of 180-cfs of capacity is required. However, this is unlikely is the Los Vaqueros system could likely be used to meet untreated water demands. • Risk of increased bypass costs if construction period lasts past 18-months into second peak pumping period. • Relies on 1940s-era building, which may or may not be seismically stable, to house critical electrical equipment. The building may not be suited to house the new electrical gear.
East of PP1 Forebay (as shown in Figure 3)	• Minimal bypass requirements as PP1 must only be shutdown during tie-in of new pump station to existing 10-ft diameter gravity pipeline from Fish Screen facility. • This results in a savings of $2M to $3M under a worst case bypass scenario. • Does not rely on 1940s era building to house electrical equipment.	• Approximately 400 linear feet of reinforced concrete pipeline must be abandoned in place.

Pump Station Hydraulics and Pump Selection

Regardless of the selected pump station location, the pump station discharge hydraulics will remain similar. System curves were produced for the single wet well, trench-style pump station. The system curves are shown on Figure 4. The system curves are based on the high and low tide elevations as well other key water surface elevations shown in Table 2. The pump curves for the selected pumps are also shown in Figure 4. The pump curves shown on the system curve are modified pump curves, which means that the actual design point is slightly higher than is shown on the figure. Figure 4 shows that the pumps, if equipped with VFDs, are capable of providing 20 to 380 cfs at all of anticipated operating points. The system curve design criteria are shown in Table 2. Table 3 includes information on the selected pumps.

Table 2 System Curve Design Criteria
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Design Criteria	Number	Comments
Hazen Williams C-factor	118	Based on field testing performed during the design of the Middle River Pump Station. This C-factor is conservative and needs to be updated during the preliminary design of the new pump station. The C-factor may be higher (less friction) due to the larger pipe diameter and polyurethane lining (instead of cement mortar lining).
Water Surface Elevation in new Wetwell	-8.4 to +8.9 ft	Per 2011 PP1 Memo
Water Surface Elevation at Discharge	+124 to +130 ft	The datum of the discharge water surface elevation needs to be cross-checked with the datum for the water surface elevation at PP1.
Pipeline Diameter	8 feet	Selected to minimize both construction costs and friction losses.
Firm Capacity	300 cfs at TDH of 140 to 163 ft	TDH = Total Design Head (Static + friction and minor losses)
Total Capacity	380 cfs at TDH of 153 to 177 ft	
Minimum Capacity	20 cfs at TDH of 115 to 138 ft	

Figure 4 - Rock Slough Pumping Plant - Pump and System Curves

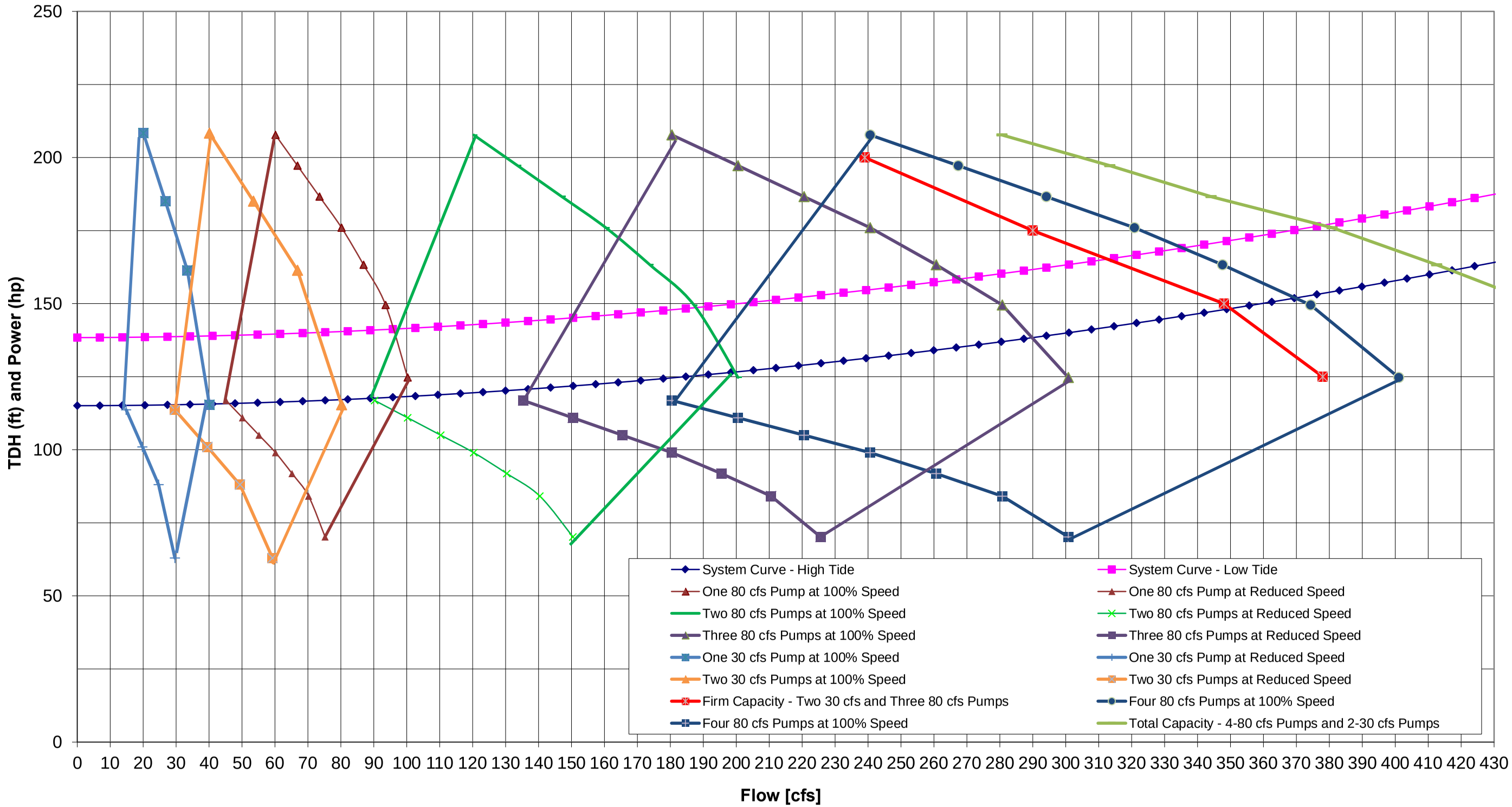

Table 3 Pump Design Criteria Canal Rehabilitation Feasibility Studies Contra Costa Water District		
Design Criteria	**Number**	**Comments**
Type	Vertical Turbine	There are a limited number of manufacturers that provide vertical turbine pumps that can provide an 80 cfs pump at this TDH. Fairbanks Morse is the dominant pump manufacturer in this size range.
Design Capacity	Four Pumps: 80 cfs @ 180 ft Two Pumps: 30 cfs @ 180 ft	
80 cfs Pump Model Number	Fairbanks 57H.2 (2-Stage)	33.25" impeller (34.5" max)
80 cfs Pump Motor Size	2000 hp	
80 cfs Pump Speed	580 rpm	
80 cfs Pump – Minimum Speed Required	435 rpm	75 percent of maximum speed
30 cfs Pump Model Number	Fairbanks 34H.2 (2-Stage)	21.5625" impeller (21.75" max)
30 cfs Pump Motor Size	800 hp	
30 cfs Pump Speed	880 rpm	
30 cfs Pump – Minimum Speed Required	650 rpm	74 percent of maximum speed
Power Draw	195 kW-hr/acre-foot	At 300 cfs, TDH of 150 ft, pump, motor, and VFD efficiency of 85%, 95%, and 95%, respectively.

Additional Pump Station Features

The pump station would include the following features:

- New WAPA substation, similar in size and configuration to the Middle River and Old River substations. The substation power demand would be slightly greater than the total power demand from the three existing WAPA substations for PP1-PP4.
- New Electrical Building, similar to the Middle River Electrical and Controls building without the water quality sampling and storage rooms.
- Ultrasonic flow meter with internally mounted transducers on the 96-inch pipeline, downstream of the new pumping plant (similar to Middle River).

Discharge Pipeline Alignment and General Characteristics

The new pumping plant will pump the untreated water into a new 8-foot diameter pipeline. The welded steel pipe (WSP) will be installed adjacent to the existing concrete lined canal within USBR property. Alternatively, the pipeline could be reinforced concrete cylinder pipe (RCCP) although RCCP is more expensive than WSP in these diameters. However, RCCP may be preferable in areas where the groundwater table is high and buoyancy is an issue.

Where the canal transitions to a siphon, the siphons will either be lined with welded steel pipe or the pipeline will be installed in a new tunnel parallel to the siphon. Similarly, where vehicle and utility bridges pass over the canal, the new pipeline will either be routed within the canal alignment or will be tunneled under, or trenched through, the roadways. The new pipeline will also be routed around the existing pumping plants to minimize downtime during construction. The proposed pipeline alignment is shown on Figure 1.

If the Rock Slough system can be shutdown for an extended period of time, the pipeline could be constructed in the existing canal, which would simplify construction and reduce risk to adjacent property owners.

The new pipeline will have the following advantages over the existing canal. The pipeline will:

- Significantly increase the reliability of the Districts untreated water conveyance system as the pipeline is not at risk to ground movement/slope instability.
- Increase the water quality; untreated water quality degradation from groundwater seepage, algae and nuisance weeds is eliminated.
- Eliminate risk to life safety from intentional or unintentional trespass.
- Significantly reduce water loss due to seepage and evaporation.
- Eliminate risk of contamination from unintended hazardous chemical spills or intentional sabotage.
- Potential to expand and improve public access recreational trails.

Discharge Pipeline Construction

The majority of the 8 ft diameter discharge pipeline can be constructed under or near the access road on the operations side of the canal. The operations side of the canal was selected because the operations side of the canal is slightly wider than the non-operations side of the canal. This allows more room for construction equipment and reduces the potential for construction impacts both to the existing canal and to the property owners that are located adjacent to the north side of the canal property line. The pipeline will be installed in a buried condition via an open trench or in an embankment condition. The two installation options and sizes relative to the existing canal property boundaries are shown in Figures 4 and 5.

Alternatively, if water supply conditions allow the canal to be shutdown for an extended period of time, the pipeline could be installed along the centerline of the existing lined canal.

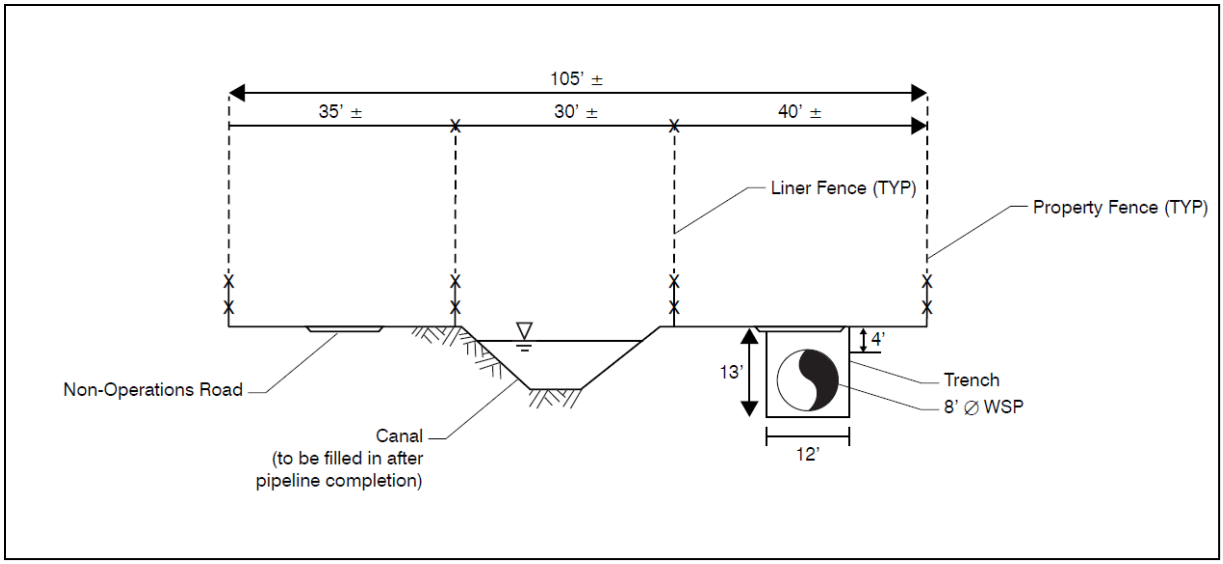

Figure 4 – Pipeline Installed in an Open Trench under the Operations Road

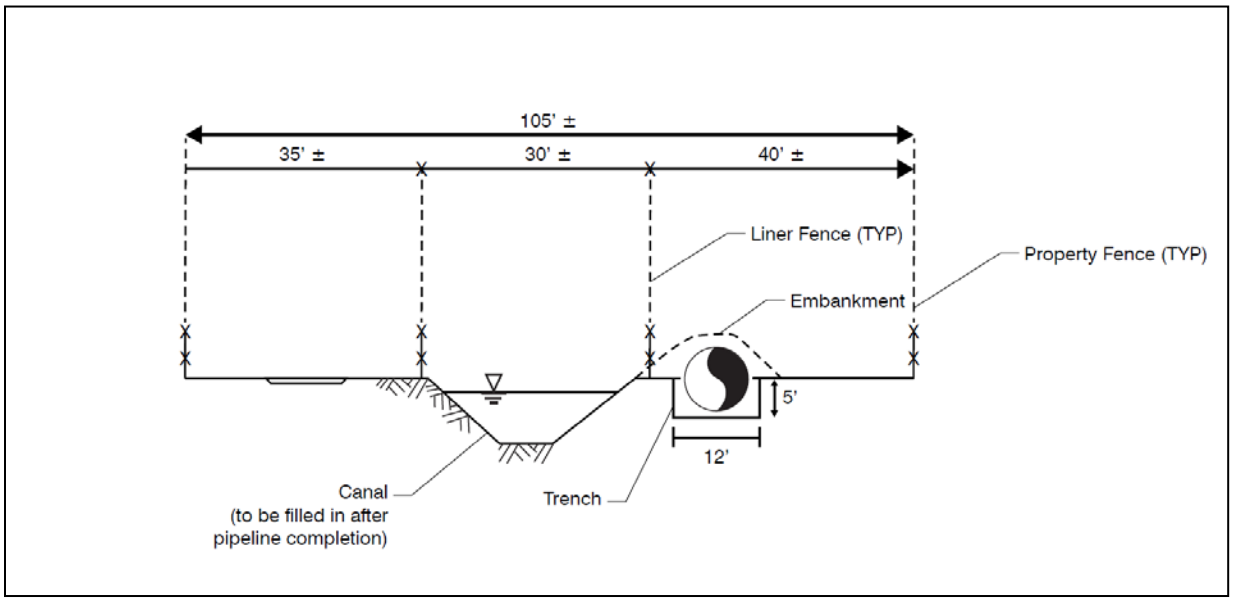

Figure 5 – Pipeline Installed in an Embankment on top of the Operations Road

Open Trench Construction

Open trench type construction is the most common type of pipeline construction. Open trench pipelines are typically constructed with a rectangular shaped trench section. A bedding material, such as sand or aggregate base rock, is placed in the bottom of the trench. After the pipeline is placed in the trench, aggregate base rock is backfilled and compacted around the pipeline in lifts up to the springline of the pipeline. Then native material is placed and compacted in lifts up to the existing grade line.

The use of native soil-cement controlled low strength material (CLSM) for backfill has modernized open trench pipeline construction. By using self-compacting native soil-cement CLSM for backfill, trenches can be constructed with circular bottoms instead of flat bottoms.

This improves the stability of the trench sidewalls and reduces the required quantity of the backfill material. The use of native soils in the CLSM mix also reduces the volume of spoils that must be disposed of. This construction technique was used by Ranger Pipelines during the construction of the 72-inch diameter pipeline across Victoria Island in 2010.

The biggest risk and cost factors in open trench construction are shoring and groundwater. Using CLSM for backfill helps to mitigate these factors because the circular trench reduces the need for shoring (e.g. shoring depth) and CLSM does not need to be installed in a dry trench to achieve 95 percent compaction.

Embankment Construction

A pipeline installed in an embankment is installed at, or just below, grade level. Backfill material and topsoil are then placed on top of the pipeline to provide lateral stability to the pipe wall and to protect the pipeline. A pipeline installed in an embankment condition may experience larger amounts of thermal expansion and contraction than a pipe buried in a trench; mitigation measures for the thermal expansion and contraction should be investigated during the preliminary design phase of the project. For the new Rock Slough pipeline, there is not a readily available supply of material that can be used to build the embankment. The cost for bringing in additional fill cancels out most of the savings from the reduced trench excavation.

Pipeline Construction Conclusion

For these reasons, open-trench construction appears to be the most viable option for this project. Accordingly, the cost estimate is based on conventional open-trench construction. During preliminary design, consideration should be given to allowing the use of CLSM for backfill. After a detailed geotechnical investigation has been performed during preliminary design, this recommendation should be re-evaluated if poor soil or high groundwater conditions are found along the pipeline alignment. In addition, a discharge location(s) for the dewatering system discharge needs to be identified, as the groundwater cannot be discharged to the canal.

Siphons

The pipeline route includes four siphons. The reinforced concrete pipe (RCP) siphons are not rated at a pressure suitable for the new pipeline, so the RCP siphons must either be lined or bypassed/removed from service.

Lining the siphon consists of lining the RCP with WSP. Lining large diameter RCP with WSP is fairly common in the water industry, especially in Southern California. Gantry Construction of Arizona was consulted during this study; they have performed RCP lining projects throughout the western United States, including for the Provo Canal to Pipeline Project.

The WSP siphon liner would have a diameter approximately 6-inches smaller than the diameter of the RCP siphon. The WSP would be shop fabricated in sticks to match the dimensions and angles of the interior of the existing siphon. The WSP would then be installed inside the pipe and welded to the adjacent WSP sticks and fittings to form a fully restrained pipeline. The annular space between the outside of the WSP and the inside of the RCP is filled with grout.

The other alternative is to abandon the siphons altogether and replace them with parallel pipelines that would be installed by tunneling under the roadways and railroad tracks. This method of construction would allow the pipeline to be constructed without impacting canal

operations but would likely be prohibitively expensive. Tunneling costs for relatively short tunnels are 5 to 10 times more expensive than conventional open trench construction.

Due to the cost of tunneling, it is recommended that the siphons be lined with WSP.

Pipeline Laterals

The Rock Slough portion of the Canal has only one large customer and several minor users. The large user is the City of Brentwood Water Treatment Plant (CBWTP). The CBWTP's maximum demand is 46.4 cfs (20,826 gpm). Currently, the untreated water is diverted from the canal through a Canal Intake Structure and conveyed under slight pressure (< 4 psig) to the CBWTP influent pump station via a 48-inch diameter lateral. The diversion is self-regulating in that the water surface elevation in the influent pump station matches that of the canal (minus friction and minor losses).

If the pipeline is constructed, the diversion will need to be modified because the pipeline will be under approximately 25 psig of pressure at the CBWTP lateral. There are two proposed methods of regulating flow to CBWTP:

- Altitude Valve: The existing lateral would be directly connected to the new 8-foot diameter pipeline with a 36-inch pipeline. The pipeline would be provided with a 36-inch diameter gate valve to allow the lateral to be isolated. One 24-inch (25,000 gpm capacity) or two 16-inch altitude valves (11,000 gpm capacity each) would be installed at the influent pump station. The altitude valve(s) would regulate flow into the influent pump station by opening and closing based on the position of a float or integral pressure sensor in the influent pump station wet well.
- Throttling valve with flowmeter: The existing lateral would be directly connected to the new 8-foot diameter pipeline with a 30-inch pipeline. The new connection would include a 30-inch diameter electrically actuated throttling valve and a 30-inch diameter magnetic flow meter. The throttling valve would regulate the flowrate through the lateral based on either the level in the influent pump station or the flowrate through the flowmeter. The PLC at the new Rock Slough Pumping Plant would control the throttling valve. The PLC would be connected to the throttling valve and flow meter with a new fiberoptic communications cable that would be installed parallel to the new pipeline.

Smaller customers, including Laterals 5.3, 6.2, and 7.1, would be equipped with similar, but smaller, facilities.

Construction Sequencing

The pump station construction is expected to occur over an 18 to 24 month period. The pump station could be constructed without impacting PP1 except for the tie-in to the existing 10-ft diameter suction pipeline. We estimate the tie-in should take no more than 30 days and could be constructed during a period of low water demand. During this period, the canal could be backfilled with untreated water from the Los Vaqueros system by using the existing overflow pipes around each of the pumping plants.

The majority of the pipeline can likely be constructed under the access road without impacting the operation of the canal. Production rates for this size pipeline are likely to range from 120 feet to 700 feet per day. This range was developed based on discussions with two pipeline contractors. A production rate of 120 feet per day is typical for urban environments where the

pipeline must be backfilled by the end of every working day. A production rate of 700 ft per day was the maximum production rate for a recent 10-foot diameter pipeline project. These production rates translate to a range of 26 to 150 working days, not including mobilization and demobilization. Assuming the worst-case scenario of 150 working days, the majority of the pipeline work could be accomplished in 210 calendar days (7 months).

However, in order to install the pipeline within the four siphons, under the three bridges, and through the single box culvert, a shutdown of the canal would be required. For each siphon, it is anticipated that lining the siphon will take approximately 2 weeks to perform. This equals a total of eight weeks, or two months. Assuming a second crew is available, the pipeline installation under the bridges and box culvert is assumed to occur concurrent to this two month period.

This results in a construction period of 9 months. Including mobilization and demobilization, the construction period would be approximately 12 months.

The most efficient method of lining the siphons and pipes under the bridges would be to shutdown the canal for the two-month period. If this is not possible, a bypass around each siphon and/or bridge could be performed, however, this would be expensive and would required that several roadways be shutdown temporarily to allow the bypass pipelines to cross over the obstacles. However, a temporary shutdown should be possible during a low water demand period, assuming another water supply can be provided to the CBWTP.

Canal/Pumping Plant Demolition

After the new pump station and pipeline are complete, the existing canal would be demolished. To demolish the canal, the concrete liner would be removed and approximately 150,000 cubic yards of fill would be required to be imported to fill the existing canal section. Drainage swales and ditches would be provided to allow stormwater to be drained from the site. Refer to Technical Memo No. 3, Main Canal Drainage Study, for additional details on stormwater drainage. The canal liner fences would be removed and the area could be hydroseeding and landscaped. More innovative uses of the canal area could also be investigated.

At the four pumping plants, the mechanical and electrical equipment would be removed and scrapped. The structures could be left in place if the pumping plants are determined to be significant historical structures. Alternatively, the structures could be demolished and the land returned to its original state. The decision to fill in the canal and/or demolish the pumping plant structures will likely depend on the availability of inexpensive fill from nearby projects, available funding, and input from other project stakeholders.

Cost Estimates

Cost estimates were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in June 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 4 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. For example, welded steel pipe quotes were obtained from Northwest Pipe, pump and drive estimates were escalated from the Middle River Pump Station Project, and Carollo's unit price catalog was used for pricing of earthwork. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

Cost Estimate Assumptions

The cost estimates presented here are preliminary in that they were prepared in advance of detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

- Construction of below grade infrastructure would be accomplished via conventional open trench.
- Groundwater along the pipeline route (above PP1) is minimal.
- Excavated material and spoils are disposed on-site.
- The following contingencies are applied to each of the estimates:
  - General contingency for unforeseen conditions, changes, or design details: 40 percent.
  - General conditions: 15 percent.
  - General Contractor Overhead, Profit, and Risk: 10 percent.
  - Escalation to the mid-point of construction: 2 percent per year (for three years).
  - Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).
  - Bid Market Allowance: 0 percent
  - Engineering, Legal, and Administration Fees: 20 percent.
  - Change Order Allowance: 5 percent.

Cost Estimates

The cost estimates for each improvement are indicated in Table 4. Detailed cost estimates are included in Appendix A.

Table 4	**Capital Improvement Costs[(1)] Canal Rehabilitation Feasibility Studies Contra Costa Water District**
Phase	**Capital Costs (Millions of Dollars)**
Rock Slough Pump Station[(2)]	$34.2
8 ft Diameter Pipeline[(2)]	$40.5
CBWTP Lateral and Minor Lateral Modifications[(2)]	$1.0
Subtotal (Construction Cost) [(2)]	**$75.7**
Design, Legal, and Administrative Fees (20%)	$15.1
Change Orders (5%)	$3.8
Total (Project Cost)	**$94.6**

Notes:

(1) Based on April 2014 dollars; ENRCCI=10,895.
(2) Includes the contingencies stated in the cost estimate assumptions section.

Prepared By:

Colin Barrett

Colin Barrett

Appendix A – Detailed Cost Estimates

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Detailed Cost Estimate

PROJECT : Rock Slough Pumping Plant
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	Sitework				$2,720,771	
2	Pump Station				$11,302,322	
3	Surge System				$371,248	
4	Substation				$1,898,718	
5	Electrical Building				$1,475,384	
	TOTAL DIRECT COST					**$17,768,444**
	Estimating Contingency	40	%	$7,107,378		
	SUBTOTAL				**$24,875,822**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,119,412		
	SUBTOTAL				**$25,995,234**	
	General Conditions	15	%	$3,731,373		
	SUBTOTAL				**$29,726,607**	
	General Contractor Overhead and Profit	10	%	$2,487,582		
	SUBTOTAL				**$32,214,189**	
	Rate of Annual Inflation	2.0	%	$1,971,766		
	SUBTOTAL				**$34,185,955**	
	ESTIMATED CONSTRUCTION COST					**$34,185,955**
	Design, Legal, and Administrative Fees	20	%	$6,837,191		
	SUBTOTAL				**$41,023,146**	
	Change Orders	5.0	%	$1,709,298		
	SUBTOTAL				**$42,732,444**	
	TOTAL PROJECT COST					**$42,732,444**

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Site Work

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$1,951,661
	Excavation	10878	CY	$4.00	1.00	1.200	$52,213	
	AC pavement	45000	SF	$2.00	1.00	1.200	$108,000	
	Dewatering	1	LS`	$200,000.00	1.00	1.200	$240,000	
	Pile Driver Mobilization	1	LS	$20,000.00	1.15	1.050	$24,150	
	Z-sheets for Pump Station	17290	SF	$40.00	1.15	1.050	$835,107	
	Walers and Bracing for Pump Station Excavation	1	LS	$200,000.00	1.15	1.050	$241,500	
	Z-sheets for Influent Pipeline	4200	SF	$40.00	1.15	1.050	$202,860	
	Trench Box for 96" Pipe	60	days	$300.00	1.00	1.200	$21,600	
	Unconfined Trench Backfill	407	CY	$12.55	1.00	1.200	$6,136	
	12' x 12' Trench and Manhole Boxes	120	days	$70.00	1.00	1.200	$10,080	
	ABC for Site	2500	CY	$70.00	1.00	1.200	$210,016	
DIV. 13000								$195,648
	Flow Meter							
	Ultrasonic meter	1	EA	$50,000.00	1.18	1.200	$70,800	
	Cathodic Protection - WSP Conveyance Pipeline							
	Anode Bed (2-60lb Magnesium Anodes)	1	EA	$3,000.00	1.36	1.200	$4,896	
	Post Mounted Test Station	1	EA	$2,000.00	1.36	1.200	$3,264	
	Insulating Flange Kits - Above Grade	6	EA	$500.00	1.36	1.200	$4,896	
	Rectifier and Deep Bed Anode	1	EA	$60,000.00	1.36	1.200	$97,920	
	6" AWG Bond Cables	30	EA	$150.00	1.36	1.200	$7,344	
	72" AWG Bond Cables	5	EA	$300.00	1.36	1.200	$2,448	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.36	1.200	$4,080	
DIV. 15000								$120,000
	Miscellaneous Piping/Valves	1	LS	$100,000.00	1.00	1.200	$120,000	
DIV. 16000								$453,462
	Electrical Allowance (Based on Middle River PS Estimate)	1	AL	20.00%	1	1.000	$453,462	
TOTAL								**$2,720,771**

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$34,736
	Class II AB below Pump Station	135	CY	$70.00	1.00	1.200	$11,368	
	Crushed Rock below Intake Structure	135	CY	$70.00	1.00	1.200	$11,368	
	Controlled Low Strength Material below Intake Structure	100	CY	$100.00	1.00	1.200	$12,000	
DIV. 03000								$912,563
	36" Base Slab	91	CY	$350.00	1.00	1.200	$38,329	
	30" Walls	501	CY	$750.00	1.00	1.200	$450,625	
	18" Elevated Slab - Intake Top Deck	125	CY	$650.00	1.00	1.200	$97,500	
	Structural Concrete - Pump Base	10	CY	$500.00	1.00	1.200	$6,000	
	18" x 30" Beams	22	CY	$1,000.00	1.00	1.200	$26,000	
	Structural Concrete - Pump Suction Wetwell Fill	700	CY	$350.00	1.00	1.200	$294,109	
	12" SOG for Valves	34	CY	$400.00	1.00	1.200	$16,427	
DIV. 05000								$131,250
	Pipe Supports	1	AL	$75,000.00	1.00	1.050	$78,750	
	Misc Metals	1	AL	$50,000.00	1.00	1.050	$52,500	
DIV. 11000								$9,298,800
	High Lift Pump, Motor and Drive	6	EA	$1,260,000	1.00	1.230	$9,298,800	
DIV. 13000								$61,344
	Pressure Transmitters	7	EA	$1,500.00	1.27	1.320	$17,602	
	Ultrasonic Level - Hydroranger 200	4	EA	$3,000.00	1.27	1.320	$20,117	
	Cathodic Protection - Pump Barrels							
	Rectifier and Wetwell Anodes	1	LS	$20,000.00	1.00	1.050	$21,000	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.00	1.050	$2,625	
DIV. 15000								$812,112
	120" RCP	80	LF	$1,000.00	1.00	1.050	$84,000	
	96" Steel Pipe	90	LF	$750.00	1.00	1.050	$70,875	
	96" Depend-o-Lock Coupling	2	EA	$15,000.00	1.00	1.050	$31,500	
	96" 90 deg Elbow	1	EA	$20,000.00	1.00	1.050	$21,000	
	Adder for M11 Reinforcement	1	AL	$30,000.00	1.00	1.050	$31,500	
	48" Discharge Pipe	40	LF	$450.00	1.00	1.050	$18,900	
	48" Depend-O-Lock Couplings	8	EA	$10,000.00	1.00	1.050	$84,000	
	48" Slanting Disc Check Valve	4	EA	$45,000.00	1.00	1.050	$189,000	
	48" Butterfly Valve and Actuator	4	EA	$29,000.00	1.00	1.050	$121,800	
	30" Discharge Pipe	20	LF	$400.00	1.00	1.050	$8,400	
	30" Depend-O-Lock Couplings	4	EA	$3,135.00	1.00	1.050	$13,167	
	30" Slanting Disc Check Valve	2	EA	$35,700.00	1.00	1.050	$74,970	
	30" Butterfly Valve and Actuator	2	EA	$19,000.00	1.00	1.050	$39,900	
	ARV 2"	6	EA	$2,000.00	1.00	1.050	$12,600	
	CAV 8"	2	EA	$5,000.00	1.00	1.050	$10,500	
DIV. 16000								$51,518
	Electrical Allowance (Based on Middle River PS Estimate	1	AL	0.50%	1	1.050	$51,518	
TOTAL								**$11,302,322**

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION Brentwood, CA
ELEMENT : 90% Estimate - Surge Protection Facility

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$39,022
	Precast Concrete Piles - Surge Tank Facility	16	EA	$2,322.74	1.00	1.05	$39,022	
DIV. 03000								$28,776
	24" Slab on grade	59.26	CY	$276.97	1.00	1.200	$19,696	
	24" Edge Forms	120	LF	$21.69	1.00	1.200	$3,124	
	Pipe supports for surge tanks	6.222	CY	$797.75	1.00	1.200	$5,957	
DIV. 11000								$231,000
	Surge Vessel	1	EA	$200,000.00	1.00	1.05	$210,000	
	25 HP Duplex Air Compressor	1	EA	$20,000.00	1.00	1.05	$21,000	
DIV. 15000								$72,450
	24" Butterfly valve	2	EA	5,000.00	1.00	1.05	$10,500	
	24" Flex coupling	4	EA	2,500.00	1.00	1.05	$10,500	
	36" Pipe	20	LF	$425.00	1.00	1.05	$8,925	
	36" 90 Deg elbow	1	LF	$5,000.00	1.00	1.05	$5,250	
	8" CAV	1	EA	$5,000.00	1.00	1.05	$5,250	
	PRV	1	EA	$500.00	1.00	1.05	$525	
	Misc Surge System Fittings and Piping	1	LS	$5,000.00	1.00	1.05	$5,250	
	Surge System LCP and integration	1	LS	$25,000.00	1.00	1.05	$26,250	
TOTAL								**$371,248**

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Substation

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 03000								$43,060
	18" Slab on Grade for Transformer	35	CY	$286.18	1.15	1.400	$15,896	
	18" Slab on Grade Edge Form	100	LF	$16.41	1.15	1.400	$2,641	
	18" Slab on Grade for Breaker/meter and Deadend Struc	21	CY	$286.18	1.15	1.400	$9,829	
	18" Slab on Grade Edge Form	125	LF	$16.41	1.15	1.400	$3,302	
	Metal Grating for Transformer Slab	205	SF	$34.52	1.15	1.400	$11,392	
DIV. 16000								$1,855,657
	#4/0 SDBC Ground Cable	1300	LF	$5.53	1.15	1.400	$11,574	
	10-foot ground rods	31	EA	$33.33	1.15	1.400	$1,664	
	Grounding connections and unlisted items @ 25%						$3,309	
	#2 XHHW	50	LF	$2.76	1.15	1.400	$222	
	#6 XHHW	100	LF	$1.36	1.15	1.400	$219	
	#10 XHHW	15600	LF	$0.76	1.15	1.400	$18,963	
	#12 XHHW	2500	LF	$0.59	1.15	1.400	$2,375	
	#14 XHHW	50	LF	$0.46	1.15	1.400	$37	
	Wire connection and unlisted items @ 15%						$3,272	
	1" GRC	20	LF	$9.26	1.15	1.400	$298	
	3/4" GRC	50	LF	$7.10	1.15	1.400	$572	
	2" PCS elbows and risers	22	EA	$175.60	1.15	1.400	$6,220	
	Conduit fittings and unlisted items @ 25%						$1,772	
	Duplex receptacle	4	EA	$105.00	1.15	1.400	$676	
	Toggle switch	3	EA	$105.00	1.15	1.400	$507	
	NiCd Battry System	1	EA	$12,000.00	1.15	1.400	$19,320	
	Substation transformer - 69kV:4.16/2.4kV, 15 MVA	1	EA	$750,000.00	1.15	1.400	$1,207,500	
	Substation dead-end structure	1	EA	$45,000.00	1.15	1.400	$72,450	
	SF6 Breaker	1	EA	$81,000.00	1.15	1.400	$130,410	
	Overhead Cable	300	FT	$2.25	1.15	1.400	$1,087	
	Substation disconnect	1	EA	$20,000.00	1.15	1.400	$32,200	
	Metering CT/PT	3	EA	$43,000.00	1.15	1.400	$207,690	
	Branch circuit panelboard	2	EA	$1,585.00	1.15	1.400	$5,104	
	Dry type transformer - 480:240/120V, 25 kVA	1	EA	$2,780.00	1.15	1.400	$4,476	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	2	EA	$570.00	1.15	1.400	$1,835	
	Type D luminaire - Ful cut-off 250W HPW pole-mounted	4	EA	$570.00	1.15	1.400	$3,671	
	Pole for type C - 25-foot	4	EA	$850.00	1.15	1.400	$5,474	
	Type F luminaire - Substation up-light	2	EA	$675.00	1.15	1.400	$2,174	
	Type G luminaire - sealed/gasketed	1	EA	$350.00	1.15	1.400	$564	
	Ground masts	2	EA	$9,500.00	1.15	1.400	$30,590	
	Transformer protection relay	1	EA	$5,760.00	1.15	1.400	$9,274	
	Backup overcurrent relay	1	EA	$1,500.00	1.15	1.400	$2,415	
	Lockout relay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Substation ductbank 1	1	EA	$2,026.13	1.15	1.400	$3,262	
	Substation ductbank 2	1	EA	$4,051.63	1.15	1.400	$6,523	
	Control Building	1	LS	$35,000.00	1.15	1.400	$56,350	
TOTAL								**$1,898,718**

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$5,600
	Class II AB	67	CY	$70.00	1.00	1.20	$5,600	
DIV. 03000								$54,802
	12" Slab on Grade	44	CY	$400.00	1.00	1.20	$21,333	
	18" Perimeter Thickened Slab on Grade	60	CY	$400.00	1.00	1.20	$28,800	
	Sump for Switchgear Conduit							
	12" Slab on Grade	2	CY	$304.53	1.00	1.20	$756	
	12" Walls	6	CY	$565.08	1.00	1.20	$3,913	
DIV. 04000								$103,447
	CMU Block Walls	3600	SF	$20.01	1.00	1.20	$86,443	
	Pilaster Adder	3600	SF	$1.56	1.00	1.20	$6,739	
	Seismic Reinforcement Adder	3600	SF	$1.15	1.00	1.20	$4,977	
	Integral CMU Colour Adder	3600	SF	$1.22	1.00	1.20	$5,288	
DIV. 05000								$34,746
	Structural Steel Roof System	1500	LB	$2.30	1.00	1.20	$4,140	
	Structural Steel Angle Around Perimeter	2120	LB	$2.30	1.00	1.20	$5,851	
	Steel Roofing	1800	SF	$5.00	1.00	1.20	$10,800	
	Ladder	1	LS	$500.00	1.00	1.20	$600	
	Hatch	1	LS	$1,000.00	1.00	1.20	$1,200	
	Single Steel Door	4	EA	$907.70	1.00	1.20	$4,357	
	Double Steel Door	3	EA	$1,820.99	1.00	1.20	$6,556	
	2.5" Galvanized Steel Grating	30	SF	$34.52	1.00	1.20	$1,243	
DIV. 12000								$5,250
	Furniture Allowance	1	LS	$5,000.00	1.00	1.050	$5,250	
DIV. 13000								$369,701
	PLC and Appurtences							
	PLC Panel	1	EA	$109,524.00	1.27	1.230	$171,087	
	Shop Drawings	1	LS	$22,500.00	1.05	1.230	$29,059	
	Loop Drawings	1	LS	$27,000.00	1.05	1.230	$34,871	
	Factory Assistance Test (FAT)	1	LS	$14,850.00	1.05	1.230	$19,179	
	Training	1	LS	$17,600.00	1.05	1.230	$22,730	
	Field Installation	1	LS	$48,600.00	1.05	1.230	$62,767	
	Radio System							
	PLC Panel	1	EA	$1,500.00	1.27	1.230	$2,343	
	Surge Suppressor	2	EA	$450.00	1.27	1.230	$1,406	
	Yagi Antennas	2	EA	$700.00	1.27	1.230	$2,187	
	Antenna Cable (appx. 60 feet each)	2	EA	$480.00	1.27	1.230	$1,500	
	Pole Antenna Mounting	1	EA	$1,100.00	1.27	1.230	$1,718	
	TransNet Spread Spectrum Radio (MDS)	1	EA	$2,150.00	1.27	1.230	$3,359	
	MDS 9710 Licensed 900 MHz Radio	1	EA	$1,750.00	1.27	1.230	$2,734	
	Lot-Andrew Sure Ground - Cable Shields	1	EA	$450.00	1.27	1.230	$703	
	Lot-Modification of Tower at Transfer Pump Station	1	LS	$6,500.00	1.27	1.230	$10,154	
	Lot - site work/testing	1	LS	$2,500.00	1.27	1.230	$3,905	
DIV. 15000								$247,927
	HVAC Unit and Ducting	1	LS	$201,566.82	1.00	1.230	$247,927	
DIV. 16000								$653,911
	#4/0 SDBC Ground Cable	350	LF	$5.53	1.15	1.400	$3,116	
	10-foot ground rods	5	EA	$33.33	1.15	1.400	$268	
	Grounding connections and unlisted items @ 25%						$846	
	#10 XHHW	4600	LF	$0.76	1.15	1.400	$5,592	
	#12 XHHW	3200	LF	$0.59	1.15	1.400	$3,040	
	#14 XHHW	2900	LF	$0.46	1.15	1.400	$2,138	
	2CS Instrument cable	500	LF	$1.85	1.15	1.400	$1,489	
	CAT 5e Ethernet	100	LF	$0.78	1.15	1.400	$126	
	Wire connection and unlisted items @ 15%						$1,858	
	250kcmil 5KV	200	LF	$8.88	1.15	1.400	$2,859	
	5kV terminations	24	EA	$370.00	1.15	1.400	$14,297	
	4" PVC 40	150	LF	$19.55	1.15	1.400	$4,721	
	2" PVC 40	100	LF	$8.10	1.15	1.400	$1,304	

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
	1.5" GRC	300	LF	$12.65	1.15	1.400	$6,110	
	1" GRC	50	LF	$9.26	1.15	1.400	$745	
	3/4" GRC	1500	LF	$7.10	1.15	1.400	$17,147	
	4" PCS Elbow & Riser	12	EA	$490.00	1.15	1.400	$9,467	
	2" PCS Elbow & Riser	4	EA	$175.60	1.15	1.400	$1,131	
	Conduit fittings and unlisted items @ 25%						$10,156	
	Duplex receptacle	30	EA	$105.00	1.15	1.400	$5,072	
	Toggle switch	14	EA	$105.00	1.15	1.400	$2,367	
	Dry type transformer - 480:240/120V, 37.5 kVA	1	EA	$3,560.00	1.15	1.400	$5,732	
	Pad-mount transformer - 4.16kV:480/277V, 300 kVA	1	EA	$13,565.00	1.15	1.400	$21,840	
	Electrical System Study	1	EA	$18,000.00	1.15	1.400	$28,980	
	Main 5kV switchgear SWGR-1	1	EA	$215,000.00	1.15	1.400	$346,150	
	Branch circuit panelboard	1	EA	$1,585.00	1.15	1.400	$2,552	
	Distribution panelboard DP-41	1	EA	$7,975.00	1.15	1.400	$12,840	
	Lighting Contactor	1	EA	$650.00	1.15	1.400	$1,047	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	22	EA	$570.00	1.15	1.400	$20,189	
	Type B luminaire - Full cut-off wall pack	6	EA	$570.00	1.15	1.400	$5,506	
	Type E luminaire - emergency/exit fixture	5	EA	$896.00	1.15	1.400	$7,213	
	Field Acceptance Tests	1	EA	$15,000.00	1.15	1.400	$24,150	
	Lockout rleay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Feeder protection relay	5	EA	$2,290.00	1.15	1.400	$18,435	
	Motor protection relay	5	EA	$3,350.00	1.15	1.400	$26,968	
	Motor protection relay remote RTD monitor	5	EA	$1,290.00	1.15	1.400	$10,385	
	Bus differential relay	1	EA	$4,440.00	1.15	1.400	$7,148	
	Fire alarm system	1	EA	$12,000.00	1.15	1.400	$19,320	
TOTAL								**$1,475,384**

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Detailed Cost Estimate

PROJECT : Rock Slough Pumping Plant
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	8' Diameter Welded Steel Pipeline - Conventional Trench				$20,291,857	
2	Siphon Lining Adder				$778,848	
	TOTAL DIRECT COST					**$21,070,705**
	Estimating Contingency	40	%	$8,428,282		
	SUBTOTAL				**$29,498,988**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,327,454		
	SUBTOTAL				**$30,826,442**	
	General Conditions	15	%	$4,424,848		
	SUBTOTAL				**$35,251,290**	
	General Contractor Overhead and Profit	10	%	$2,949,899		
	SUBTOTAL				**$38,201,189**	
	Rate of Annual Inflation	2.0	%	$2,338,218		
	SUBTOTAL				**$40,539,407**	
	ESTIMATED CONSTRUCTION COST					**$40,539,407**
	Design, Legal, and Administrative Fees	20	%	$8,107,881		
	SUBTOTAL				**$48,647,289**	
	Change Orders	5.0	%	$2,026,970		
	SUBTOTAL				**$50,674,259**	
	TOTAL PROJECT COST					**$50,674,259**

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

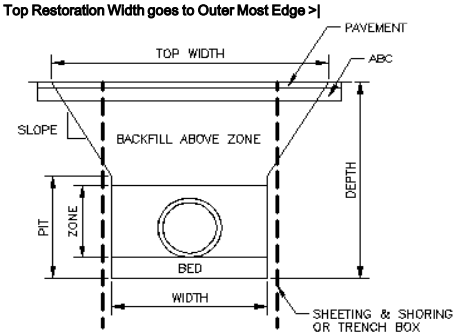
QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **Rock Slough Option 1**
Item: **96" WSP**

Date: **17-May-14**
Proj Mgr:: **CB**

|< Top Restoration Width goes to Outer Most Edge >|



DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	96.00	inches
Average **Total** Exc **Depth**	13.00	feet (Include Bed Thickness)
Length	18,000.00	feet
Trench Slope: 1 Vert. to	1.00	Horiz.
Pavement Thickness:	3.00	inches
ABC Depth:	8.00	inches
No.of Pavement Cuts	0.00	Each

Calculated Values

19.0 ft = Top Trench Width
21.0 ft = Top Resoration Width

CALCULATED QUANTITIES for ESTIMATE			
Pavement Cutting (per Inch Depth x Length)	=	0	**ln ft**
Pavement Removal	=	378,000	**sq ft**
Trench Excavation	=	106,000	**cu yd**
Bed + Zone fill (Excludes Pipe Volume)	=	36,323	**cu yd**
Zone Only Fill (Excludes Pipe Volume)	=	28,990	**cu yd**
Bed Only Fill	=	7,333	**cu yd**
Backfill Above Zone	=	36,167	**cu yd**
Waste if Import Bed, Zone	=	69,833	**cu yd**
Waste if Native Bed, Zone	=	33,510	**cu yd**
Surface Restoration Area	=	378,000	**sq ft**
Shoring Area (Optional): Trench Shored Area	=	324,000	**sq ft**
Shoring Area (Optional): With 30% Toe-In	=	430,920	**sq ft**

INPUT VARIABLES		
Bed Depth =	12.0 in	Default = 6"
Zone Depth Above Pipe =	6.0 in	Default = 6"
Min. Width =	36.0 in	Indicate Practical Bucket Width
Side Width (per side x 2) =	36.0 in	Default @ 12" per side
Pit Depth =	9.0 ft	**See Note #2, #3 and #4**
	1.0 ft	Add'l **allowance** for surface restoration per side **(see Note #5)**

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Pavement Cutting	0	in FT	**$0.44**	$0	*$0.00*	AC Thickness = 3 in
Pavement Removal	378,000	SF	**$0.47**	$177,660	*$9.87*	
Disposal Haul	3,500	CY	**$21.00**	$73,500	*$4.08*	Assumed haul distance is: 10 miles
Trench Excavation	106,000	CY	**$2.11**	$223,713	*$12.43*	Assumed excavator used is: CAT 235 with 2 CY Bucket
~~Bed + Zone fill~~	~~36,323~~	~~CY~~		~~$0~~	~~*$0.00*~~	
Zone Only Fill	28,990	CY	**$75.00**	$2,174,226	*$120.79*	Imported confined material used: CLSM
Bed Only Fill	7,333	CY	**$75.00**	$550,000	*$30.56*	Imported confined material used: Cl 2 AB
Backfill Above Zone	36,167	CY	**$17.50**	$632,917	*$35.16*	Native unconfined material from trench used
Waste if Import Bed, Zone	69,833	CY	**$4.25**	$296,792	*$16.49*	Assumed waste is spead and distributed on the ROW
~~Waste if Native Bed, Zone~~	~~33,510~~	~~CY~~		~~$0~~	~~*$0.00*~~	
New Access Rd	378,000	SF	**$4.25**	$1,606,500	*$89.25*	Assumes new 3" AC w/8" AB roadbed
Shoring Area	365	DY	**$1,050.00**	$383,250	*$21.29*	Trench Boxes
Dewatering	1	AL	**$500,000.00**	$500,000	*$27.78*	Allowance (groundwater above PP1 should not be an
Sheetpile Shoring Allowance	1	AL	**$500,000.00**	$500,000	*$27.78*	issue)
Earthwork Subtotal				$7,118,557	*$395.48*	
Pipe						
	18,000	LF	**$705.60**	$12,700,800	*$705.60*	8' Diameter WSP (Poly coated and lined)
	30	EA	**$15,750.00**	$472,500	*$26.25*	Pipe cost includes some fittings
Pipe Subtotal				$13,173,300	*$731.85*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$20,291,857**	***$1,127.33***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$3,043,779	*$169.10*	
Subtotal				**$23,335,636**	***$1,296.42***	
Contingency			30.0%	$7,000,691	*$388.93*	
Subtotal				**$30,336,327**	***$1,685.35***	
General Contractor Overhead, Profit & Risk			10.0%	$3,033,633	*$168.54*	
Subtotal				**$33,369,959**	***$1,853.89***	
Escalation to Mid-Point			6.0%	$2,002,198	*$111.23*	2% per year compounded over three years.
Subtotal				**$35,372,157**	***$1,965.12***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$1,591,747	*$88.43*	
Subtotal				**$36,963,904**	***$2,053.55***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$16,672,047**	***$926.22***	
TOTAL ESTIMATED CONSTRUCTION COST				**$36,963,904**	***$2,053.55***	

Engineering, Legal & Administration Fees	20.0%	$7,392,781	*$410.71*
Owner's Reserve for Change Orders	5.0%	$1,848,195	*$102.68*
TOTAL ESTIMATED PROJECT COST		**$46,204,880**	***$2,566.94***

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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Detailed Cost Estimate

PROJECT : Rock Slough Pumping Plant
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	8' Diameter Welded Steel Pipeline - Embankment				$19,465,868	
2	Siphon Lining Adder				$778,848	
	TOTAL DIRECT COST					**$20,244,716**
	Estimating Contingency	40	%	$8,097,887		
	SUBTOTAL				**$28,342,603**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,275,417		
	SUBTOTAL				**$29,618,020**	
	General Conditions	15	%	$4,251,390		
	SUBTOTAL				**$33,869,411**	
	General Contractor Overhead and Profit	10	%	$2,834,260		
	SUBTOTAL				**$36,703,671**	
	Rate of Annual Inflation	2.0	%	$2,246,558		
	SUBTOTAL				**$38,950,229**	
	ESTIMATED CONSTRUCTION COST					**$38,950,229**
	Design, Legal, and Administrative Fees	20	%	$7,790,046		
	SUBTOTAL				**$46,740,275**	
	Change Orders	5.0	%	$1,947,511		
	SUBTOTAL				**$48,687,786**	
	TOTAL PROJECT COST					**$48,687,786**

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CONCEPTUAL PIPELINE MODEL - TYPE "3" TRENCH - MOUND COVER

Version 2.0-4

This template calculates the excavation and backfill volumes for, what we refer to, as **TYPE 3 TRENCHES**, that have a **MOUND COVER,** based on a "**Type 2**" trench configuration. For purposes of calculating quantities, the pipe zone quantity incorporates what would be considered "backfill" for a pipeline that is totally buried under the surface. Therefore, for Type 3 Trenches, the zone and "backfill" are one in the same; the quantity being identifed as "zone" for both the pipe zone material below the surface and the mound material above the surface.

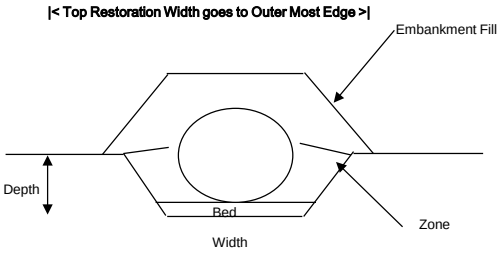
The text and numbers in **RED** are the variables to change to fit your project. These are the **ONLY** inputs that need to be changed. All of the other values shown are based on formulas. By using the side slope of: 1 Vert.to **0 Horiz**, a **vertical trench** is obtained. Calculated values appear in the highlighted box with **bold** lettering. These values can be transferred to your estimate worksheet. **Important Assumption:** The width at the top of the mound is assumed to be the same as the width of the trench at the bottom of the excavation. If this top width needs to be different, zone (and Mound) quantity needs to be calculated separately.

Note: All earthwork quantities are "Bank Measure" volumes without any shrink/swell factors. Operational Notes provided at approximately cell P46.

QUANTITY CALCULATIONS:

MOUNDED COVER

Proj Name/No: **Rock Slough Option 1** Date: **03-Oct-13**
Item: **96" WSP** Proj Mgr:: **CB**



	INPUT	
Pipe Diameter, Nom (OD)	96.00	inches
Average **Total** Exc **Depth**	6.00	feet (Include Bedding Thickness)
Length	18,000.00	feet
Excavation Slope: 1 Vert. to	0.00	Horiz.
Mound Slope: 1 Vert to	2.00	Horiz.
Stripping Depth	0.50	feet
Topsoil cover	0.00	feet

CALCULATED QUANTITIES for ESTIMATE			
Stripping (Basis = Mound Surface Width Plus Allowance)	=	11,000	cu yd
Trench Excavation	=	44,000	cu yd
Bed + Zone (includes Mound mtl, zone excludes pipe volume)	=	80,490	cu yd
Zone Only (includes Mound mtl, zone excludes pipe volume)	=	73,156	cu yd
Bed Only	=	7,333	cu yd
Backfill Above Zone (see Zone)	=	N/A	cu yd
Waste if Import Bed & Zone (= Excavated Volume)	=	44,000	cu yd
Waste if Native Bed & Zone (= Pipe Volume)	=	33,510	cu yd
Material Needed to Construct Mound (Apx)	=	29,181	cu yd
Surface Restoration Area	=	636,492	sq ft
Shoring Area (Optional): Trench Shored Area	=	216,000	sq ft
Shoring Area (Optional): With 30% Toe-In	=	287,280	sq ft
Topsoil Replacement	=	0	cu yd

Calculated Values

31.0	ft	= Ground Surface Width of Mound
33.0	ft	= Stripping Width (incld's allow)
35.4	ft	= Mound Surface Length+Allow

Input Variables

Bed Depth =	12.0	in	Default = 6"
Zone Depth Above Pipe =	24.0	in	Default = 24"
Min. Width =	48.0	in	Indicate Practical Bucket Width
Side Width (per side x 2) =	36.0	in	Default @ 12" per side
	1.0	ft	Add'l **allowance** per side for Surface Restoration beyound Mound **(See note #4)**

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	$/LF	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Stripping of Topsoil	11,000	CY	$9.50	$104,500	*$5.81*	
Disposal Haul	11,000	CY	$21.00	$231,000	*$12.83*	Assumed haul distance is: 10 miles
Trench Excavation	44,000	CY	$2.11	$92,840	*$5.16*	Assumed excavator used is: CY bucket
Bed + Zone fill	51,308	CY	$75.00	$3,848,115	*$213.78*	Imported confined material used: CL 2 AB
~~Zone Only Fill~~	~~73,156~~	~~CY~~		~~$0~~	~~*$0.00*~~	
~~Bed Only Fill~~	~~7,333~~	~~CY~~		~~$0~~	~~*$0.00*~~	
~~Backfill Above Zone~~		~~CY~~		~~$0~~	~~*$0.00*~~	
Waste if Import Bed, Zone	44,000	CY	$4.25	$187,000	*$10.39*	Assumed waste is spead and distributed on the ROW
~~Waste if Native Bed, Zone~~	~~33,510~~	~~CY~~		~~$0~~	~~*$0.00*~~	Assumed haul distance is:
Material Needed to Construct Mound	29,181	CY	$10.00	$291,815	*$16.21*	Assume Native is available.
Surface Restoration	636,492	SF	$0.20	$127,298	*$7.07*	Hydroseeding
New Access Rd	270,000	SF	$4.25	$1,147,500	*$63.75*	
Topsoil Replacement	0	CY	$10.00	$0	*$0.00*	Use Native
Dewatering/Trench Boxes	1	AL	$262,500.00	$262,500	*$14.58*	
Earthwork Subtotal				$6,292,568	*$349.59*	
Pipe						
	18,000	LF	$705.60	$12,700,800	*$705.60*	8' Diameter WSP (Poly coated and lined)
	30	EA	$15,750.00	$472,500	*$26.25*	Pipe cost includes some fittings
Pipe Subtotal				$13,173,300	*$731.85*	
Miscellaneous						
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$19,465,868**	***$1,081.44***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$2,919,880	*$162.22*	
Subtotal				**$22,385,749**	***$1,243.65***	
Contingency			30.0%	$6,715,725	*$373.10*	
Subtotal				**$29,101,473**	***$1,616.75***	
General Contractor Overhead, Profit & Risk			10.0%	$2,910,147	*$161.67*	

Subtotal		**$32,011,620**	***$1,778.42***	
Escalation to Mid-Point	6.0%	$1,920,697	*$106.71*	2% per year compounded over three years.
Subtotal		**$33,932,318**	***$1,885.13***	
Sales Tax (Based on 9% on 50% of subtotal)	4.5%	$1,526,954	*$84.83*	
Subtotal		**$35,459,272**	***$1,969.96***	
Bid Market Allowance	0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:		**$15,993,404**	***$888.52***	
TOTAL ESTIMATED CONSTRUCTION COST		**$35,459,272**	***$1,969.96***	
Engineering, Legal & Administration Fees	20.0%	$7,091,854	*$393.99*	
Owner's Reserve for Change Orders	5.0%	$1,772,964	*$98.50*	
TOTAL ESTIMATED PROJECT COST		**$44,324,090**	***$2,462.45***	

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Siphon Installation Adder

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 15000								$778,848
	Mobilization (Cranes, confined space, etc)	1	LS	$157,500.00	1.00	1.150	$181,125	
	WSP (installation labor adder)	608	LF	$525.00	1.15	1.000	$367,080	
	Grouting	637	CY	$315.00	1.15	1.000	$230,643	
TOTAL								$778,848

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Ken Wilkins and Todd Yamello		
Subject:	Rock Slough Pumping Plants and Canal Renewal Alternatives Technical Memorandum No. 2 - Main Canal Renewal Alternatives		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

The Main Canal conveys untreated water from Rock Slough and the Los Vaqueros System by gravity to customers and District facilities in eastern and central Contra Costa County. The Main Canal has been operational for more than 70 years and is approaching the end of its useful life as a water conveyance facility.

The 2013 Update of the Untreated Water Facilities Improvement Program (UWFIP) presented an assessment of the upgrade and replacement alternatives for the Main Canal. The assessment concluded that the replacement of the main canal with an 8-foot diameter pipeline and pump station near the existing Neroly Blending facility was the most viable conveyance renewal alternative. This conclusion was based on consideration of cost, safety, operational reliability, water quality, and risk minimization.

PURPOSE

This memorandum presents refinements to upgrades and replacement concepts for the Main Canal presented in the 2013 UWFIP update.

DESCRIPTION OF EXISTING INFRASTRUCTURE

The Main Canal is the District's raw water conveyance backbone, delivering untreated water from its sources in East Contra Costa County to customers in the Central Contra Costa County. Although the District's 42-inch diameter Multi-Purpose Pipeline (MPP), which parallels the Main Canal from milepost (MP) 7.05 to MP 25.7, provides some redundancy to the Main Canal, the MPP does not have the capacity to meet customer demands during high demand periods. Therefore, the reliability of the Main Canal is key to the District's ability to provide year-round 24/7 water service.

The Main Canal conveys untreated water from both Rock Slough and the Los Vaqueros System. The Rock Slough Conveyance System, or the portion of the Main Canal from MP 0.00 to MP 7.05, consists of a fish screening facility, four pumping plants, and a canal. The last pumping plant in the system, Pumping Plant No. 4, discharges to the Main Canal near MP 7.05.

Untreated water is also delivered to the Main Canal from Los Vaqueros Reservoir, Old River Pump Station, and/or Middle River Pump Station. Untreated water from these facilities is conveyed via the 78-inch diameter Los Vaqueros Pipeline to the Neroly Blending Facility near MP 7.05. At the Neroly Blending Facility, two sleeve valves are used to control flow into the Main Canal. A turbine was also recently installed, in parallel to the sleeve valves, to allow the District to generate electricity from the excess hydraulic energy, instead of "burning" the excess pressure in the sleeve valves.

At MP 7.05, untreated water can be diverted to the Randall Bold Water Treatment Plant and/or conveyed to Central Contra Costa County through the Main Canal. For untreated water that will be conveyed through the Main Canal, the untreated water from Rock Slough and Los Vaqueros combine in a box culvert. Untreated water flows through the 1500-foot long box culvert, which is connected to a 9-ft diameter siphon at MP 7.36. The untreated water then follows the meandering Main Canal 18.5 miles to MP 25.7 where the Shortcut Pipeline connects to the Main Canal. After MP 25.7, the canal continues on to the Martinez Reservoir but this portion of the canal is named the Loop Canal.

Untreated water customers draw water from the Main Canal at various points along the canal. The Shortcut Pipeline and its laterals convey a significant quantity of untreated water to downstream customers. The Loop Canal also provides water to customers, but not during the winter months.

The Main Canal requires significant investments of manpower and capital to meet the District's supply needs and operational/reliability objectives. The infrastructure is nearing the end of its useful life, and the annual costs to maintain service will continue to increase in the future as canal lining failures and slope stability issues increase in frequency and severity.

BACKGROUND ON THE ALTERNATIVES DEVELOPED DURING THE 2013 UPDATE TO THE UWFIP

Five conveyance alternatives were developed and evaluated in the 2013 Update to the UWFIP:

- Alternative 1 - Status Quo: Maintain Canal in its Present State in Perpetuity.
- Alternative 2 - Canal Relining.
- Alternative 3 - Replace Canal with 12-foot diameter Pipeline.
- Alternative 4 - Replace Canal with 8-foot diameter Pipeline and New Neroly Pump Station.
- Alternative 5 - Replace Canal with 8-foot diameter Pipeline and Pressurize Pipeline with Contra Loma Reservoir.

Alternative 4, Replacement of the Main Canal with an 8-foot diameter pipeline and new Neroly Pump Station, was selected as the most viable alternative because of its low net present value, increased water conveyance reliability, and several additional tangible benefits to the District and its customers. This alternative was considered superior to the Status Quo for the following reasons:

- Piped conveyance eliminates the life safety hazards and risks associated with the open canal (i.e., attractive nuisance).
- Piped conveyance significantly reduces labor-intensive annual maintenance.

- Piped conveyance reduces the recurring annual rehabilitation and replacement (R&R) costs, which have become a significant percentage of the District's annual R&R budget.
- Piped conveyance significantly reduces risk due to accidental or intentional contamination of the District's untreated water supply.
- Piped conveyance improves water quality; resulting from elimination of stormwater runoff, algae, and nuisance aquatic weeds (and weed control chemicals).
- Piped conveyance significantly reduces water losses due to seepage, evaporation, and illegal water connections.

This memorandum builds on the 2013 Update to the UWFIP by expanding the conceptual engineering of the new pipeline and Neroly Pump Station beyond what was presented in the 2013 Update to the UWFIP. The memorandum provides additional figures, schematics, concepts, and costs for the pipeline, pump station, equalization reservoirs and, perhaps most importantly, construction sequencing. Key refinements include an increase in pipe diameter from 8 feet to 8.5 feet and the ability to operate the pipeline in gravity mode for flows up to 120 cfs.

OVERVIEW OF NEW PIPELINE AND NEROLY PUMP STATION

An overview of the Main Canal is shown on Figure 1. Due to the large scale of the Main Canal, the Main Canal was broken up into nine segments, as shown in Figure 1. The Neroly Blending Facility and Rock Slough Pumping Plant No. 1 (PP1) are located just to the east of Segment No 1. The new Neroly Pump Station will be constructed with a new equalization/terminal reservoir at this location. A the west end of the Main Canal, in Segment 9, lie the Short Cut Pipeline intake and the termination of the Main Canal. The new pipeline will stretch from the new Neroly Pump Station, within the existing canal alignment, to a new equalization reservoir located just past the existing Shortcut Pipeline Intake. A schematic of the pump station, reservoirs, and pipeline are shown in Figure 2. The conceptual design for the new pumping plant, reservoirs, and pipeline are discussed in the following sections.

Figure 1
MAIN CANAL OVERVIEW
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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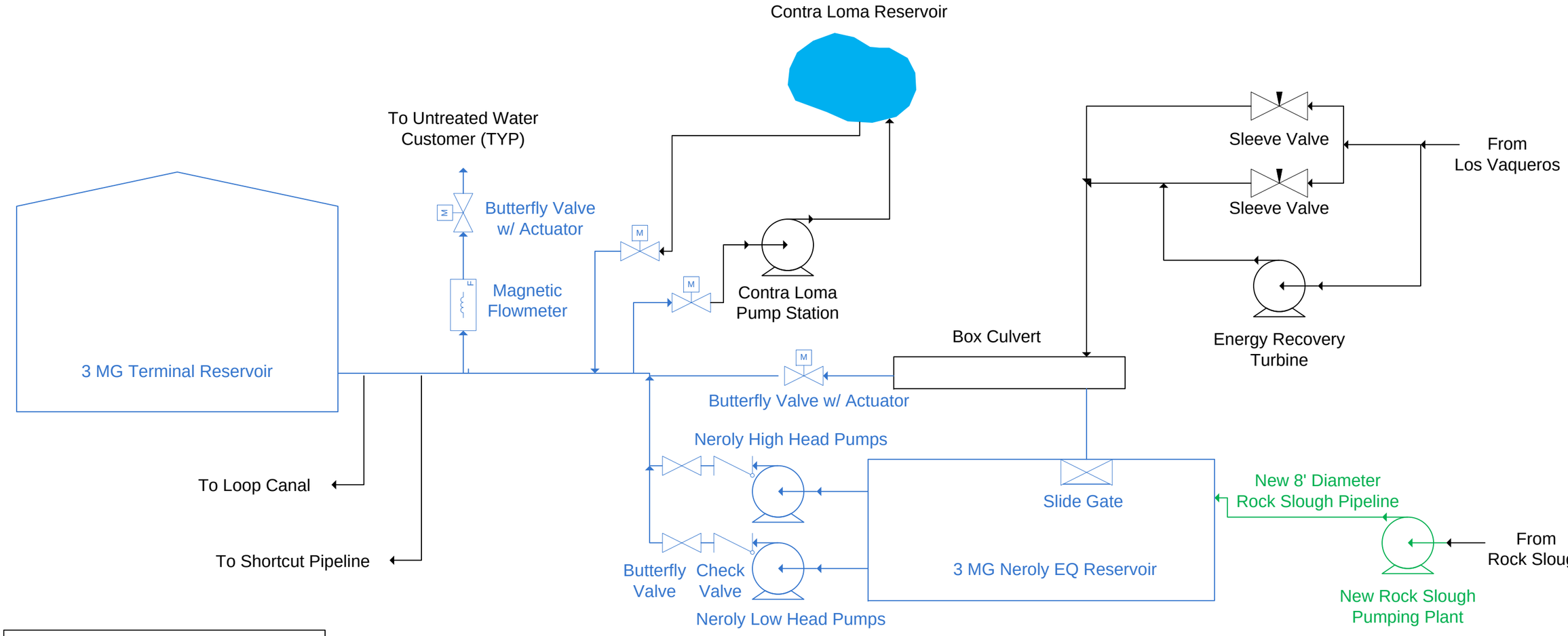


Figure 2
Schematic of New Pipeline, Neroly Pump Station, Reservoirs Necessary to Replace Main Canal
Technical Memorandum No. 2
Contra Costa Water District

REQUIRED CAPACITY FOR THE MAIN CANAL

In 2050, the required capacity of Main Canal is 372 cfs. This is based on the 2002 Future Water Supply Study's (FWSS) demand projections and assumes 73 cfs of the demand will be met through existing storage. Therefore, the Neroly Pump Station and the new pipeline will be designed to have a capacity of 372 cfs.

PUMP STATION LOCATION AND CONFIGURATION

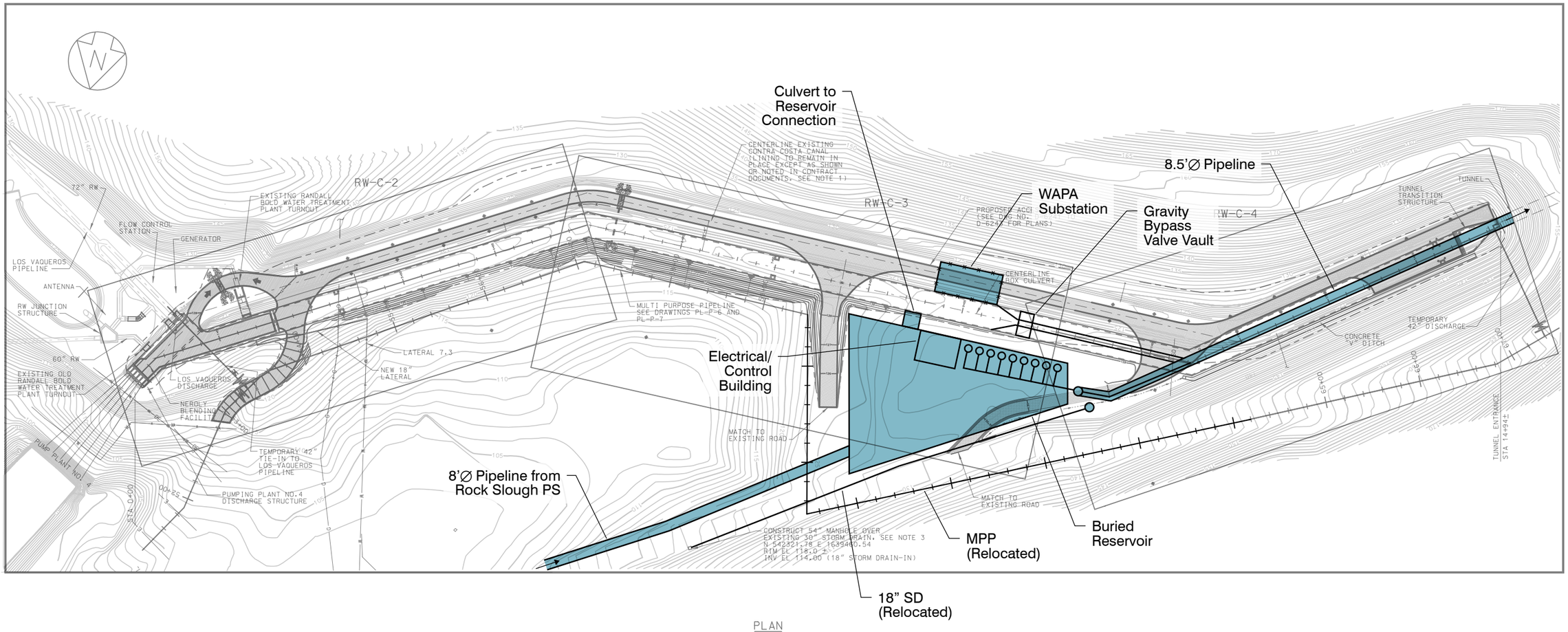
The location of the new Neroly Pump Station is governed by two key constraints:

- The pump station must be located near the existing Neroly Blending Facility to allow the new Pump Station to pump the untreated water from Los Vaqueros and Rock Slough.
- The pump station must be co-located with an equalization reservoir. The equalization reservoir provides the District with equalization capacity to simplify the flow controls associated with the Los Vaqueros system and the proposed Rock Slough Pumping Plant.

The only available property that meets these two requirements is a District owned laydown area located east of the Antioch Service Center and just to the north of the existing box culvert which houses the Main Canal. The laydown area is sufficient in size to house a buried, reinforced concrete reservoir with a capacity of 3 to 4 million gallons (MG). The reservoir would be constructed with a column supported, reinforced concrete roof that would be designed to support vehicle loads. This would allow the area to be used again as a laydown area and allow for maintenance of the reservoir and pump station. An alternative location was studied (District owned property to the south of the Neroly Blending Facility) but this property is at a relatively high elevation of 200 ft and would require extensive earthwork and/or excess pumping.

The reservoir would be trapezoidal shaped to fit the site and would have a nominal sidewater depth of approximately 26 feet (104 to 130 feet). The upper portion of the reservoir (122 to 130 feet) would be used for equalization storage when the new pipeline operates in gravity mode (during low demand periods) and the lower portion (104 to 122 feet) would be used when the pipeline is pressurized by the new Neroly Pump Station (during high demand periods). The water level would be allowed to fluctuate within those control bands to minimize the need for changes to the Los Vaqueros and Rock Slough discharge flowrates in response to changes in demand from untreated water customers. The District is in the process of obtaining SCADA data from the level transmitters in the Main Canal to quantify the equalization capacity of the existing system. The required reservoir volume needs to be refined based on this SCADA data and further investigation into the response times of the Los Vaqueros flow control valves.

The reservoir would be tied into the existing box culvert by a new concrete box culvert. A gate would be installed in the reservoir between the box culvert to allow the reservoir to be isolated from the existing box culvert. The reservoir location would require that approximately 650 linear feet of the MPP and a few hundred feet of an 18-inch diameter storm drain be relocated to the north of the new reservoir. Figure 3 shows the reservoir location.



PLAN

Figure 3
CONCEPTUAL PLAN OF NEROLY PUMP STATION AND RESERVOIR
CANAL REHABILITATION FEASIBILITY STUDIES
CONTRA COSTA WATER DISTRICT

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Due to site constraints and to reduce construction costs, the Neroly Pump Station would be located on top of the southwest corner of the reservoir. The pump station would be comprised of vertical turbine pumps. The discharge heads of the wet pit type vertical turbine pumps would be mounted on top of the reservoir. The pump columns would extend down through the reservoir into cans that would be poured into a trench below the reservoir (similar to the Middle River Pump Station). The extended columns and cans provide improved suction hydraulics and allow the pumps to use the entire reservoir volume without compromising submergence and net positive suction head requirements.

ADDITIONAL PUMP STATION FEATURES

The pump station would include the following features:

- An isolation valve, likely a butterfly valve, installed between the new pipeline and the existing box culvert. The valve would be equipped with an electric actuator and would close when the pump station is in operation. During low demand periods when the pipeline is operated in gravity mode and the pump station is off, the valve would be opened.
- A 3-MG terminal reservoir near MP 25.7 is included in the conceptual design to allow the pump station to operate without “deadheading” the pipeline. The 3-MG reservoir allows the pump station to be operated based on level control and provides some equalization capacity to accommodate fluctuations in demand. The terminal reservoir is discussed in more detail in the following sections.
- A new WAPA substation, similar in size and configuration to the Middle River and Old River substations.
- A new Electrical Building, similar to the Middle River Electrical and Controls building without the water quality sampling and storage rooms.
- An ultrasonic flow meter with internally mounted transducers on the discharge pipeline, downstream of the new pumping plant (similar to Middle River).
- A hydro pneumatic surge vessel is not included in the layout. While a surge analysis is not within the scope of work for this study, a surge analysis should be completed during the preliminary design of the project. However, it is possible that hydraulic transients will not be an issue with this pump station because the pump station is not pumping against a large amount of static head.

PUMP STATION HYDRAULICS AND PUMP SELECTION

An initial assessment of the system hydraulics, including system curves, was prepared. The system curves are shown on Figure 4. The system curves are based on the high and low water elevations in the reservoir at Neroly as well as high and low water elevation in the terminal reservoir near MP 25.7. Other key design criteria are including in Table 1. The pump curves for the selected pumps are also shown in Figure 4.

Table 1 **System Curve Design Criteria** **Canal Rehabilitation Feasibility Studies** **Contra Costa Water District**		
Design Criteria	**Number**	**Comments**
Hazen Williams C-factor	118	Based on field testing performed during the design of the Middle River Pump Station. The C-factor needs to be updated during the preliminary design of the new pump station. The C-factor may be higher (less friction) due to the larger pipe diameter and polyurethane lining (instead of cement mortar lining).
Allowance for Minor Losses	40%	Allowance for losses through fittings and valves.
Water Surface Elevation in Neroly Reservoir	104 to 122 ft	
Water Surface Elevation in Terminal Reservoir	+125 to +133 ft	
Pipeline Diameter	8.5 feet	Selected to minimize both construction costs and friction losses.
Firm Capacity	370 cfs at TDH of 82 to 105 ft	TDH = Total Design Head (Static + friction and minor losses)
Minimum Capacity	60 cfs at TDH of 18 to 31 ft	

Figure 4 shows that the pumps, if equipped with VFDs, are capable of providing 60 to 370 cfs at all of the anticipated operating points. An important item to note is that Table 1 shows the pipeline diameter at 8.5 feet. During the pump selection process, the pipe diameter was increased from 8 feet to 8.5 feet to reduce the friction losses in the pipeline. The reason for this is the pumps are pumping against a relatively low amount of static head and a relatively high proportion of friction head, especially at higher flows. This made pump selection challenging in that even with a set of smaller low head pumps and set of larger, high head pumps, it was difficult to find pumps that could cover the full range of flows while overcoming the friction losses from the smaller 8-foot diameter pipe.

Another key consideration is that when demands are less than 120 cfs, the 8.5-foot diameter pipeline is capable of conveying the entire capacity of conveying untreated water to meet those demands without pumping. This would allow the District to convey untreated water without using the pump station during low demand periods.

Figure 4: Neroly Pump Station System and Pump Curves

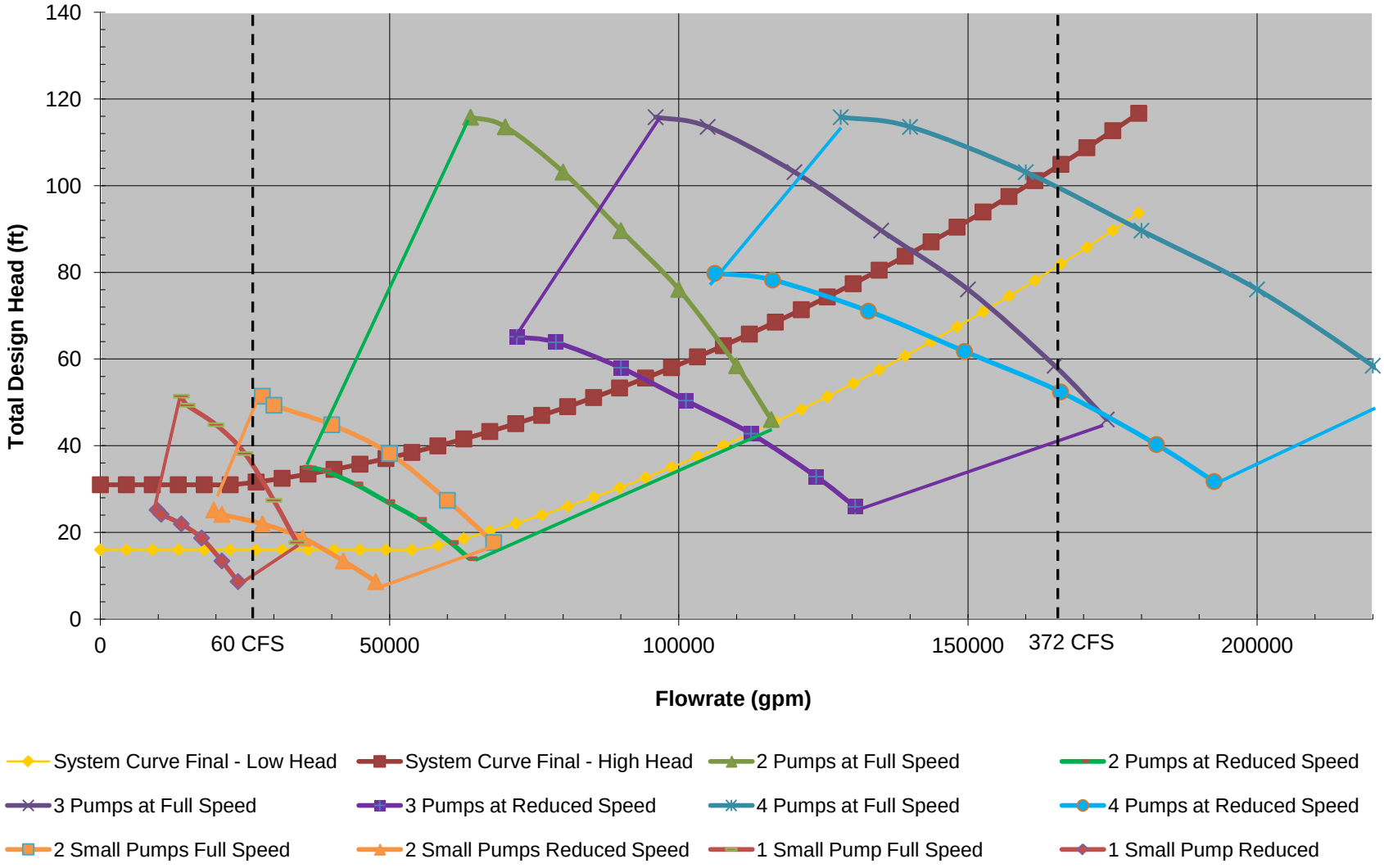

Table 2 shows the pump design criteria for the Neroly Pump Station.

Table 2 Pump Design Criteria
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Design Criteria	Number	Comments
Type	Vertical Turbine	There are a limited number of manufacturers that provide vertical turbine pumps that can provide 70-90 cfs pumps at this TDH. Fairbanks Morse is the dominant pump manufacturer in this size range.
Design Capacity	Five Pumps: 93 cfs @ 102 ft Four Pumps: 74 cfs @ 60 ft	4 + 1 (duty + standby) 3 + 1 (duty + standby)
93 cfs Pump Model Number	Fairbanks 57H 7000	39.375" impeller (40" max)
93 cfs Pump Motor Size	1250 hp	
93 cfs Pump Speed	590 rpm	
74 cfs Pump Model Number	Fairbanks 57H 7000	35.8125" impeller (40" max)
74 cfs Pump Motor Size	700 hp	
74 cfs Pump Speed	510 rpm	

DISCHARGE PIPELINE ALIGNMENT AND GENERAL CHARACTERISTICS

The new pumping plant will pump the untreated water from the Neroly Equalization Reservoir into a new 8.5-foot diameter pipeline. The welded steel pipeline will be installed within the existing canal alignment. Where the canal transitions to a siphon, the siphons will either be lined with welded steel pipe or the pipeline will be installed in a new tunnel parallel to the siphon. Similarly, where vehicle and utility bridges pass over the canal, the new pipeline will either be routed within the canal alignment or will be tunneled under, or trenched through, the roadways.

The new pipeline will have the following advantages over the existing canal. The pipeline will:

- Significantly increase the reliability of the Districts untreated water conveyance system as the pipeline is not at risk to ground movement/slope instability.
- Increase the water quality; untreated water quality degradation from groundwater seepage, algae and nuisance weeds is eliminated.
- Eliminate risk to life safety from intentional or unintentional trespass.
- Significantly reduce water loss due to seepage and evaporation.
- Eliminate risk of contamination from hazardous chemical spills or intentional sabotage.

- Provide a new community benefit because the East Bay Regional Parks District (EBRPD) public access recreational trail can be expanded and improved.

DISCHARGE PIPELINE CONSTRUCTION

Unlike Rock Slough, the Main Canal does not have enough property on either side of the canal to allow the new pipeline to be constructed parallel to the existing canal. Therefore, the pipeline must be constructed within the canal and the canal will have to be bypassed during construction. The bypass will be discussed in the following section.

The pipeline will be installed in a buried condition via open trench construction. Because the cross section of the canal property changes along the canal length, three typical trench sections were prepared to show how the new pipeline would be constructed within the existing canal alignment. Figures 5, 6, and 7 show the pipeline trench section. The location of the bypass pipeline is also shown in each figure.

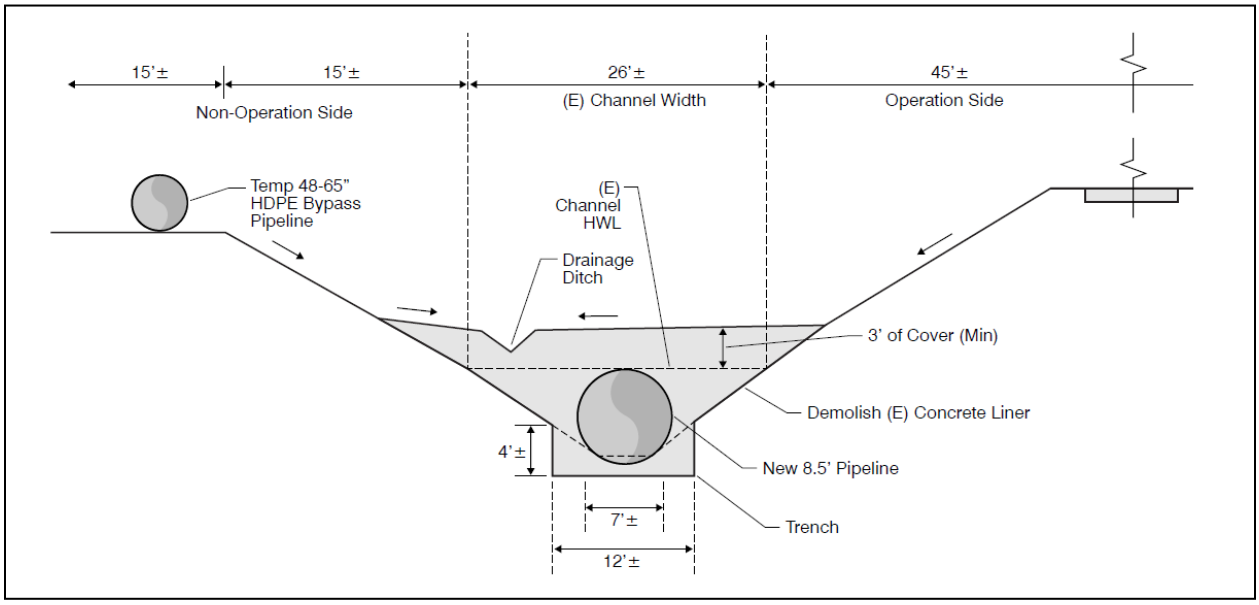

Figure 5 – Pipeline Installed in the Canal where the Canal is in a Valley between the Operations and Non-Operations sides of the Canal.

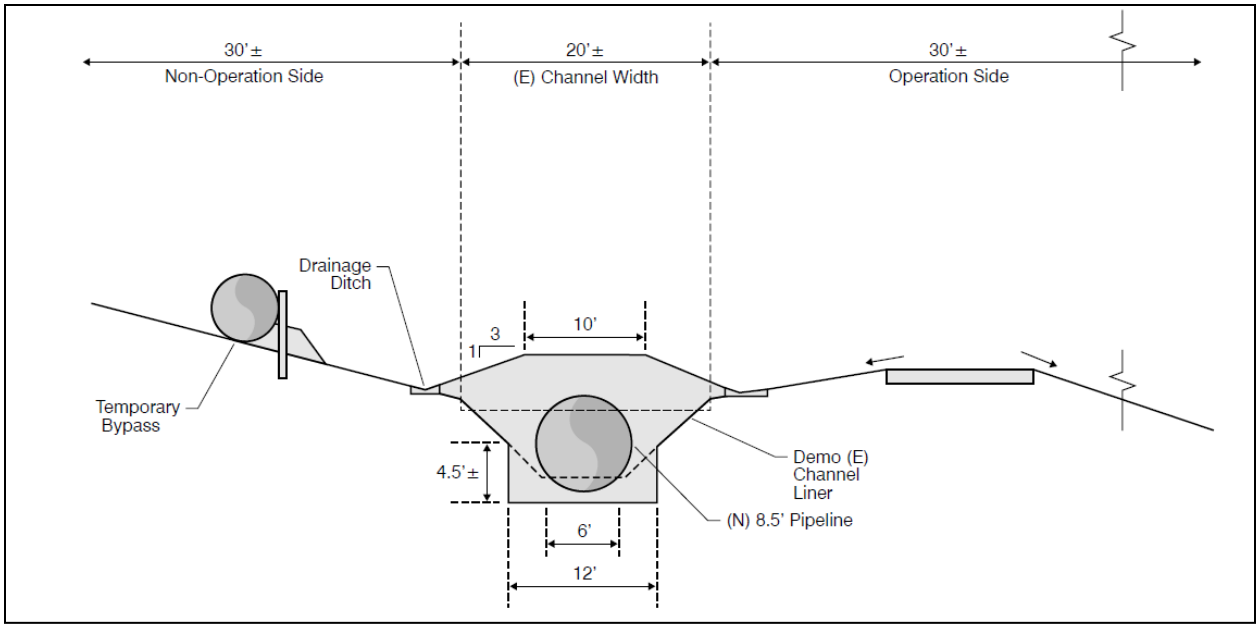

Figure 6 – Pipeline Installed in the Canal where the Canal is Constructed on a Slope

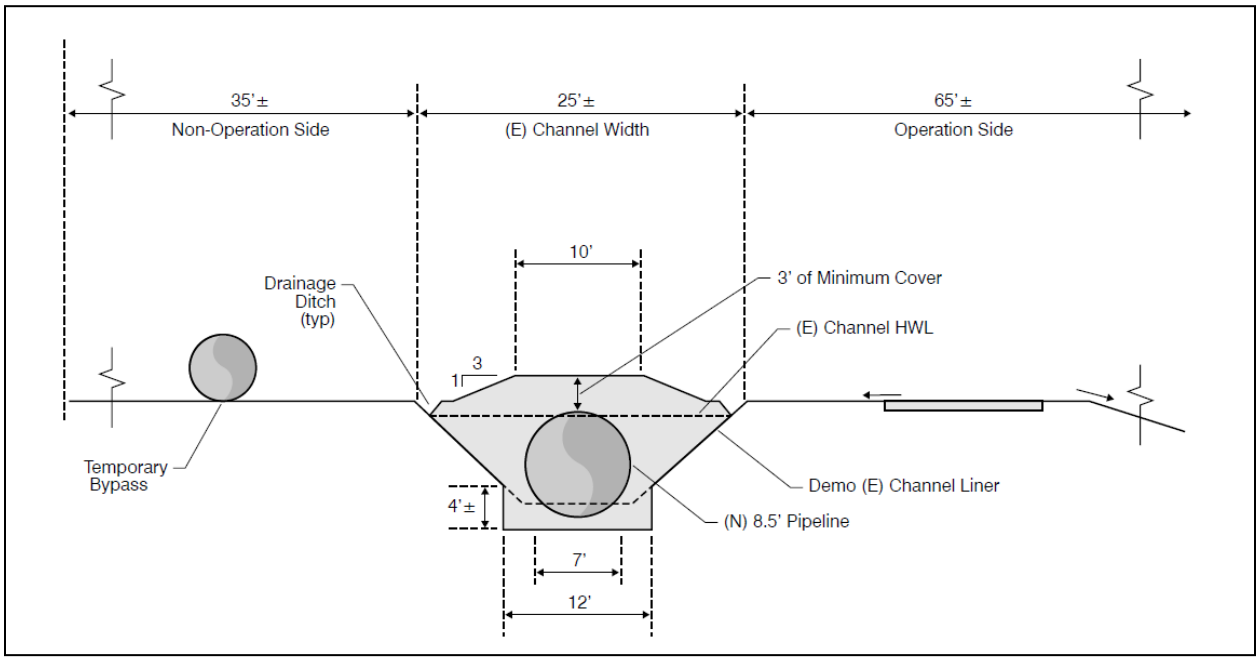

Figure 7 – Pipeline Installed in the Canal where the Canal is at the same Grade as the Operations and Non-Operations sides of the Canal

As shown in Figures 5, 6, and 7, installing the pipeline in the center of the canal allows the trench excavation to be minimized. With a conventional rectangular trench, the trench excavation would only have to be four feet deep, which minimizes the shoring requirements. Aggregate base rock would be trucked in to provide bedding and backfill material. For backfill above the springline, it is likely that there will not be enough native material to provide 2-3 ft of

cover over the pipeline. A key consideration during the design of the new pipeline will be locating inexpensive sources of backfill materials.

Another option would be to use native soil-cement controlled low strength material (CLSM) for backfill. By using self-compacting native soil-cement CLSM for backfill, the trench could be constructed with a circular bottom instead of a flat bottom. This would improve the stability of the trench sidewalls and reduces the required quantity of the backfill material. This construction technique was used by Ranger Pipelines during the construction of the 72-inch diameter pipeline across Victoria Island in 2010.

It may be beneficial to the District to allow both types of trenches in the contract documents for the pipeline phase of the project. This would allow the pipeline contractors to determine the most cost effective approach to the work based on their experience and market conditions.

STORMWATER DRAINAGE

The trench sections shown in Figures 4, 5, and 6 all allow for the construction of stormwater drainage ditches along the pipeline alignment. The conveyance of stormwater runoff from nearby properties is a key consideration for this canal to pipeline conversion project. Stormwater drainage is discussed in more detail in Technical Memorandum No. 3.

Siphons/Tunnels

The pipeline route includes approximately 11 siphons and tunnels. The reinforced concrete pipe (RCP) siphons are not rated at a pressure suitable for the new pipeline, so the RCP siphons must either be lined or bypassed/removed from service.

Lining the siphon consists of lining the RCP with welded steel pipe (WSP). Lining large diameter RCP with WSP is fairly common in the water industry, especially in Southern California. Gantry Construction of Arizona was consulted during this study; they have performed RCP lining projects throughout the western United States, including for the Provo Canal to Pipeline Project.

The WSP would have a diameter approximately 6-inches smaller than the diameter of the RCP. The WSP would be shop fabricated to match the dimensions of the interior of the existing siphon. The WSP would then be installed inside the pipe and welded to the adjacent WSP sticks and fittings to form a fully restrained pipeline. The annular space between the outside of the WSP and the inside of the RCP is filled with grout.

The other alternative is to abandon the siphons altogether and replace them with parallel pipelines that would be installed by tunneling under the roadways and railroad tracks. This method of construction would allow these portions of the pipeline to be constructed without impacting the operation of the canal. However, it would be less expensive to construct smaller diameter tunnels for a temporary bypass pipeline during construction than it would be to construct larger diameter tunnels for the permanent 8.5’ diameter pipeline. In addition, the bypass pipeline tunnels could be maintained for future use if/when the lined siphons are taken out of service for maintenance.

Because constructing smaller diameter tunnels for the temporary bypass pipeline is less expensive than constructing large diameter tunnels for the permanent 8.5 ft diameter pipeline, it is recommended that the siphons be lined with WSP and tunnels be constructed for the bypass pipeline.

Pipeline Laterals

The Main Canal has many laterals that provide water to both large and small untreated water customers. When a new pipeline is constructed, each lateral will need to be modified to accommodate the new pipeline, which may operate in both a pressurized and gravity modes. There are two proposed methods of regulating and metering flow to each customer. Depending on the nature of each customers facilities, either or both of the options described below may be well suited to each customer.

- Option 1- Throttling valve with flowmeter: The existing lateral would be directly connected to the new 8.5-foot diameter pipeline. The new connection would include an electrically actuated butterfly valve and a magnetic flow meter sized to allow the customer to draw the quantity of untreated water that they require over the full range of pipeline operating pressures. The throttling valve would regulate the flowrate through the lateral based on either the level in the customer's storage basin or the flowrate through the flowmeter. The PLC at the new Neroly Pump Station would control the throttling valve. The PLC would be connected to the throttling valve and flow meter with a new fiber optic communications cable that would be installed parallel to the new pipeline.
- Option 2 - Altitude Valve: If the customers have a storage tank or basin, the existing lateral would be directly connected to the new 8.5-foot diameter pipeline. The lateral would be provided with a gate valve for isolation and a magnetic flow mete. An altitude valve would be installed on the lateral at the customers' storage tank or basin The altitude valve would regulate flow into the storage tank or basin by opening and closing based on the position of a float or integral pressure sensor in storage tank or basin.

During preliminary design, a survey of the untreated water customers facilities should be performed to determine the appropriate type of flow regulation for each customer.

Terminal Reservoir

The 3-MG reservoir will be likely be a buried, prestressed concrete, cylindrical type reservoir, as this is the most cost effective type of reservoir construction in this size range . It will provide equalization storage for the new pump station and pipeline storage system. it will also provide some limited equalization when the pipeline is operated in gravity mode.

The ideal location for the buried reservoir would be under an existing hill just to the east of the canal. However, this location would require that the District obtain a permanent easement, or that property be acquired, from the Concord Naval Weapons Station. The reservoir will have a column supported flat concrete roof, which will be covered with earth after construction of the tank is complete. The reservoir will have a diameter of 160 feet and a sidewater depth of 20 ft.

Alternatively, the equalization reservoir could be located just to the south of the canal on a flat, preexisting cut near MP 25.2. This property is also part of the Concord Naval Weapons Station.

Construction Sequencing

The Main Canal is the District's key conveyance facility and can only be taken off-line for brief time periods during low demand periods. For this reason, the sequencing of the construction of the new pump station, pipeline and reservoirs is critical and complex. The following subsections describe one approach for constructing the pipeline while meeting the District's untreated water demands.

Construction of Neroly Pump Station and Reservoir:

The Neroly pump station and reservoir can be constructed over a 24-month period without significant impacts to the operation of the Main Canal. The first step would be to relocate the MPP and the stormwater drain pipeline. The relocated section of the MPP could be constructed first and then tied into the existing MPP. We estimate that this tie-in should take no more than 14 days. After construction of the reservoir and pump station, temporary bulkheads would be required for the construction of the tie-in between the reservoir and the box culvert and for the construction of the isolation valve vault between the pump station discharge and the box culvert.

If completed prior to the first segment of the new 8.5-foot diameter pipeline, the Neroly reservoir could be used as a wet well for the temporary bypass pumps that will be discussed in the pipeline subsection below.

Construction of 8.5 foot Diameter Pipeline:

Because the pipeline will be constructed in the existing canal, operation of the canal is not possible during pipeline construction. For this reason, a temporary bypass of the canal is required. Because it is not realistic to bypass the entire 18.5 mile length of the Main Canal, the canal must be bypassed in segments. A bypass length of two miles was selected based on bypass pipeline production rates, WSP production rates, and the pumping limitations of typical bypass pumps.

The design bypass flowrate was selected using monthly water demands provided by the District The water demands are summarized in Table 3. The demands for the winter months were not included in the water demands provided the District so estimated values are provided in the Table. Using the pump curves from the most commonly used high capacity bypass pump (DV-400c by PowerPrime pumps), 2-mile long HDPE pipes were modeled using a design TDH of 100 feet. The DV-400c has a capacity of 30 cfs at a TDH of 100 feet. A 65-inch diameter HDPE pipeline coupled with eight DV-400c pumps is capable of providing over 210 cfs of flow through a 2-mile temporary bypass pipeline. This combination is sufficient to allow the bypass to be operated in all months except for the months of July and August. This assumes a worst-case scenario where the MPP could not be used to bypass any of the untreated water demand. The pumping operation would be similar in scope to the temporary bypass operation that took place during the construction of the District's Rock Slough Fish Screen Facility.

Therefore, to allow for the new pipeline to be constructed, the canal would need to be bypassed with a 2-mile, 65-inch outside diameter HDPE and eight DV-400c pumps.

The production rate for an HDPE pipeline of this diameter is approximately 160 feet per day. For a two-mile bypass, this translates to a construction period of 65 working days for the bypass pipeline.

Production rates for the 8.5-foot diameter WSP pipeline are likely to range from 120 feet to 700 feet per day. This range was developed based on discussions with two pipeline contractors. A production rate of 120 feet per day is typical for urban environments where the pipeline must be backfilled by the end of every working day. A production rate of 700 feet per day was the maximum production rate for a recent 10-foot diameter pipeline project. These production rates translate to a range of 15 to 88 working days, not including mobilization and demobilization.

Table 3 Untreated Water Demand Canal Rehabilitation Feasibility Studies Contra Costa Water District	
Month	**Demand (cfs)**
January	100 (assumed)
February	100 (assumed)
March	130 (assumed)
April	140
May	180
June	200
July	210
August	230
September	200
October	170
November	130 (assumed)
December	100 (assumed)

Assuming that the first two miles of bypass pipeline are constructed prior to a canal shutdown in September, the first two miles of 8.5-foot diameter pipeline would be constructed in 3 months. After this segment of pipe is complete, it would take approximately 2 months of time to relocate and re-fuse the HPDE bypass pipeline and pumps, and another three months to construct the section 2-miles of WSP. Assuming 1 month each for mobilization and demobilization, in 10 months, 4 miles of canal could be replaced. This translates to a 5-year construction period for the pipeline.

The pipeline must be constructed from east to west (segment 1 to segment 9) to allow the use of the Neroly Pump Station during the interim stages of construction when only a portion of the pipeline is complete. Throttling valves will be provided, if necessary, to allow the pump station to function despite the low head conditions during the initial phases of construction. It is also possible that the higher head set of Neroly Pumps could be used in place of the bypass pumps.

Bypassing Around/Through Siphons, Roadways, and Bridges

Because the Main Canal passes under a myriad of roadways, railroad tracks, and waterways either via siphons or under bridges, the bypass pipeline must either be routed over the obstacle, under the bridge, or tunneled below the obstacle. For this study, five 2-mile segments of this canal route were selected for more detailed study of bypass options around these obstacles. The bypass pipeline routes for segments 1, 2, 6, 7, and 9 are shown in Figures 8, 9, 10, 11, and 12, respectively. In general, tunnels were selected for locations where the bypass pipeline could not fit under bridges (e.g., at siphons) or where there were multiple obstacles in close vicinity to each other (e.g., Highway 4 and Bailey Rd in Segment 6). It was assumed that the bypass pipeline could be routed over local roads, necessitating a 3 to 4 month road closure, if other nearby routes were available for traffic detours. The figures show that the construction and operation of a temporary bypass appears feasible.

Due to the lengthy construction period associated with tunneling projects, it is anticipated that the tunnels will be constructed well in advance of the pipe construction in those segments. Some property may have to be purchased for the tunnel jacking and receiving pits. Where possible, the jacking and receiving pits were located in parking lots and in undeveloped areas.

A less expensive alternative would be to install the temporary pipe across the highly trafficked roadways via open trench construction. This would require full or partial roadway shutdowns that may not be feasible. This alternative should be studied in more detail during the next phase of this project.

Terminal Reservoir

The terminal reservoir at MP 25.7 should be constructed in advance of the completion of segment 9 of the pipeline. Other than that, no special construction is expected at this location.

Figure 8
SEGMENT 1 BYPASS PLAN
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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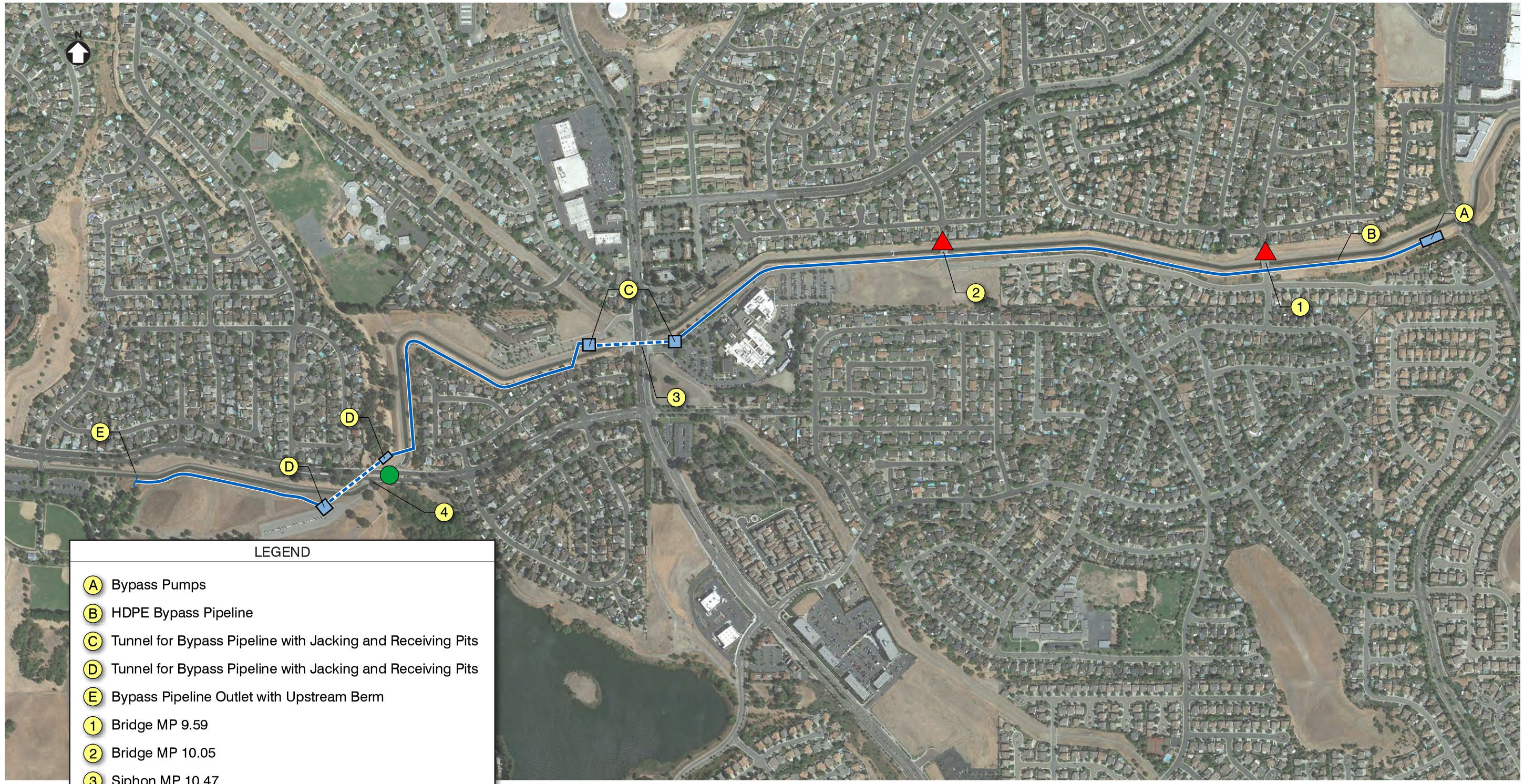

LEGEND

- (A) Bypass Pumps
- (B) HDPE Bypass Pipeline
- (C) Tunnel for Bypass Pipeline with Jacking and Receiving Pits
- (D) Tunnel for Bypass Pipeline with Jacking and Receiving Pits
- (E) Bypass Pipeline Outlet with Upstream Berm
- (1) Bridge MP 9.59
- (2) Bridge MP 10.05
- (3) Siphon MP 10.47
- (4) Siphon MP 11.01
- Road Closure
- No Road Closure

Figure 9
SEGMENT 2 BYPASS PLAN
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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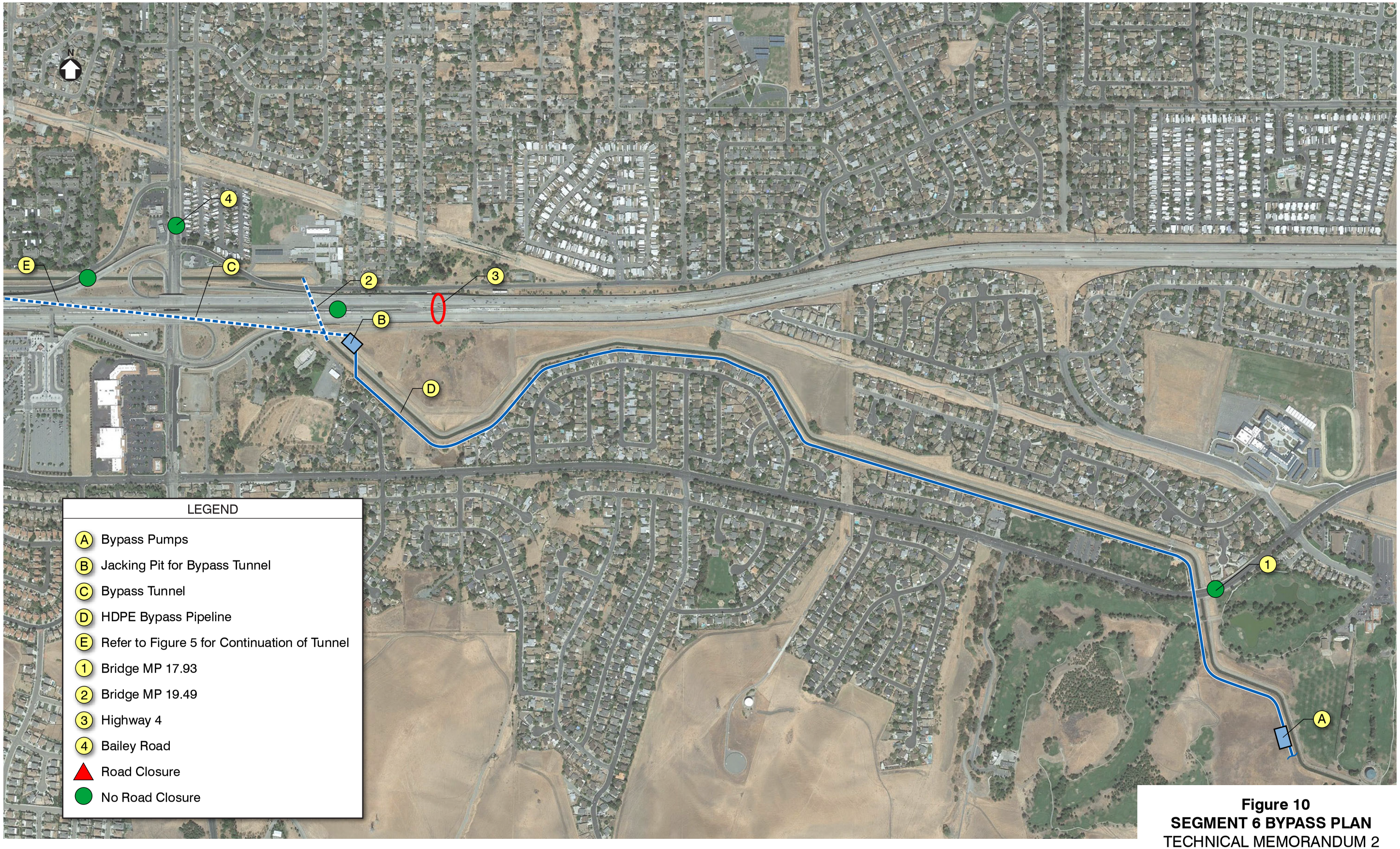

Figure 10
SEGMENT 6 BYPASS PLAN
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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Figure 11
SEGMENT 7 BYPASS PLAN
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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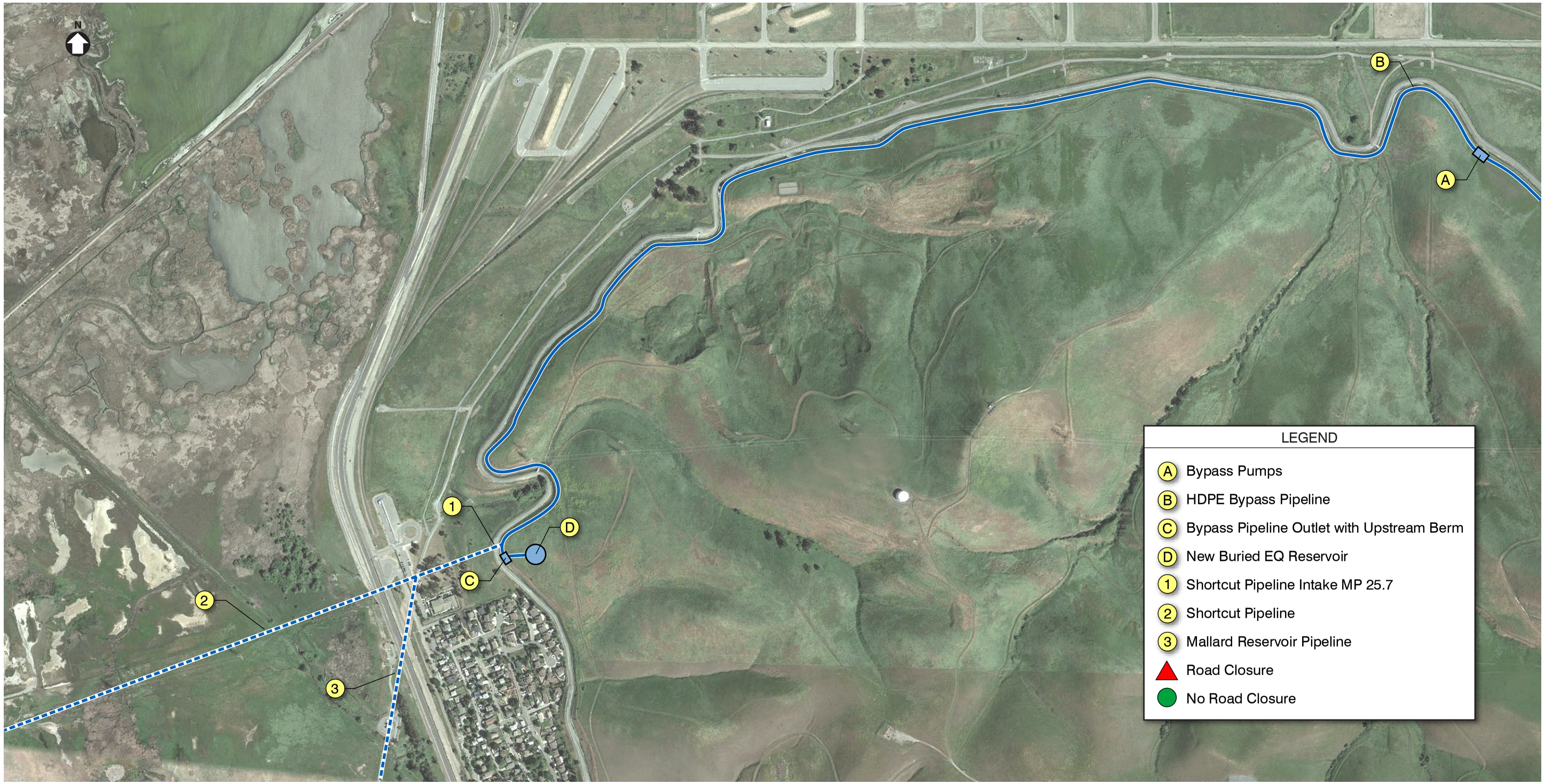

Figure 12
SEGMENT 9 BYPASS PLAN
TECHNICAL MEMORANDUM 2
CONTRA COSTA WATER DISTRICT

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COST ESTIMATES

Cost estimates were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in April 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 4 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. For example, welded steel pipe quotes were obtained from Northwest Pipe, pump and drive estimates were escalated from the Middle River Pump Station Project, and Carollo's unit price catalog was used for pricing of earthwork. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

Cost Estimate Assumptions

The cost estimates presented here are preliminary in that they were prepared in advance of any detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

1. Construction of below grade infrastructure would be accomplished via conventional open trench.
2. Groundwater along the canal is minimal.
3. Excavated material and spoils are disposed on-site.
4. The following contingencies are applied to each of the estimates:
    a. General contingency for unforeseen conditions, changes, or design details: 40 percent.
    b. General conditions: 15 percent.
    c. General Contractor Overhead, Profit, and Risk: 10 percent.
    d. Escalation to the mid-point of construction: 2 percent per year (for three years).

e. Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).

f. Bid Market Allowance: 0 percent

g. Engineering, Legal, and Administration Fees: 20 percent.

h. Change Order Allowance: 5 percent.

Cost Estimates

The cost estimates for each improvement are indicated in Table 4. Detailed cost estimates are included in Appendix A.

Table 4 Capital Improvement Costs[1]
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Phase	Capital Costs (Millions of Dollars)
Neroly Pump Station and Reservoir[2]	$35.9
MPP Relocation[2]	$0.9
8.5 ft Diameter Pipeline[2]	$143.7
Terminal Reservoir	$6.7
Bypass Pipeline and Pumps	$19.3
Bypass Tunnels	$27.4
Bypass Operation (Labor, Equipment, Fuel)	$13.8
Lateral Modifications[2]	$8.4
Subtotal (Construction Cost) [2]	**$256.1**
Design, Legal, and Administrative Fees (20%)	$51.2
Change Orders (5%)	$12.8
Total (Project Cost)	**$320.1**

Notes:
(1) Based on April 2014 dollars; ENRCCI=10,895.
(2) Includes the contingencies stated in the cost estimate assumptions section.

ITEMS FOR FURTHER CONSIDERATION AND STUDY

- The future role of Contra Loma Pump Station and Reservoir in relation to the new pipeline and Neroly Pump Station should be investigated. The Reservoir could be used in place of the terminal reservoir, but this would require pumping to an elevation of 205 ft under all conditions. This would be energy intensive.
- The volumes of the new Neroly reservoir and the terminal reservoir should be further defined based on District SCADA information, the characteristics of the Los Vaqueros flow control valves, and input from District Engineering and Operations staff.

- Once the pump selection is finalized, a surge analysis should be performed to verify that measures to mitigate hydraulic transients are not required.
- The project phasing, construction schedules, and bid packages should be defined.
- The remaining pipe segments should be surveyed to define where tunnels and road closures are required. The ability of the District to shut down certain roadways during pipeline construction should be confirmed.
- Bypass flowrates should be confirmed with District Engineering and Operations staff.
- Explore cost saving measures such as using CLSM backfill for the pipeline, discussions with pipeline contractors to confirm installation costs, and the use of the Neroly pumps in place of temporary bypass pumps.

Prepared By:

Colin Barrett

Appendix A – Detailed Cost Estimates

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Detailed Cost Estimate

PROJECT : Neroly Pumping Plant and Reservoir
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	Sitework				$3,017,832	
2	Pump Station and Reservoir				$12,244,895	
4	Substation				$1,898,718	
5	Electrical Building				$1,475,384	
	TOTAL DIRECT COST					**$18,636,829**
	Estimating Contingency	40	%	$7,454,732		
	SUBTOTAL				**$26,091,561**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,174,120		
	SUBTOTAL				**$27,265,681**	
	General Conditions	15	%	$3,913,734		
	SUBTOTAL				**$31,179,415**	
	General Contractor Overhead and Profit	10	%	$2,609,156		
	SUBTOTAL				**$33,788,572**	
	Rate of Annual Inflation	2.0	%	$2,068,131		
	SUBTOTAL				**$35,856,702**	
	ESTIMATED CONSTRUCTION COST					**$35,856,702**
	Design, Legal, and Administrative Fees	20	%	$7,171,340		
	SUBTOTAL				**$43,028,043**	
	Change Orders	5.0	%	$1,792,835		
	SUBTOTAL				**$44,820,878**	
	TOTAL PROJECT COST					**$44,820,878**

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PROJECT : Neroly Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Site Work

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$2,199,212
	Excavation	16963	CY	$4.00	1.00	1.200	$81,422	
	AC pavement	6000	SF	$4.00	1.00	1.200	$28,800	
	Dewatering	1	LS`	$250,000.00	1.00	1.200	$300,000	
	Pile Driver Mobilization	1	LS	$20,000.00	1.15	1.050	$24,150	
	Z-sheets for Reservoir	24800	SF	$40.00	1.15	1.050	$1,197,840	
	Walers and Bracing for Pump Station Excavation	1	LS	$400,000.00	1.15	1.050	$483,000	
	ABC for Site	1000	CY	$70.00	1.00	1.200	$84,000	
DIV. 13000								$195,648
	Flow Meter							
	Ultrasonic meter	1	EA	$50,000.00	1.18	1.200	$70,800	
	Cathodic Protection - WSP Conveyance Pipeline							
	Anode Bed (2-60lb Magnesium Anodes)	1	EA	$3,000.00	1.36	1.200	$4,896	
	Post Mounted Test Station	1	EA	$2,000.00	1.36	1.200	$3,264	
	Insulating Flange Kits - Above Grade	6	EA	$500.00	1.36	1.200	$4,896	
	Rectifier and Deep Bed Anode	1	EA	$60,000.00	1.36	1.200	$97,920	
	6" AWG Bond Cables	30	EA	$150.00	1.36	1.200	$7,344	
	72" AWG Bond Cables	5	EA	$300.00	1.36	1.200	$2,448	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.36	1.200	$4,080	
DIV. 15000								$120,000
	Miscellaneous Piping/Valves	1	LS	$100,000.00	1.00	1.200	$120,000	
DIV. 16000								$502,972
	Electrical Allowance (Based on Middle River PS Estimate)	1	AL	20.00%	1	1.000	$502,972	
TOTAL								**$3,017,832**

carollo

Engineers...Working Wonders With Water™

PROJECT : Neroly Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 03000								$3,274,384
	24" Base Slab	1,259	CY	$350.00	1.00	1.200	$528,889	
	30" Walls	1,556	CY	$750.00	1.00	1.200	$1,400,000	
	18" Elevated Slab - Reservoir Top Deck	944	CY	$650.00	1.00	1.200	$736,667	
	Columns	105	CY	$1,500.00	1.00	1.200	$188,496	
	Structural Concrete - Pump Base	20	CY	$500.00	1.00	1.200	$12,000	
	18" x 30" Beams	118	CY	$1,000.00	1.00	1.200	$141,667	
	Structural Concrete - Pump Suction Wetwell Fill	444	CY	$500.00	1.00	1.200	$266,667	
DIV. 05000								$131,250
	Pipe Supports	1	AL	$75,000.00	1.00	1.050	$78,750	
	Misc Metals	1	AL	$50,000.00	1.00	1.050	$52,500	
DIV. 11000								$7,227,684
	High Lift Pump, Motor and Drive - 1500hp.	5	EA	$775,621	1.00	1.230	$4,770,069	
	Low Lift Pump, Motor and Drive - 800hp.	4	EA	$499,515	1.00	1.230	$2,457,614	
DIV. 13000								$52,848
	Pressure Transmitters	9	EA	$1,500.00	1.27	1.180	$20,231	
	Ultrasonic Level - Hydroranger 200	2	EA	$3,000.00	1.27	1.180	$8,992	
	Cathodic Protection - Pump Barrels							
	Rectifier and Wetwell Anodes	1	LS	$20,000.00	1.00	1.050	$21,000	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.00	1.050	$2,625	
DIV. 15000								$1,514,100
	Slide Gate	1	EA	$50,000.00	1.00	1.050	$52,500	
	96" Steel Pipe	50	LF	$750.00	1.00	1.050	$39,375	
	96" Depend-o-Lock Coupling	2	EA	$15,000.00	1.00	1.050	$31,500	
	96" 90 deg Elbow	1	EA	$20,000.00	1.00	1.050	$21,000	
	Allowance for 102" BFV and Valve Vault	1	AL	$200,000.00	1.00	1.050	$210,000	
	Allowance for Tie-in to Box Culvert	1	AL	$150,000.00	1.00	1.050	$157,500	
	Adder for M11 Reinforcement	1	AL	$30,000.00	1.00	1.050	$31,500	
	48" Discharge Pipe	90	LF	$450.00	1.00	1.050	$42,525	
	48" Depend-O-Lock Couplings	18	EA	$10,000.00	1.00	1.050	$189,000	
	48" Slanting Disc Check Valve	9	EA	$45,000.00	1.00	1.050	$425,250	
	48" Butterfly Valve and Actuator	9	EA	$29,000.00	1.00	1.050	$274,050	
	ARV 2"	9	EA	$2,000.00	1.00	1.050	$18,900	
	CAV 8"	4	EA	$5,000.00	1.00	1.050	$21,000	
DIV. 16000								$44,629
	Electrical Allowance (Based on Middle River PS Estimate	1	AL	0.50%	1	1.000	$44,629	
TOTAL								**$12,244,895**

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PROJECT : Neroly Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Substation

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 03000								$43,060
	18" Slab on Grade for Transformer	35	CY	$286.18	1.15	1.400	$15,896	
	18" Slab on Grade Edge Form	100	LF	$16.41	1.15	1.400	$2,641	
	18" Slab on Grade for Breaker/meter and Deadend Struc	21	CY	$286.18	1.15	1.400	$9,829	
	18" Slab on Grade Edge Form	125	LF	$16.41	1.15	1.400	$3,302	
	Metal Grating for Transformer Slab	205	SF	$34.52	1.15	1.400	$11,392	
DIV. 16000								$1,855,657
	#4/0 SDBC Ground Cable	1300	LF	$5.53	1.15	1.400	$11,574	
	10-foot ground rods	31	EA	$33.33	1.15	1.400	$1,664	
	Grounding connections and unlisted items @ 25%						$3,309	
	#2 XHHW	50	LF	$2.76	1.15	1.400	$222	
	#6 XHHW	100	LF	$1.36	1.15	1.400	$219	
	#10 XHHW	15600	LF	$0.76	1.15	1.400	$18,963	
	#12 XHHW	2500	LF	$0.59	1.15	1.400	$2,375	
	#14 XHHW	50	LF	$0.46	1.15	1.400	$37	
	Wire connection and unlisted items @ 15%						$3,272	
	1" GRC	20	LF	$9.26	1.15	1.400	$298	
	3/4" GRC	50	LF	$7.10	1.15	1.400	$572	
	2" PCS elbows and risers	22	EA	$175.60	1.15	1.400	$6,220	
	Conduit fittings and unlisted items @ 25%						$1,772	
	Duplex receptacle	4	EA	$105.00	1.15	1.400	$676	
	Toggle switch	3	EA	$105.00	1.15	1.400	$507	
	NiCd Battry System	1	EA	$12,000.00	1.15	1.400	$19,320	
	Substation transformer - 69kV:4.16/2.4kV, 15 MVA	1	EA	$750,000.00	1.15	1.400	$1,207,500	
	Substation dead-end structure	1	EA	$45,000.00	1.15	1.400	$72,450	
	SF6 Breaker	1	EA	$81,000.00	1.15	1.400	$130,410	
	Overhead Cable	300	FT	$2.25	1.15	1.400	$1,087	
	Substation disconnect	1	EA	$20,000.00	1.15	1.400	$32,200	
	Metering CT/PT	3	EA	$43,000.00	1.15	1.400	$207,690	
	Branch circuit panelboard	2	EA	$1,585.00	1.15	1.400	$5,104	
	Dry type transformer - 480:240/120V, 25 kVA	1	EA	$2,780.00	1.15	1.400	$4,476	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	2	EA	$570.00	1.15	1.400	$1,835	
	Type D luminaire - Ful cut-off 250W HPW pole-mounted	4	EA	$570.00	1.15	1.400	$3,671	
	Pole for type C - 25-foot	4	EA	$850.00	1.15	1.400	$5,474	
	Type F luminaire - Substation up-light	2	EA	$675.00	1.15	1.400	$2,174	
	Type G luminaire - sealed/gasketed	1	EA	$350.00	1.15	1.400	$564	
	Ground masts	2	EA	$9,500.00	1.15	1.400	$30,590	
	Transformer protection relay	1	EA	$5,760.00	1.15	1.400	$9,274	
	Backup overcurrent relay	1	EA	$1,500.00	1.15	1.400	$2,415	
	Lockout relay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Substation ductbank 1	1	EA	$2,026.13	1.15	1.400	$3,262	
	Substation ductbank 2	1	EA	$4,051.63	1.15	1.400	$6,523	
	Control Building	1	LS	$35,000.00	1.15	1.400	$56,350	
TOTAL								**$1,898,718**

Engineers...Working Wonders With Water™

PROJECT : Neroly Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$5,600
	Class II AB	67	CY	$70.00	1.00	1.20	$5,600	
DIV. 03000								$54,802
	12" Slab on Grade	44	CY	$400.00	1.00	1.20	$21,333	
	18" Perimeter Thickened Slab on Grade	60	CY	$400.00	1.00	1.20	$28,800	
	Sump for Switchgear Conduit							
	12" Slab on Grade	2	CY	$304.53	1.00	1.20	$756	
	12" Walls	6	CY	$565.08	1.00	1.20	$3,913	
DIV. 04000								$103,447
	CMU Block Walls	3600	SF	$20.01	1.00	1.20	$86,443	
	Pilaster Adder	3600	SF	$1.56	1.00	1.20	$6,739	
	Seismic Reinforcement Adder	3600	SF	$1.15	1.00	1.20	$4,977	
	Integral CMU Colour Adder	3600	SF	$1.22	1.00	1.20	$5,288	
DIV. 05000								$34,746
	Structural Steel Roof System	1500	LB	$2.30	1.00	1.20	$4,140	
	Structural Steel Angle Around Perimeter	2120	LB	$2.30	1.00	1.20	$5,851	
	Steel Roofing	1800	SF	$5.00	1.00	1.20	$10,800	
	Ladder	1	LS	$500.00	1.00	1.20	$600	
	Hatch	1	LS	$1,000.00	1.00	1.20	$1,200	
	Single Steel Door	4	EA	$907.70	1.00	1.20	$4,357	
	Double Steel Door	3	EA	$1,820.99	1.00	1.20	$6,556	
	2.5" Galvanized Steel Grating	30	SF	$34.52	1.00	1.20	$1,243	
DIV. 12000								$5,250
	Furniture Allowance	1	LS	$5,000.00	1.00	1.050	$5,250	
DIV. 13000								$369,701
	PLC and Appurtences							
	PLC Panel	1	EA	$109,524.00	1.27	1.230	$171,087	
	Shop Drawings	1	LS	$22,500.00	1.05	1.230	$29,059	
	Loop Drawings	1	LS	$27,000.00	1.05	1.230	$34,871	
	Factory Assistance Test (FAT)	1	LS	$14,850.00	1.05	1.230	$19,179	
	Training	1	LS	$17,600.00	1.05	1.230	$22,730	
	Field Installation	1	LS	$48,600.00	1.05	1.230	$62,767	
	Radio System							
	PLC Panel	1	EA	$1,500.00	1.27	1.230	$2,343	
	Surge Suppressor	2	EA	$450.00	1.27	1.230	$1,406	
	Yagi Antennas	2	EA	$700.00	1.27	1.230	$2,187	
	Antenna Cable (appx. 60 feet each)	2	EA	$480.00	1.27	1.230	$1,500	
	Pole Antenna Mounting	1	EA	$1,100.00	1.27	1.230	$1,718	
	TransNet Spread Spectrum Radio (MDS)	1	EA	$2,150.00	1.27	1.230	$3,359	
	MDS 9710 Licensed 900 MHz Radio	1	EA	$1,750.00	1.27	1.230	$2,734	
	Lot-Andrew Sure Ground - Cable Shields	1	EA	$450.00	1.27	1.230	$703	
	Lot-Modification of Tower at Transfer Pump Station	1	LS	$6,500.00	1.27	1.230	$10,154	
	Lot - site work/testing	1	LS	$2,500.00	1.27	1.230	$3,905	
DIV. 15000								$247,927
	HVAC Unit and Ducting	1	LS	$201,566.82	1.00	1.230	$247,927	
DIV. 16000								$653,911
	#4/0 SDBC Ground Cable	350	LF	$5.53	1.15	1.400	$3,116	
	10-foot ground rods	5	EA	$33.33	1.15	1.400	$268	
	Grounding connections and unlisted items @ 25%						$846	
	#10 XHHW	4600	LF	$0.76	1.15	1.400	$5,592	
	#12 XHHW	3200	LF	$0.59	1.15	1.400	$3,040	
	#14 XHHW	2900	LF	$0.46	1.15	1.400	$2,138	
	2CS Instrument cable	500	LF	$1.85	1.15	1.400	$1,489	
	CAT 5e Ethernet	100	LF	$0.78	1.15	1.400	$126	
	Wire connection and unlisted items @ 15%						$1,858	
	250kcmil 5KV	200	LF	$8.88	1.15	1.400	$2,859	
	5kV terminations	24	EA	$370.00	1.15	1.400	$14,297	
	4" PVC 40	150	LF	$19.55	1.15	1.400	$4,721	
	2" PVC 40	100	LF	$8.10	1.15	1.400	$1,304	

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PROJECT : Neroly Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
	1.5" GRC	300	LF	$12.65	1.15	1.400	$6,110	
	1" GRC	50	LF	$9.26	1.15	1.400	$745	
	3/4" GRC	1500	LF	$7.10	1.15	1.400	$17,147	
	4" PCS Elbow & Riser	12	EA	$490.00	1.15	1.400	$9,467	
	2" PCS Elbow & Riser	4	EA	$175.60	1.15	1.400	$1,131	
	Conduit fittings and unlisted items @ 25%						$10,156	
	Duplex receptacle	30	EA	$105.00	1.15	1.400	$5,072	
	Toggle switch	14	EA	$105.00	1.15	1.400	$2,367	
	Dry type transformer - 480:240/120V, 37.5 kVA	1	EA	$3,560.00	1.15	1.400	$5,732	
	Pad-mount transformer - 4.16kV:480/277V, 300 kVA	1	EA	$13,565.00	1.15	1.400	$21,840	
	Electrical System Study	1	EA	$18,000.00	1.15	1.400	$28,980	
	Main 5kV switchgear SWGR-1	1	EA	$215,000.00	1.15	1.400	$346,150	
	Branch circuit panelboard	1	EA	$1,585.00	1.15	1.400	$2,552	
	Distribution panelboard DP-41	1	EA	$7,975.00	1.15	1.400	$12,840	
	Lighting Contactor	1	EA	$650.00	1.15	1.400	$1,047	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	22	EA	$570.00	1.15	1.400	$20,189	
	Type B luminaire - Full cut-off wall pack	6	EA	$570.00	1.15	1.400	$5,506	
	Type E luminaire - emergency/exit fixture	5	EA	$896.00	1.15	1.400	$7,213	
	Field Acceptance Tests	1	EA	$15,000.00	1.15	1.400	$24,150	
	Lockout rleay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Feeder protection relay	5	EA	$2,290.00	1.15	1.400	$18,435	
	Motor protection relay	5	EA	$3,350.00	1.15	1.400	$26,968	
	Motor protection relay remote RTD monitor	5	EA	$1,290.00	1.15	1.400	$10,385	
	Bus differential relay	1	EA	$4,440.00	1.15	1.400	$7,148	
	Fire alarm system	1	EA	$12,000.00	1.15	1.400	$19,320	
TOTAL								**$1,475,384**

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Detailed Cost Estimate

PROJECT : Main Canal Pipeline
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	8.5' Diameter Welded Steel Pipeline - Conventional Trench				$71,531,729	
2	Siphon Lining Adder				$3,130,417	
	TOTAL DIRECT COST					**$74,662,145**
	Estimating Contingency	40	%	$29,864,858		
	SUBTOTAL				**$104,527,004**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$4,703,715		
	SUBTOTAL				**$109,230,719**	
	General Conditions	15	%	$15,679,051		
	SUBTOTAL				**$124,909,769**	
	General Contractor Overhead and Profit	10	%	$10,452,700		
	SUBTOTAL				**$135,362,470**	
	Rate of Annual Inflation	2.0	%	$8,285,266		
	SUBTOTAL				**$143,647,736**	
	ESTIMATED CONSTRUCTION COST					**$143,647,736**
	Design, Legal, and Administrative Fees	20	%	$28,729,547		
	SUBTOTAL				**$172,377,283**	
	Change Orders	5.0	%	$7,182,387		
	SUBTOTAL				**$179,559,670**	
	TOTAL PROJECT COST					**$179,559,670**

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **8.5' Diameter Pipeline** Date: **17-May-14**
Item: **102" WSP** Proj Mgr:: **CB**

DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	102.00	inches
Average **Total** Exc **Depth**	4.50	feet (Include Bed Thickness)
Length	98,000.00	feet
Trench Slope: 1 Vert. to	1.25	Horiz.
Pavement Thickness:	0.00	inches
ABC Depth:	0.00	inches
No.of Pavement Cuts	0.00	Each

CALCULATED QUANTITIES for ESTIMATE			
Liner Removal	=	2,940,000	sq ft
Trench Excavation	=	171,500	cu yd
Bed + Zone fill (Excludes Pipe Volume)	=	130,667	cu yd
Zone Only Fill (Excludes Pipe Volume)	=	111,611	cu yd
Bed Only Fill	=	19,056	cu yd
Backfill Above Zone	=	181,481	cu yd
Surface Restoration Area	=	2,940,000	sq ft
Shoring Area (Optional): Trench Shored Area	=	882,000	sq ft
Shoring Area (Optional): With 30% Toe-In	=	1,173,060	sq ft

INPUT VARIABLES		
Bed Depth =	6.0	in
Zone Depth Above Pipe =	6.0	in
Min. Width =	36.0	in
Side Width (per side x 2) =	24.0	in
Pit Depth =	4.5	ft
	1.0	ft

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Canal Liner Removal	2,940,000	SF	$0.53	$1,558,200	*$15.90*	
Trench Excavation	171,500	CY	$2.11	$361,951	*$3.69*	Assumed excavator used is: CAT 235 with 2 CY Bucket
Surface Restoration	2,940,000	CY	$0.21	$617,400	*$6.30*	Hydroseeding
Zone Only Fill	111,611	CY	$75.00	$8,370,833	*$85.42*	Imported confined material used: Cl 2 AB
Bed Only Fill	19,056	CY	$75.00	$1,429,167	*$14.58*	Imported confined material used: Cl 2 AB
Backfill Above Zone	181,481	CY	$5.25	$952,778	*$9.72*	Assumes relatively inexpensive backfill is availablea above
Earthwork Subtotal				$13,290,329	*$135.62*	springline
Pipe						
	98,000	LF	$594.30	$58,241,400	*$594.30*	8.5' Diameter WSP (Poly coated and lined)
Pipe Subtotal				$58,241,400	*$594.30*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$71,531,729**	***$729.92***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$10,729,759	*$109.49*	
Subtotal				**$82,261,488**	***$839.40***	
Contingency			40.0%	$32,904,595	*$335.76*	
Subtotal				**$115,166,083**	***$1,175.16***	
General Contractor Overhead, Profit & Risk			10.0%	$11,516,608	*$117.52*	
Subtotal				**$126,682,691**	***$1,292.68***	
Escalation to Mid-Point			6.0%	$7,600,961	*$77.56*	2% per year compounded over three years.
Subtotal				**$134,283,653**	***$1,370.24***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$6,042,764	*$61.66*	
Subtotal				**$140,326,417**	***$1,431.90***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$68,794,689**	***$701.99***	
TOTAL ESTIMATED CONSTRUCTION COST				**$140,326,417**	***$1,431.90***	
Engineering, Legal & Administration Fees			20.0%	$28,065,283	*$286.38*	
Owner's Reserve for Change Orders			5.0%	$7,016,321	*$71.60*	
TOTAL ESTIMATED PROJECT COST				**$175,408,021**	***$1,789.88***	

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general

The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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PROJECT : CCWD - Rock Slough Pumping Plant
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Siphon Installation Adder

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 15000								$3,130,417
	Mobilization (Cranes, confined space, etc)	1	LS	$157,500.00	1.00	1.150	$181,125	
	WSP (installation labor adder)	3000	LF	$525.00	1.15	1.000	$1,811,250	
	Grouting	3142	CY	$315.00	1.15	1.000	$1,138,042	
TOTAL								**$3,130,417**

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Detailed Cost Estimate

PROJECT : MPP Relocation
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	36" MPP				$473,604	
	TOTAL DIRECT COST					**$473,604**
	Estimating Contingency	40	%	$189,442		
	SUBTOTAL				**$663,046**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$29,837		
	SUBTOTAL				**$692,883**	
	General Conditions	15	%	$99,457		
	SUBTOTAL				**$792,340**	
	General Contractor Overhead and Profit	10	%	$66,305		
	SUBTOTAL				**$858,645**	
	Rate of Annual Inflation	2.0	%	$52,556		
	SUBTOTAL				**$911,201**	
	ESTIMATED CONSTRUCTION COST					**$911,201**
	Design, Legal, and Administrative Fees	20	%	$182,240		
	SUBTOTAL				**$1,093,441**	
	Change Orders	5.0	%	$45,560		
	SUBTOTAL				**$1,139,001**	
	TOTAL PROJECT COST					**$1,139,001**

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

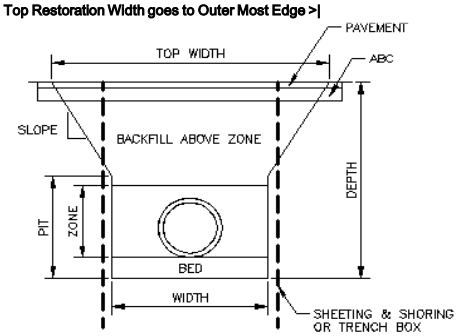
QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **MPP Relocation** Date: **17-May-14**
Item: **42" WSP** Proj Mgr:: **CB**

DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	42.00	inches
Average **Total** Exc **Depth**	8.50	feet (Include Bed Thickness)
Length	650.00	feet
Trench Slope: 1 Vert. to	1.00	Horiz.
Pavement Thickness:	3.00	inches
ABC Depth:	12.00	inches
No.of Pavement Cuts	0.00	Each

|< Top Restoration Width goes to Outer Most Edge >|



Calculated Values

5.5	ft	= Top Trench Width
7.5	ft	= Top Resoration Width

CALCULATED QUANTITIES for ESTIMATE			
Pavement Cutting (per Inch Depth x Length)	=	0	**In ft**
Pavement Removal	=	4,875	**sq ft**
Trench Excavation	=	1,125	**cu yd**
Bed + Zone fill (Excludes Pipe Volume)	=	430	**cu yd**
Zone Only Fill (Excludes Pipe Volume)	=	298	**cu yd**
Bed Only Fill	=	132	**cu yd**
Backfill Above Zone	=	463	**cu yd**
Waste if Import Bed, Zone	=	662	**cu yd**
Waste if Native Bed, Zone	=	232	**cu yd**
Surface Restoration Area	=	4,875	**sq ft**
Shoring Area (Optional): Trench Shored Area	=	11,050	**sq ft**
Shoring Area (Optional): With 30% Toe-In	=	14,697	**sq ft**

= For driven solid shoring

INPUT VARIABLES

Bed Depth =	12.0	in	Default = 6"
Zone Depth Above Pipe =	6.0	in	Default = 6"
Min. Width =	36.0	in	Indicate Practical Bucket Width
Side Width (per side x 2) =	24.0	in	Default @ 12" per side
Pit Depth =	8.5	ft	**See Note #2, #3 and #4**
	1.0	ft	Add'l **allowance** for surface restoration per side **(see Note #5)**

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Pavement Cutting	0	in FT	$0.42	$0	*$0.00*	AC Thickness = 3 in
Pavement Removal	4,875	SF	$0.45	$2,194	*$3.38*	
Disposal Haul	45	CY	$21.00	$948	*$1.46*	Assumed haul distance is: 10 miles
Trench Excavation	1,125	CY	$2.10	$2,363	*$3.64*	Assumed excavator used is: CAT 235 with 2 CY Bucket
~~Bed + Zone fill~~	~~430~~	~~CY~~		~~$0~~	*~~$0.00~~*	
Zone Only Fill	298	CY	$75.00	$22,351	*$34.39*	Imported confined material used: CLSM
Bed Only Fill	132	CY	$75.00	$9,931	*$15.28*	Imported confined material used: Cl 2 AB
Backfill Above Zone	463	CY	$16.80	$7,786	*$11.98*	Native unconfined material from trench used
Waste if Import Bed, Zone	662	CY	$4.25	$2,814	*$4.33*	Assumed waste is spead and distributed on the ROW
~~Waste if Native Bed, Zone~~	~~232~~	~~CY~~		~~$0~~	*~~$0.00~~*	
New Access Rd	4,875	SF	$4.25	$20,719	*$31.88*	Assumes new 3" AC w/8" AB roadbed
Shoring Area	0	DY	$0.00	$0	*$0.00*	N/A
Dewatering	1	AL	$50,000.00	$50,000	*$76.92*	Allowance (groundwater above PP1 should not be an issue)
Trenchbox Allowance	1	AL	$50,000.00	$50,000	*$76.92*	
Earthwork Subtotal				$169,104	*$260.16*	
Pipe						
	650	LF	$420.00	$273,000	*$420.00*	
	3	EA	$10,500.00	$31,500	*$48.46*	Pipe cost includes some fittings
Pipe Subtotal				$304,500	*$468.46*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$473,604**	***$728.62***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$71,041	*$109.29*	
Subtotal				**$544,645**	***$837.92***	
Contingency			30.0%	$163,394	*$251.37*	
Subtotal				**$708,039**	***$1,089.29***	
General Contractor Overhead, Profit & Risk			10.0%	$70,804	*$108.93*	
Subtotal				**$778,842**	***$1,198.22***	
Escalation to Mid-Point			6.0%	$46,731	*$71.89*	2% per year compounded over three years.
Subtotal				**$825,573**	***$1,270.11***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$37,151	*$57.16*	
Subtotal				**$862,724**	***$1,327.27***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$389,119**	***$598.65***	
TOTAL ESTIMATED CONSTRUCTION COST				**$862,724**	***$1,327.27***	

Engineering, Legal & Administration Fees	20.0%	$172,545	*$265.45*
Owner's Reserve for Change Orders	5.0%	$43,136	*$66.36*
TOTAL ESTIMATED PROJECT COST		**$1,078,405**	***$1,659.08***

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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Detailed Cost Estimate

PROJECT : Terminal Reservoir
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	3 MG Reservoir				$3,484,885	
	TOTAL DIRECT COST					**$3,484,885**
	Estimating Contingency	40	%	$1,393,954		
	SUBTOTAL				**$4,878,838**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$219,548		
	SUBTOTAL				**$5,098,386**	
	General Conditions	15	%	$731,826		
	SUBTOTAL				**$5,830,212**	
	General Contractor Overhead and Profit	10	%	$487,884		
	SUBTOTAL				**$6,318,096**	
	Rate of Annual Inflation	2.0	%	$386,718		
	SUBTOTAL				**$6,704,814**	
	ESTIMATED CONSTRUCTION COST					**$6,704,814**
	Design, Legal, and Administrative Fees	20	%	$1,340,963		
	SUBTOTAL				**$8,045,776**	
	Change Orders	5.0	%	$335,241		
	SUBTOTAL				**$8,381,017**	
	TOTAL PROJECT COST					**$8,381,017**

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PROJECT : Terminal Reservoir
JOB # : 9028B.00
LOCATION : Concord, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$413,063
	Excavation	19955	CY	$4.00	1.00	1.200	$95,784	
	Structural Backfill	2400	CY	$75.00	1.00	1.200	$215,984	
	Native Backfill	10000	CY	$5.00	1.00	1.200	$60,000	
	ABC for Site	492	CY	$70.00	1.00	1.200	$41,294	
DIV. 03000								$2,625,000
	Prestressed Concrete DN Tanks Reservoir. 160 ft diameter with 20 ft sidewater depth. Flat roof.	1	CY	$2,500,000.00	1.00	1.050	$2,625,000	
DIV. 05000								$52,500
	Misc Metals	1	AL	$50,000.00	1.00	1.050	$52,500	
DIV. 15000								$228,375
	Allowance for 48"Valve Vault	1	AL	$100,000.00	1.00	1.050	$105,000	
	Allowance for Tie-in to Pipeline	1	AL	$50,000.00	1.00	1.050	$52,500	
	48" Discharge Pipe	50	LF	$450.00	1.00	1.050	$23,625	
	48" Depend-O-Lock Couplings	2	EA	$10,000.00	1.00	1.050	$21,000	
	48" Butterfly Valve and Actuator	1	EA	$25,000.00	1.00	1.050	$26,250	
DIV. 16000								$165,947
	Electrical and Controls Allowance	1	AL	5.00%	1	1.050	$165,947	
TOTAL								**$3,484,885**

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Detailed Cost Estimate

PROJECT : Bypass Pipeline and Pump Purchase
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	65" OD HDPE Pipeline and Bypass Pumps				$10,801,875	
	TOTAL DIRECT COST					**$10,801,875**
	Estimating Contingency	30	%	$3,240,563		
	SUBTOTAL				**$14,042,438**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$631,910		
	SUBTOTAL				**$14,674,347**	
	General Conditions	15	%	$2,106,366		
	SUBTOTAL				**$16,780,713**	
	General Contractor Overhead and Profit	10	%	$1,404,244		
	SUBTOTAL				**$18,184,957**	
	Rate of Annual Inflation	2.0	%	$1,113,065		
	SUBTOTAL				**$19,298,021**	
	ESTIMATED CONSTRUCTION COST					**$19,298,021**
	Design, Legal, and Administrative Fees	20	%	$3,859,604		
	SUBTOTAL				**$23,157,626**	
	Change Orders	5.0	%	$964,901		
	SUBTOTAL				**$24,122,527**	
	TOTAL PROJECT COST					**$24,122,527**

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PROJECT : HDPE Bypass Pipeline and Bypass pumps
JOB # : 9028B.00
LOCATION : Concord, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 11000								$3,360,000
	Bypass Pumps. - DV 400c with Diesel Engine	8	EA	$420,000.00	1.00	1.000	$3,360,000	
DIV. 15000								$7,441,875
	HDPE Pipeline - 2 miles, 65" OD, 59" ID.	5250000	LB	$1.42	1.00	1.000	$7,441,875	
	(assumes it will be replaced once)							
TOTAL								**$10,801,875**

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Detailed Cost Estimate

PROJECT : Bypass Pipeline and Pump Purchase
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	Tunnels, Casings, and Jacking/Receiving Pits				$15,328,970	
	TOTAL DIRECT COST					**$15,328,970**
	Estimating Contingency	30	%	$4,598,691		
	SUBTOTAL				**$19,927,661**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$896,745		
	SUBTOTAL				**$20,824,406**	
	General Conditions	15	%	$2,989,149		
	SUBTOTAL				**$23,813,555**	
	General Contractor Overhead and Profit	10	%	$1,992,766		
	SUBTOTAL				**$25,806,321**	
	Rate of Annual Inflation	2.0	%	$1,579,553		
	SUBTOTAL				**$27,385,874**	
	ESTIMATED CONSTRUCTION COST					**$27,385,874**
	Design, Legal, and Administrative Fees	20	%	$5,477,175		
	SUBTOTAL				**$32,863,049**	
	Change Orders	5.0	%	$1,369,294		
	SUBTOTAL				**$34,232,343**	
	TOTAL PROJECT COST					**$34,232,343**

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PROJECT : Bypass Tunnels
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Site Work

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$5,441,960
	Excavation	160000	CY	$4.25	1.00	1.000	$680,000	
	Dewatering	1	LS`	$840,000.00	1.00	1.000	$840,000	
	Mobilization	4	LS	$105,000.00	1.15	1.000	$483,000	
	Shoring for Jacking/Receiving Pits	51200	SF	$42.00	1.15	1.000	$2,472,960	
	Walers and Bracing for Jacking/Receiving Pits	8	LS	$105,000.00	1.15	1.000	$966,000	
DIV. 15000								$9,887,010
	84" WSP Casing	2047	LF	$4,200.00	1.00	1.150	$9,887,010	
TOTAL								**$15,328,970**

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Detailed Cost Estimate

PROJECT : Bypass Pipe/Pump Installation/Operation
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	Bypass Installation/Operation				$7,715,994	
	TOTAL DIRECT COST					**$7,715,994**
	Estimating Contingency	30	%	$2,314,798		
	SUBTOTAL				**$10,030,793**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$451,386		
	SUBTOTAL				**$10,482,178**	
	General Conditions	15	%	$1,504,619		
	SUBTOTAL				**$11,986,797**	
	General Contractor Overhead and Profit	10	%	$1,003,079		
	SUBTOTAL				**$12,989,877**	
	Rate of Annual Inflation	2.0	%	$795,084		
	SUBTOTAL				**$13,784,961**	
	ESTIMATED CONSTRUCTION COST					**$13,784,961**
	Design, Legal, and Administrative Fees	20	%	$2,756,992		
	SUBTOTAL				**$16,541,953**	
	Change Orders	5.0	%	$689,248		
	SUBTOTAL				**$17,231,201**	
	TOTAL PROJECT COST					**$17,231,201**

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PROJECT : Bypass Pipe/Pump Instatllation/Operation
JOB # : 9028B.00
LOCATION : Concord, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 11000								$7,715,994
	Labor/Equipment to Install Bypass Pipeline	540	DAY	$3,150.00	1.00	1.000	$1,701,000	
	Fusing Machine Rental	18	Month	$21,000.00	1.00	1.000	$378,000	
	Fusing Machine Technician	540	day	$840.00	1.00	1.000	$453,600	
	Bypass Pumps. - Fuel	1234142	gallon	$4.20	1.00	1.000	$5,183,394	
	Bypass Pumps Mob/Demob	9	AL	$31,500.00	1.00	1.000	$283,500	
TOTAL								$7,715,994

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Todd Yamello		
Subject:	Technical Memorandum No. 3 - Main Canal Drainage Study		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

The Main Canal conveys untreated water from Rock Slough and the Los Vaqueros System by gravity to customers and District facilities in eastern and central Contra Costa County. The Main Canal has been operational for more than 70 years and is approaching the end of its useful life as a water conveyance facility.

In addition to conveying untreated water from the California Delta to customers and District facilities, the Main Canal collects and conveys stormwater runoff. Stormwater from the United State Bureau of Reclamation (USBR) property on either side of the canal drains into the canal. In addition, there are off-site properties on the upstream side of the canal that drain into the canal.

The 2013 Update of the Untreated Water Facilities Improvement Program (UWFIP) presented an assessment of the upgrade and replacement alternatives for the Main Canal. The assessment concluded that the replacement of the Main Canal with an 8-foot diameter pipeline and pump station near the existing Neroly Blending facility was the most viable conveyance renewal alternative.

PURPOSE

If the District replaces the Main Canal with a pipeline, the canal will no longer be available to collect and convey stormwater runoff. This memorandum quantifies the stormwater runoff into the Main Canal and presents an approach for handling the stormwater after the existing canal is removed from service.

SUMMARY AND CONCLUSIONS

- If the Main Canal is replaced by a pipeline, managing stormwater drainage from the canal property and off-site properties that drain to the canal appears feasible. The estimated cost of the stormwater facilities is $15.8 M.
- There are relatively few sources of off-site stormwater runoff to the Main Canal, with the exception of Concord Naval Weapons Station (CNWS). The CNWS accounts for 84 percent of the total off-site property that drains to the Main Canal.

- Connections to the existing stormwater collection systems and natural drainage features (e.g. creeks) appear feasible. Because the capacities of the existing collection systems and creeks are unknown, it was assumed that detention basins, sufficient to contain runoff from wet weather event with a 100-year recurrence interval and a 24-hour duration, would be constructed to minimize the hydraulic impacts on the existing collection systems.
- The majority of the detention basins can be placed within existing canal property, with the exception of the detention basins for the portion of the Main Canal that passes through the CNWS. These detention basins will require acquisition of property or easements from the CNWS. However, these detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure is capable of handling the increased stormwater runoff flows.
- Within the canal property, concrete lined ditches will be constructed to convey stormwater to the detention basins. The ditches will discharge to grass lined swales upstream of the detention basins to provide stormwater treatment.
- Additional investigations and modeling should be performed to analyze the capacity of the existing stormwater collection systems and natural drainage features.

DESCRIPTION OF EXISTING INFRASTRUCTURE

The Main Canal is the District's untreated water conveyance backbone, delivering untreated water from its sources in East Contra Costa County to customers in the Central Contra Costa County. Stretching from milepost (MP) 0.0 to MP 25.7, the Main Canal conveys untreated water from both Rock Slough and the Los Vaqueros System to Central Contra Costa County.

The Rock Slough Conveyance System, or the portion of the Main Canal from MP 0.00 to MP 7.05, consists of a fish screening facility, four pumping plants, and a canal. The last pumping plant in the system, Pumping Plant No. 4, discharges to the Main Canal near MP 7.05. After being blended with untreated water from the Los Vaqueros system, the untreated water then flows by gravity through the meandering Main Canal 18.5 miles to MP 25.7 where the Shortcut Pipeline connects to the Main Canal.

After MP 25.8, the canal continues on to the Martinez Reservoir but this portion of the canal is named the Loop Canal. Untreated water customers draw water from the Main Canal at various points along the canal. The Shortcut Pipeline and its offshoots convey a significant quantity of untreated water to downstream customers. The Loop Canal also provides water to customers, but not during the winter months.

BACKGROUND ON TECHNICAL MEMORANDUMS NO. 1 AND NO. 2

This memorandum builds on the two previous technical memorandums prepared during this phase of the Canal Rehabilitation Feasibility Studies. Technical Memorandum No. 1 describes conceptual engineering for the replacement of the Rock Slough portion of the Main Canal with a pipeline and replacement of the four existing Rock Slough Pumping Plants with a new pumping plant. Technical Memorandum No. 2 describes conceptual engineering for the replacement of the Main Canal from MP 7.05 to MP 25.8 with a new pipeline and pumping plant at MP 7.05.

This memorandum complements Technical Memorandums No. 1 and No. 2 by providing an approach to providing conveyance and disposal of stormwater runoff once the canal is decommissioned.

SUMMARY OF 1995 CANAL DRAINAGE STUDY

In 1995, the District's Planning Department prepared a Canal Drainage Study. The study's primary purpose was to assess the potential impacts on stormwater on the water quality of the untreated water. The 1995 Canal Drainage Study identified characteristics of sites that drain to the canal and addressed the significance of drainage on Main Canal water flows and water quality. The study's key conclusions were that:

- Flooding of the Canal system is not likely to occur except under extreme rainfall events of heavy intensity and long duration.
- A storm with a high intensity and long duration has a potential to contribute as much as 68 cfs to the Canal flow.
- The Concord Naval Weapons Station contributes the largest volume of drainage (approximately 50 percent of the total drainage volume).
- There is little evidence that Canal water quality is adversely affected by Canal drainage.

While the study focused primarily on stormwater impacts on water quality in both the Main and Loop Canals, the study provided valuable information for this Main Canal Drainage Study. Particularly of note was the list of eight sites that drain to the Main Canal from outside canal property. These areas were investigated in further detail during the preparation of the drainage area and runoff estimates.

SUMMARY OF 2006 STORMWATER REMEDIATION STUDY

In 2006, GEI Consultants prepared a Stormwater Remediation Study for the District. The study's primary purpose was to develop short and long term mitigation strategies to eliminate stormwater runoff into the Main and Loop Canals at eight high priority sites. The 2006 Stormwater Remediation Study provided preliminary designs as well as short and long term costs to eliminate stormwater runoff into the Canals at these eight locations.

The study focused on providing solutions to eliminate runoff primarily to reduce the sediment load into the Canals and to protect the Canals from slope failures caused by the stormwater runoff. Because the slope failures will be less likely to occur and less likely to damage the pipeline when the canal is converted to a pipeline, some of the proposed improvements are not included in this study (e.g. Nichols Site improvements). In addition, many of the improvements are designed to reroute stormwater flows from relatively small off-site properties. The costs for these improvements are not included in this study because the stormwater facilities proposed by this study will be designed to accommodate the runoff from these off-site facilities, with the following exceptions:

- The stormwater system improvements to reroute the flow from the 15 acre residential development near the Hillcrest Area at MP 8.06 were included in this study because this is a relatively large runoff area.
- New facilities/costs were developed to accommodate runoff from the Concord Naval Weapons Station instead of using the cost estimates included in the 2006 Stormwater Remediation study.

EXISTING STORMWATER INFRASTRUCTURE

Understanding the existing stormwater infrastructure that is located in the vicinity of the Main Canal is important for two key reasons:

- Based on local stormwater collection system maps, it can be inferred as to whether developed and undeveloped properties on either side of the canal drain to the canal or to a downstream component of the stormwater collection system.
- The local stormwater collection system may be utilized to convey stormwater from the canal property once the canal is decommissioned. Therefore, the characteristics and location of the existing local collection systems are important to defining the scope and cost of the new stormwater facilities necessary to replace the canal as a stormwater conveyance facility.

Information on the local collection systems were obtained from several sources. The District obtained stormwater collection system maps from the following Cities and Agencies (only those Cities and Agencies that pertain to the Main Canal are listed below):

- City of Oakley.
- City of Antioch.
- Contra Costa County Flood Control District (City of Antioch and uincorporated areas of the County).
- City of Concord.

In addition, the District provided a copy of the District's Untreated Water Structure Book. The District also provided 11 x 17 color maps of the Main Canal, at an approximate scale of 1":40', that included milepost markers and symbols corresponding to the some of the key infrastructure noted in the structure book.

For areas where stormwater collection system maps were not available (e.g. Concord Naval Weapons Base), Google Earth Pro was used in conjunction with the Structure Book to determine the location of key culverts under the canal. By using all of these sources, a sketch of the existing stormwater collection systems was produced on top of the 11 x 17 color maps of the Main Canal.

DRAINAGE AREAS

In order to estimate the quantity of stormwater runoff from the canal property and other properties that drain to the canal, the Main Canal was divided into 32 separate stormwater drainage areas. For the purpose of this study, only sections of the Main Canal between MP 4.06 and MP 25.8 were studied. Upstream of MP 4.06, the District is currently in the process of replacing the existing unlined canal as part of the Canal Replacement Project. It is assumed that stormwater management measures are incorporated into the design of this project. Beyond MP 25.8, the Main Canal transitions to the Loop Canal. Technical Memorandum No. 5 provides recommendations on stormwater management for the Loop Canal.

Division of the Main Canal into segments is beneficial because it allows stormwater from each segment of the canal to be conveyed to nearby natural or engineered drainage structures instead of being conveyed for long distances. In general, the canal segments were determined by existing barriers to stormwater runoff (e.g. siphons, hills), distance (the limit was set at 1 mile

+/-), the location of existing collection system infrastructure, or natural drainage paths (e.g. creeks, wasteways, etc).

Based on the colorized maps, information contained with the 1995 Canal Drainage Study, the 2006 Stormwater Remediation Study, and Google Earth Pro, the total area of the canal property within each area was calculated using Google Earth Pro's Polygon tool. In addition, the total areas of any offsite properties that appeared to drain to the Canal were also calculated. Elevation and 3D topography information from Google Earth Pro was also used to determine boundaries of off-site watersheds, especially for undeveloped properties adjacent to the Main Canal and within the boundaries of the Concord Naval Weapons Base.

While most sections of the Canal do not appear to collect stormwater from off-site properties, several notable sections that do appear to collect stormwater from off-site properties are included in Table 1. The Concord Naval Weapons Base accounts for 84 percent of the off-site property that drains to the Main Canal. Appendix A contains details on all of the canal drainage areas, including acreage for canal property and off-site properties that drain to the canal.

Stormwater Runoff Estimates

Stormwater runoff estimates were determined using the Rational Equation and design guidelines provided on the Contra Costa County Flood Control District's (CCCFCD) website. To be conservative, runoff was calculated for a wet weather event, or storm, with a 100 year recurrence interval. The key assumptions for this analysis and sources for the assumptions are shown in Table 2.

The peak stormwater runoff for all of the canal property and the off-site properties for a storm with a 100-year recurrence interval was determined to be 258 cfs. Because Main Canal is over 20 miles long, it is unlikely that the peak runoff would occur simultaneously in all of the individual drainage areas. The runoff from each drainage area as well as the area-specific runoff characteristics (rainfall intensity, time of concentration, etc) are included in Appendix A.

Table 1 **Off-Site Drainage Area Summary** **Canal Rehabilitation Feasibility Studies** **Contra Costa Water District**		
Drainage Area	**Off-Site Runoff Area (ac)**	**Comments**
9 (MP 8.06- MP 9.34)	1.7	The hill on the south side of the Main Canal near MP 8.65 appears to drain to the canal. Runoff from the 15-acre Hillcrest residential development will be diverted from the Canal to the City of Pittsburg's stormwater collection system per the 2006 Stormwater Remediation Study.
11 (MP10.05 – MP 10.48)	8.3	Includes the Sutter Delta Medical Center parking lot and the undeveloped area to the east of the parking lot. Refer to the 1995 Canal Drainage Study for discussion on runoff from the parking lot.
13 (MP 11.1 – MP 11.6)	3.9	Includes runoff from a portion of the park not served by storm drains.
14 (MP 11.6 – 12.1)	10.0	Includes runoff from the undeveloped property north of Contra Loma dam (the portion that does not drain to the unnamed creek northwest of the dam)
17 (MP 18.58-14.57)	5.1	Includes segment of Buchanan Rd that drains to the Canal. Refer to the 1995 and 2006 studies for discussions on runoff from this area.
25 (MP 20.1-21.35)	13.0	Assumes that the undeveloped property between Highway 4 and the Main Canal drains to the canal.
26 (MP 21.35 - MP 21.8)	6.1	Includes a nearby hillside that appears to drain to the canal.
28 (MP 22.3 – MP 23.1)	33.0	Includes a large area of the hillside northeast of the nearby housing development that is not drained by the existing stormwater system.
29 (MP 23.1 – MP 23.5)	45.2	Includes two large areas of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal.
30 (MP 23.5 – MP 24.4)	68.0	Includes two large areas of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal.
31 (MP 24.4 – MP 25.2)	54.5	Includes two large areas of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal.
32 (MP 25.2 – MP 25.8)	20.6	Includes large area of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal.

Table 2 Stormwater Runoff Calculation Summary Canal Rehabilitation Feasibility Studies Contra Costa Water District		
Component	**Criteria**	**Comments/Source**
Runoff Formula	Rational Formula	Q = CiA where C is the runoff coefficient, i is the rainfall intensity in in/hr and A is the runoff area in square feet.
Runoff Coefficient (C)	0.3	0.2-0.4 for open, undeveloped areas per CCCFCD runoff coefficient guidelines
Rainfall Intensity (i)	Varies between 0.81 in/hr and 2.19 in/hr	Rainfall Intensity was calculated using the average mean precipitation for the Main Canal (14 to 15 in per annum) from CCCFCD's drawing B-166. The time of concentration (t_c) for each drainage area was then determined for each area using either the Kirpich equation or a velocity of 1.5 fps (the estimated velocity through the concrete lined ditches with a minimum slope). Using the CCCFCD's Precipitation-Duration-Frequency-Depth curves for a storm with a 100 year recurrence interval (Drawing B-162), the rainfall intensity was derived using the drawing and the time of concentration.

PROPOSED STORMWATER FACILITIES

The following stormwater facilities are proposed to manage the stormwater runoff within the canal property. Two examples of the proposed stormwater facilities are shown in Figure 1 (Drainage Areas 1 and 2) and Figure 2 (Drainage Areas 28-32). The figures show the limits of the canal and off-site properties that drain into the canal. The Figures also show potential locations of the concrete lined ditches, detention basins, and connections to existing stormwater systems and/or natural drainage features. Information on drainage areas not shown in Figures 1 and 2 is included in Appendix A.

Concrete-Lined Ditches

Within the canal property, concrete lined, trapezoidal or v-shaped, ditches will be constructed to convey stormwater to the detention basins. The concrete lined ditches will likely discharge to grass lined swales upstream of the detention basins to provide stormwater treatment. In most cases, the V-ditches will be constructed with the minimum constructible slope of 0.1 percent. This minimizes the depth of the ditch in sections of the canal where the ditch conveys stormwater over long lengths of property.

The ditch cross section will vary according to the location along the canal and the corresponding runoff. However, in general, the ditch will have a width of approximately 2 ft at the water line and normal water depth of 1 ft. The concrete lined ditch will be constructed with a slip form and will be reinforced with wire mesh. The placement of the ditch within the canal property will also vary based on the existing and final topography.

Detention Basins and Grass Lined Swales

The concrete lined ditches will drain to detention basins within each canal drainage area. The detention basins would be designed per CCCFCD standards. The required volume of each area's detention basin is contained in Appendix A. For the purpose of this study, it was assumed that the detention basins would hold the entire volume of runoff for a storm with a 100-year recurrence interval and a 24-hour duration (assuming a runoff coefficient of 0.3). This is a conservative assumption that assumes the downstream stormwater collection system and natural drainage features have no available capacity.

The detention basins would have a peak water depth of 4-5 feet and the majority would require less than a half acre of property. Most of the detention basins can be shaped to fit within existing canal property either by building them as a rectangular basins or building a series of smaller basins, with the exception of the detention basins for the portion of the Main Canal that passes through the CNWS. The detention basins at CNWS will require acquisition of property or easements from the CNWS. However, these detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure is capable of handling the increased stormwater runoff flows.

If required, grass swales could be incorporated into the design of the detention basins. The grass swales would be located between the concrete lined ditches and the detention basins and would provide treatment of the stormwater.

Connections to Existing Stormwater Collection Systems and Natural Drainage Features

For each drainage area, connections to the existing stormwater collection systems and natural drainage features appear feasible. Because the unutilized capacity of the existing collection systems and drainage features are unknown, it was assumed that detention basins would be constructed to minimize the hydraulic impacts on the existing collection systems.

The detention basins would be connected to the existing collection systems or natural drainage features by relatively short lengths of pipe, catch basins, and/or concrete lined ditches. Only the drainage areas with the largest runoff would require connection pipes larger than 12 inches in diameter. The drainage areas with the largest runoff would require pipes with a diameter of 18-24 inches. Initial pipe sizes and detention basin volumes are included in Appendix A.

Additional investigations and modeling should be performed to analyze the capacity of the existing stormwater collection systems and natural drainage features prior to designing the stormwater management facilities.

Figure 1
AREAS 1 & 2 STORMWATER DRAINAGE PLAN
MAIN CANAL DRAINAGE STUDY
CONTRA COSTA WATER DISTRICT

ccwd1013f15-9028.ai

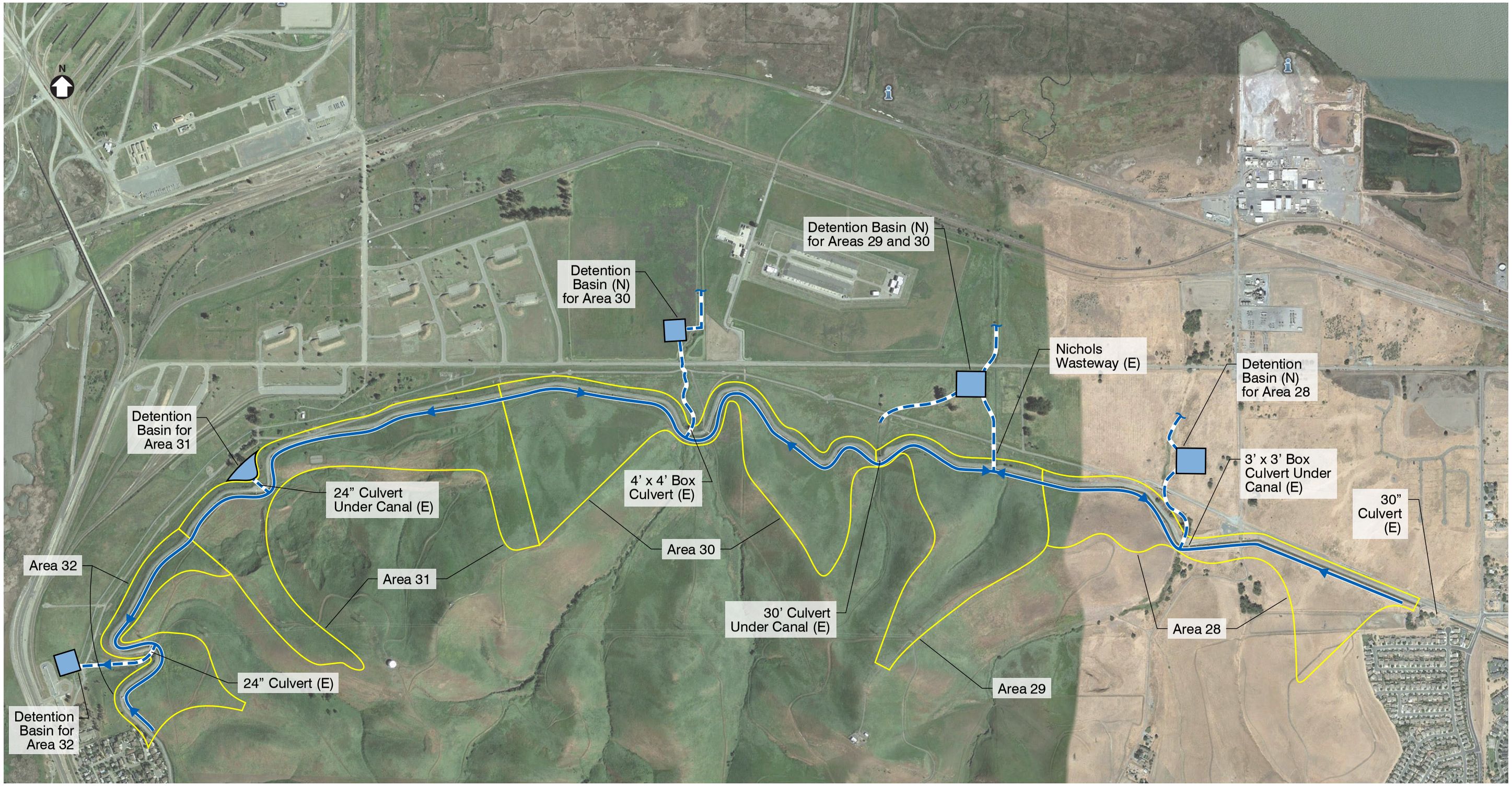

Figure 2
STORMWATER DRAINAGE PLAN FOR AREAS 28-32
MAIN CANAL DRAINAGE STUDY
CONTRA COSTA WATER DISTRICT

ccwd1013f16-9028.ai

COST ESTIMATES

Cost estimates for the new facilities were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in April 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 4 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

COST ESTIMATE ASSUMPTIONS

The cost estimates presented here are preliminary in that they were prepared in advance of detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

- Unit costs for concrete lined ditches were escalated from unit prices contained within the 1999 USBR Canal-Lining Demonstration Project Year 7 Durability Report.
- Costs for dry detention basins were escalated from a cost equation published by the EPA on their NPDES-Stormwater website.
- Construction of below grade infrastructure would be accomplished via conventional open trench.
- Groundwater along the canal is minimal.
- Excavated material and spoils are disposed on-site.
- The following contingencies are applied to each of the estimates:
    a. General contingency for unforeseen conditions, changes, or design details: 40 percent.
    b. General conditions: 15 percent.
    c. General Contractor Overhead, Profit, and Risk: 10 percent.

d. Escalation to the mid-point of construction: 2 percent per year (for three years).

e. Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).

f. Bid Market Allowance: 0 percent.

g. Engineering, Legal, and Administration Fees: 20 percent.

h. Change Order Allowance: 5 percent.

Cost Estimates

The cost estimates for each improvement are indicated in Table 3. Detailed cost estimates are included in Appendix B.

Table 3 Capital Improvement Costs[(1)]
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Phase	Capital Costs (Millions of Dollars)
Concrete Lined Ditches	$4.9
Detention Basins[(2)]	$5.6
Connections to Existing Stormwater Systems[(3)]	$2.1
Subtotal (Construction Cost) [(2)]	**$12.6**
Design, Legal, and Administrative Fees (20%)	$2.5
Change Orders (5%)	$0.6
Total (Project Cost)	**$15.8**

Notes:
(1) Based on April 2014 dollars; ENRCCI=10,895.
(2) Does not include the cost of land acquisition and/or easements at the CNWS.
(3) Does not include connection fees to existing local stormwater collection systems.

Prepared By:

Colin Barrett

Appendix A – Main Canal Stormwater Drainage Area Characteristics and Details on Required Stormwater Management Facilities

Appendix A - Details on each Drainage Area, Stormwater Runoff Calculations, and Description of New Stormwater Management Facilities
Main Canal Drainage Study
Contra Costa Water District

Drainage Area Characteristics					Details on Proposed Stormwater Drainage Connections and Comments			Stormwater Runoff Calculations								General Infrastructure Sizing			
Area ID	MP Start	MP End	Canal Property Drainage Area (ac)	Off-site Watershed Area (ac)	Proposed Stormwater Drain Connection	Required New Stormwater Facilities	Comments	Mean Annual Rainfall (in)	Total Rainfall for 100 year-24 hr storm (in)	Longest Distance to Drain (ft)	Tc (via 1.5 ft/sec waterway)	Tc (via Kirpich Equation)	Intensity (in/hr)	Runoff Coefficient	Peak Runoff, cfs (w/o Detention Basin)	Pipe Size (Diameter in inches)	Detention Basin Volume (cf)	Detention Basin, width (ft) (assumes square shape)	Detention Basin Water Depth (ft)
1	4.06	4.33	3.6	0.0	Drain via adjacent concrete lined ditch on south side of Main St. Ultimately discharges to 42" Oakley SD.	30' concrete ditch and detention basin	Verify Capacity of ditch and 42" SD. Detention basin can be built in canal area near MP 4.1	14	4.2	1425.6	15.84	29.90	1.97	0.3	2.12	12.00	16,371	57	5
2	4.33	4.7	5.3	0.0	Drain to existing 48" Oakley SD near Mp 4.4	300' pipeline and detention basin	Verify Capacity of pipeline. Build detention basin Near MP 4.35. Easement for future Oakley SD pipe could be given to Oakley in exchange for SD connection fee.							0.3					
3	4.7	4.93	3.4	0.0	Drain via canal ROW to existing 48" Oakley SD near MP 4.95.	N/A - drain via Area 2	Detention basin could be constructed at PP2 site. See Area 2 comments for additional comments.	14	4.2	3168	35.2	55.30	1.36	0.3	3.55	12.00	39,652	89	5
4	4.93	5.85	15.7	0.0	Build 300' drain line to existing Oakley 66" SD near MP 4.95	300' pipeline. Build detention basin.	Verify capacity of 66" pipeline.							0.3					
5	5.85	6.03	3.6	0.0	Drain via canal ROW to existing Oakley 66" SD near MP 6.71	N/A - drain via Area 4	See Area 4 comments. Build detention basin at PP3 site.							0.3					
6	6.03	6.64	6.5	0.0	Drain via canal ROW to existing Oakley 66" SD near MP 6.71	N/A - drain via Area 4	See Area 4 comments.	14	4.2	9028.8	100.32	123.86	0.81	0.3	6.30	12.00	118,110	154	5
7	6.64	7.04	5.0	0.0	Drain to Antioch SD to East Antioch Creek	Catchbasin and manhole. Build detention basin.	Verify capacity of Antioch SD.	14	4.2	2112	23.47	40.47	1.79	0.3	2.69	12.00	22,906	68	5
8	7.62	8.06	5.8	0.0	Drain to Antioch SD Jbox near MP 8.0. SD drains to another branch of East Antioch Creek	50' pipeline and detention basin	Verify capacity of Antioch SD. Assumes that 15 acre residential development will be redirected to city stormwater system per 2006 SW Remediation Study (costs for this improvement were escalated and included in the stormwater connection cost estimate) .	14	4.2	2006.4	22.29	38.90	1.88	0.3	3.27	12.00	26,475	73	5
9	8.06	9.34	24.8	1.7	Drain to Antioch SD at MP 8.55. Drains to another brand of East Antioch Creek	Catchbasin, MH, and detention basin	Verify capacity of Antioch SD. Extra watershed near MP 8.65	14.5	4.4	4171.2	46.35	68.34	1.17	0.3	9.25	12.00	126,787	159	5
10	9.34	10.05	14.3	0.0	Drain to Antioch SD at MP 9.6. Drains to East Antioch Creek.	Catchbasin, MH, and detention basin	Verify capacity of Antioch SD.	14.5	4.4	2376	26.40	44.31	1.59	0.3	6.84	12.00	68,710	117	5
11	10.05	10.48	5.4	8.3	Drain to one of two Antioch SD at MP 10.48. Drains to West Antioch Creek.	Catchbasin, MH, and detention basin	Includes Sutter Delta Medical Center Parking Lot and undeveloped lot in watershed area. Verify capacity of Antioch SD.	14.5	4.4	2270.4	25.23	42.79	1.66	0.3	6.84	12.00	65,596	115	5
12	10.48	11.1	8.0	0.0	Drain directly to West Antioch Creek	Earthwork and detention Basin only	West Antioch creek is adjacent to canal from MP 10.83 to MP 11.0. Potential to create park at this location.	14.5	4.4	3273.6	36.37	56.71	1.32	0.3	3.15	12.00	38,105	87	5
13	11.1	11.6	5.7	3.9	Drain to West Antioch Creek at MP 11.07	300' pipeline and detention basin	Includes runoff from a portion of the parkland.	14.5	4.4	2640	29.33	48.05	1.53	0.3	4.41	12.00	45,903	96	5
14	11.6	12.1	7.4	10.0	Drain to unnamed creek at MP 11.8.	Earthwork and detention Basin only	Includes Contra Loma Runoff (north of dam). A portion of the runoff is already directed to an unnamed creek. Check capacity of Antioch SD downstream of unnamed creek.	14.5	4.4	1584	17.60	32.43	1.84	0.3	9.62	12.00	83,495	129	5
15	12.1	12.9	16.3	0.0	Drain northwest to Markley Creek.	Earthwork only	Check capacity of Markley Creek. Use detention basin in Area 16.												
16	12.9	13.58	25.3	0.0	Drain to Markely Creek at MP 13.35	Earthwork only. Build a detention basin at MP 13.1	It appears the large undeveloped property to the south of the canal does not drain to the canal.	14.5	4.4	6600	73.33	97.31	0.90	0.3	11.22	12.00	121,151	156	5
17	13.58	14.57	15.0	5.1	Drain to Medanos Wasteway at MP 13.85	Earthwork and detention Basin only	Portion of Buchanan Rd drains to canal area. Other undeveloped area appears to drain to Antioch SD system. 2006 SW Remediation Study costs not included because off-site runoff will be handled by new canal SW facilities.	14.5	4.4	3801.6	42.24	63.63	1.28	0.3	7.74	12.00	96,645	139	5

Appendix A - Details on each Drainage Area, Stormwater Runoff Calculations, and Description of New Stormwater Management Facilities
Main Canal Drainage Study
Contra Costa Water District

Drainage Area Characteristics					Details on Proposed Stormwater Drainage Connections and Comments			Stormwater Runoff Calculations								General Infrastructure Sizing			
18	14.85	15.6	13.1	0.0	Drain to 66" Pittsburg SD at MP 15.05	Earthwork and detention Basin only	Check capacity of Pittsburg SD. 2006 SW Remediation Study costs at Loveridge site not included in this study because this appears to be a City of Pittsburg issue and also will be less of an issue when canal is replaced with pipeline.	14.5	4.4	2904	32.27	51.71	1.39	0.3	5.49	12.00	62,892	112	5
19	15.6	16.42	12.0	0.0	Drain to creek at MP 15.95	Earthwork and detention Basin only	Check capacity of creek and Pittsburg SD downstream. Check runoff from area of pittsburg south of MP 16.15.	14.5	4.4	2481.6	27.57	45.82	1.63	0.3	5.86	12.00	57,323	107	5
20	16.42	17.93	24.5	0.0	Drain to creek at MP 17.3	Earthwork and detention Basin only	Check capacity of creek. Check 36" inlet from Pittsburg WTP	15	4.5	4646.4	51.63	74.26	1.10	0.3	8.12	12.00	120,150	155	5
21	17.93	18.56	12.5	0.0	Connect to 36" Pittsburg SD at MP 18.23	Catchbasin, MH, and detention basin	Check capacity of SD. Can build detention basin a MP 18.35. Assumes nearby park is drained to Pittsburg SD.	15	4.5	1742.4	19.36	34.90	1.86	0.3	6.96	12.00	61,169	111	5
22	18.56	19.01	6.2	0.0	Connect to 60" Pittsburg SD at MP 18.76	Catchbasin, MH, and detention basin		15	4.5	1320	14.67	28.18	2.05	0.3	3.82	12.00	30,517	78	5
23	19.01	19.41	7.5	0.0	Connect to 24" CMP at canal bend near Leland Rd.	Catchbasin, MH, and detention basin	Expand existing detention basin north and south of canal.	15	4.5	1108.8	12.32	24.64	2.19	0.3	4.94	12.00	36,842	86	5
24	19.5	20.1	8.2	0.0	Connect to 30" CCCSD SD just west of Bailey Rd. SD drains to nearby creek.	Catchbasin, MH, and detention basin	No room for detention basin.	15	4.5	1848	20.53	36.51	2.05	0.3	5.05	12.00	40,319	90	5
25	20.1	21.35	13.0	13.0	Drain to creek at MP 21.1	Earthwork and Detention Basin only	Assumes that undeveloped land between HWY 4 and Canal drains to Canal. 2006 SW Remediation Study costs for "Two Churches Site" not included because off-site runoff will be handled by new canal SW facilities. PG&E facility stormwater issues were resolved by PG&E.	15	4.5	5280	58.67	81.95	1.07	0.3	8.37	12.00	127,310	160	5
26	21.35	21.75	4.2	6.1	Drain to CCCSD box culvert at Mp 21.65	Catchbasin and manhole and 100 ft pipe. Some roadwork required.	Assumes that a portion of the nearby hillside drains to the canal	15	4.5	1584	17.60	32.43	2.05	0.3	6.34	12.00	50,592	101	5
27	21.75	22.3	5.8	0.0	Drain to creek at MP 22.22	2 Catchbasins, 400 LF pipe, and detention basin	Includes some runoff from south slope above canal (below concrete gutter ditch).	15	4.5	2376	26.40	44.31	1.59	0.3	2.79	12.00	28,629	76	5
28	22.3	23.1	12.0	33.0	Drain to creek at MP 22.77	1 catchbasin, 200 LF pipe, and detention basin	Includes large area of runoff not captured by stormwater system above nearby development. 2006 SW Remediation Study costs for Nicols site were not included in this project because these costs appear to be primarily to solve slope stability issue which will not be an issue when pipeline is in place.	15	4.5	2474	27.49	45.71	1.53	0.3	20.65	15.00	220,781	210	5
29	23.1	23.5	5.0	45.2	Drain to Nichols Wasteway at MP 23.22	Use existing wasteway	Includes large area of runoff not directed to a creek with a culvert under the canal.	15	4.5	1200	13.33	26.19	2.16	0.3	32.50	18.00	245,792	222	5
30	23.5	24.4	11.6	68.0	Drain to Creek at Mp 24.0	1 catchbasin, 200 LF pipe, and detention basin	Includes two large area of runoff not collected by culverts/creeks	15	4.5	3500	38.89	59.71	1.31	0.3	31.31	18.00	389,992	279	5
31	24.4	25.2	7.1	54.5	Drain to old creek area at MP 25.0	Upsize existing 24" culvert. Add new CB. Earthwork. New detention basin.	Includes two large areas of runoff not collected by culvert at 24.99. 24" culvert may be undersized. May need to be upsized to prevent additional runoff into canal area.	15	4.5	3168	35.20	55.30	1.36	0.3	25.19	24.00	301,720	246	5
32	25.2	25.8	6.4	20.6	Drain to creek at MP 25.55	Upsize existing 24" culvert. Add new CB. Earthwork and detention basin.	Need to check downstream capacity of CCCSD SD under Port Chicago Hwy and the RR ROW.	15	4.5	2300	25.56	43.21	1.64	0.3	13.31	12.00	132,257	163	5

Appendix B – Detailed Cost Estimates

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Detailed Cost Estimate

PROJECT : Concrete Lined Stormwater
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	3.5' x 3.5' x 1' Trapezoidal Concrete Lined Ditches (Unit Prices per USBR Literature)	736,666	SF	$2.53	$1,861,964	
2	5' x 5' x 1.5' Trapezoidal Concrete Lined Ditches (Unit Prices per USBR Literature)	264,739	SF	$2.53	$669,143	
	TOTAL DIRECT COST					**$2,531,107**
	Estimating Contingency	40	%	$1,012,443		
	SUBTOTAL				**$3,543,550**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$159,460		
	SUBTOTAL				**$3,703,010**	
	General Conditions	15	%	$531,532		
	SUBTOTAL				**$4,234,542**	
	General Contractor Overhead and Profit	10	%	$354,355		
	SUBTOTAL				**$4,588,897**	
	Rate of Annual Inflation	2.0	%	$280,877		
	SUBTOTAL				**$4,869,774**	
	ESTIMATED CONSTRUCTION COST					**$4,869,774**
	Design, Legal, and Administrative Fees	20	%	$973,955		
	SUBTOTAL				**$5,843,729**	
	Change Orders	5.0	%	$243,489		
	SUBTOTAL				**$6,087,218**	
	TOTAL PROJECT COST					**$6,087,218**

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Detailed Cost Estimate

PROJECT : Detention Ponds
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	Area 1 Detention Basin	16,371	CF	$1.7	$27,532	
2	Area 2 & 3 Detention Basin	39,652	CF	$1.4	$54,216	
3	Area 4, 5, & 6 Detention Basin	118,110	CF	$1.1	$125,091	
4	Area 7 Detention Basin	22,906	CF	$1.6	$35,611	
5	Area 8 Detention Basin	26,475	CF	$1.5	$39,787	
6	Area 9 Detention Basin	126,787	CF	$1.0	$132,071	
7	Area 10 Detention Basin	68,710	CF	$1.2	$82,606	
8	Area 11 Detention Basin	65,596	CF	$1.2	$79,722	
9	Area 12 Detention Basin	38,105	CF	$1.4	$52,588	
10	Area 13 Detention Basin	45,903	CF	$1.3	$60,649	
11	Area 14 Detention Basin	83,495	CF	$1.1	$95,906	
12	Area 15 & 16 Detention Basin	121,151	CF	$1.1	$127,550	
13	Area 17 Detention Basin	96,645	CF	$1.1	$107,276	
14	Area 18 Detention Basin	62,892	CF	$1.2	$77,193	
15	Area 19 Detention Basin	57,323	CF	$1.3	$71,901	
16	Area 20 Detention Basin	120,150	CF	$1.1	$126,742	
17	Area 21 Detention Basin	61,169	CF	$1.2	$75,567	
18	Area 22 Detention Basin	30,517	CF	$1.5	$44,362	
19	Area 23 Detention Basin	36,842	CF	$1.4	$51,247	
20	Area 24 Detention Basin	40,319	CF	$1.4	$54,913	
21	Area 25 Detention Basin	127,310	CF	$1.0	$132,488	
22	Area 26 Detention Basin	50,592	CF	$1.3	$65,340	
23	Area 27 Detention Basin	28,629	CF	$1.5	$42,244	
24	Area 28 Detention Basin	220,781	CF	$0.9	$201,989	
25	Area 29 Detention Basin	245,792	CF	$0.9	$219,295	
26	Area 30 Detention Basin	389,992	CF	$0.8	$312,322	
27	Area 31 Detention Basin	301,720	CF	$0.9	$256,584	
28	Area 32 Detention Basin	132,257	CF	$1.0	$136,415	
	TOTAL DIRECT COST					**$2,889,207**
	Estimating Contingency	40	%	$1,155,683		
	SUBTOTAL				**$4,044,890**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$182,020		
	SUBTOTAL				**$4,226,910**	
	General Conditions	15	%	$606,733		
	SUBTOTAL				**$4,833,643**	
	General Contractor Overhead and Profit	10	%	$404,489		
	SUBTOTAL				**$5,238,132**	
	Rate of Annual Inflation	2.0	%	$320,616		
	SUBTOTAL				**$5,558,748**	
	ESTIMATED CONSTRUCTION COST					**$5,558,748**
	Design, Legal, and Administrative Fees	20	%	$1,111,750		
	SUBTOTAL				**$6,670,497**	
	Change Orders	5.0	%	$277,937		
	SUBTOTAL				**$6,948,435**	
	TOTAL PROJECT COST					**$6,948,435**

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Detailed Cost Estimate

PROJECT : Connections to Existing Stormwater Systems
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	Area 1	1	AL	$3,150.0	$3,150	
2	Area 2	1	AL	$56,700.0	$56,700	
3	Area 3	1	AL	$0.0	$0	
4	Area 4	1	AL	$75,600.0	$75,600	
5	Area 5	1	AL	$0.0	$0	
6	Area 6	1	AL	$0.0	$0	
7	Area 7	1	AL	$8,400.0	$8,400	
8	Area 8	1	AL	$353,890.0	$353,890	
9	Area 9	1	AL	$8,400.0	$8,400	
10	Area 10	1	AL	$8,400.0	$8,400	
11	Area 11	1	AL	$26,250.0	$26,250	
12	Area 12	1	AL	$10,500.0	$10,500	
13	Area 13	1	AL	$56,700.0	$56,700	
14	Area 14	1	AL	$10,500.0	$10,500	
15	Area 15	1	AL	$10,500.0	$10,500	
16	Area 16	1	AL	$0.0	$0	
17	Area 17	1	AL	$10,500.0	$10,500	
18	Area 18	1	AL	$10,500.0	$10,500	
19	Area 19	1	AL	$10,500.0	$10,500	
20	Area 20	1	AL	$10,500.0	$10,500	
21	Area 21	1	AL	$8,400.0	$8,400	
22	Area 22	1	AL	$8,400.0	$8,400	
23	Area 23	1	AL	$8,400.0	$8,400	
24	Area 24	1	AL	$8,400.0	$8,400	
25	Area 25	1	AL	$8,400.0	$8,400	
26	Area 26	1	AL	$33,600.0	$33,600	
27	Area 27	1	AL	$130,200.0	$130,200	
28	Area 28	1	AL	$71,400.0	$71,400	
29	Area 29	1	AL	$0.0	$0	
30	Area 30	1	AL	$84,000.0	$84,000	
31	Area 31	1	AL	$42,525.0	$42,525	
32	Area 32	1	AL	$42,525.0	$42,525	
	TOTAL DIRECT COST					**$1,117,240**
	Estimating Contingency	40	%	$446,896		
	SUBTOTAL				**$1,564,136**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$70,386		
	SUBTOTAL				**$1,634,522**	
	General Conditions	15	%	$234,620		
	SUBTOTAL				**$1,869,143**	
	General Contractor Overhead and Profit	10	%	$156,414		
	SUBTOTAL				**$2,025,556**	
	Rate of Annual Inflation	2.0	%	$123,980		
	SUBTOTAL				**$2,149,536**	
	ESTIMATED CONSTRUCTION COST					**$2,149,536**
	Design, Legal, and Administrative Fees	20	%	$429,907		
	SUBTOTAL				**$2,579,444**	
	Change Orders	5.0	%	$107,477		
	SUBTOTAL				**$2,686,920**	
	TOTAL PROJECT COST					**$2,686,920**

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Todd Yamello		
Subject:	Technical Memorandum No. 4 – Contra Loma Alternative		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

Technical Memorandum No. 2 describes conceptual engineering of an alternative to upgrade the Main Canal from a concrete lined canal to a pressurized pipeline. The alternative includes a new equalization reservoir and pump station at Neroly, an 8.5 ft diameter pipeline from MP 7.08 to MP 25.8, and a terminal reservoir near MP 25.8.

The Neroly alternative included in Technical Memorandum No. 2 (TM 2) includes two key constraints:

1. There is a limited amount of available property at the Neroly Blending Facility and Pumping Plant No. 4 to locate the new Equalization Reservoir and Pump Station. Construction of these facilities will require extensive shoring and relocation of a segment of the Multi-Purpose Pipeline (MPP).
2. In addition to the pipeline, the alternative includes three new facilities (Neroly equalization reservoir, Neroly pump station, and terminal reservoir) that would have to be constructed and maintained by the District.

Based on input from the User Group, the decision was made to reassess one of the other alternatives (Main Canal Alternative 5) developed during the 2013 Untreated Water Facility Improvement Program (FY13 UWFIP).

This alternative, now referred to as the Contra Loma Alternative, would be comprised of:

- 3 miles of 8.5-foot pipeline from Rock Slough to Neroly (refer to TM2).
- 10-foot pipeline from Neroly to Contra Loma. Note that the diameter was reduced from the 10.5-foot diameter listed in the FY13 UWFIP. Refer to the hydraulics section for additional information.
- New pump station and equalization reservoir at Contra Loma that will lift untreated water into the existing Contra Loma Reservoir during flows higher than 90 cfs. During flows lower than 90 cfs, the pipeline would continue to flow by gravity.
- The Contra Loma Reservoir would be used to pressurize a new 6.5-foot diameter pipeline between Contra Loma and MP 25.8. Note that the diameter of the pipeline was reduced from the 8-foot diameter listed in TM2. Refer to the hydraulics section for additional information.

- While this alternative does not include the new Rock Slough Pump Station and Pipeline described in Technical Memorandum No. 1 (TM1), this alternative is dependent on the implementation of the upgrades described in TM1.

PURPOSE

This memorandum presents additional conceptual engineering of the Contra Loma Alternative to allow this alternative to be compared to the Neroly Pump Station alternative described in Technical Memorandum No. 2.

REQUIRED CAPACITY FOR THE MAIN CANAL

In 2050, the required capacity of Main Canal is 372 cfs. This is based on the 2002 Future Water Supply Study's (FWSS) demand projections and assumes 73 cfs of the demand will be met through existing storage. This alternative will be designed with a capacity of 372 cfs. Due to large untreated water demands (Antioch and Gaylord) between Neroly and Contra Loma, the demands downstream of Contra Loma are only 256 cfs. Therefore, the pipeline segment between Neroly and Contra Loma will be designed for a capacity of 372 cfs while the new pump station and pipeline between Contra Loma and MP 25.8 will be designed for a capacity of 256 cfs.

PUMP STATION LOCATION AND CONFIGURATION

The Contra Loma pump station would include the following features:

- The new pump station would be located on top of a new equalization reservoir located in the northwest corner of the existing Contra Loma Pump Station site. The area where the equalization reservoir and pump station would be located is shown in Figure 1.
- The new pump station would replace the existing Contra Loma Pump Station. The discharge of the new pump station would be connected to the existing 6 ft diameter drain/fill pipeline that passes through the existing Contra Loma Dam. The pump station discharge would also be connected to the new 6.5-foot diameter pipeline that would replace the canal between Contra Loma and MP 25.8. The Contra Loma Reservoir would be hydraulically connected to the new 6.5-foot diameter pipeline and would serve as the regulating reservoir for the segment of the new pipeline from Contra Loma to MP 25.8. The new Contra Loma Pump Station would be designed to maintain a constant level of 205 ft in the existing Contra Loma Reservoir.
- An isolation valve, likely a butterfly valve, would be installed between the new 10 ft pipeline and the new 6.5-foot diameter pipeline. The valve would be equipped with an electric actuator and would close when the pump station is in operation. During low demand periods when the pipeline is operated in gravity mode and the pump station is off, the valve would be opened.
- The new pump station would be located on top of a new, buried, rectangular, reinforced concrete reservoir with a capacity of 3 to 4 MG.
- A new electrical substation, similar to the Middle River and Old River substations, would be required. The electrical substation would step down the voltage of the WAPA electricity that would be wheeled through PG&E's transmission/distribution system to Contra Loma.
- A new Electrical Building, similar to the Middle River Electrical and Controls building (without the water quality sampling and storage rooms).

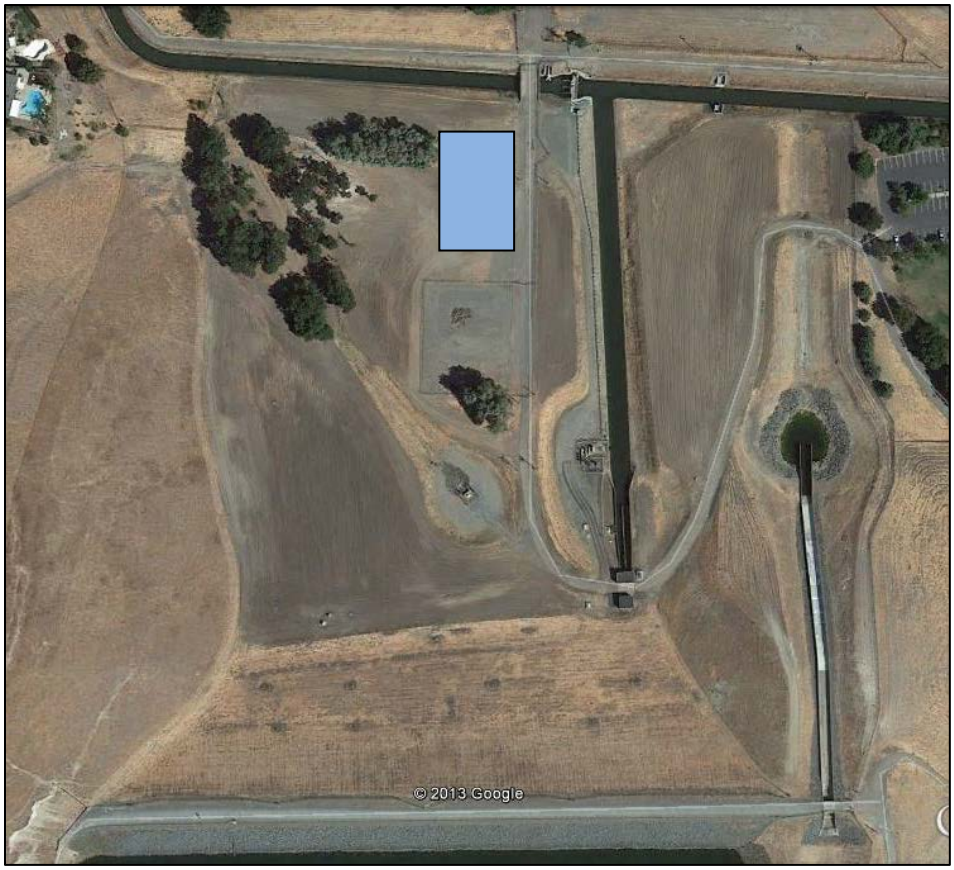

Figure 1 – Location of New Contra Loma Pump Station and EQ Reservoir

- An ultrasonic flow meter with internally mounted transducers on the discharge pipeline, downstream of the new pump station (similar to Middle River).
- A hydropneumatic surge vessel is not included. While a surge analysis is not within the scope of work for this study, a surge analysis should be completed during the preliminary design of the project. Hydraulic transients may not be an issue with this pump station because the pump station is not pumping against a large amount of static head and the existing Contra Loma Reservoir would act as a standpipe.

PIPELINE AND PUMP STATION HYDRAULICS AND PUMP SELECTION

An initial assessment of the system hydraulics was prepared. Key hydraulic design criteria are included in Table 1. Figure 2 shows the hydraulic profile for this alternative.

Because the pumps would be pumping to a relatively static water level of 205 ft in Contra Loma Reservoir, only one set of pumps is required. This is a positive in that the pumps are relatively easy to design and only one size is required. It is also a disadvantage in that even at relatively low flows (e.g. 100 cfs), the pumps will have to lift the untreated water up to the static water level of 205 feet.

The pipeline diameter between Neroly and Contra Loma is 10 feet. The pipeline diameter between Neroly and Control Loma is predicated on the ability to operate the new pipeline at a pressure of 140 ft above sea level (total head of 20 ft) at Neroly. This is the maximum head available when the Los Vaqueros pipeline is operating at 400 cfs (per the Los Vaqueros Pipeline record drawings). To generate 140 feet of head in the Rock Slough system, the new pump

station and pipeline, as described in TM1, would need to be implemented (with slightly larger pumps).

Table 1 System Curve Design Criteria
Contra Loma Alternative
Contra Costa Water District

Design Criteria	Number	Comments
Hazen Williams C-factor	118	Based on field testing performed during the design of the Middle River Pump Station. The C-factor needs to be updated during the preliminary design of the new pump station. The C-factor will likely be higher (less friction) due to the larger pipe diameter and polyurethane lining (instead of cement mortar lining).
Allowance for Minor Losses	40%	Allowance for losses through fittings and valves.
Water Surface Elevation at Neroly (during high demand periods)	140 ft	**Assumes that flow control valves and turbine will be bypassed at high flows to allow the Los Vaqueros system to pressurize the pipeline between Neroly and Contra Loma. The new Rock Slough Pump Station can be designed to discharge to 140 ft.**
Water Surface Elevation at Neroly (during low demand periods)	122 ft	
Water Surface Elevation at Contra Loma	120 ft	
Water Surface Elevation at new EQ Reservoir at Contra Loma	96 to 120 ft	Allows the EQ reservoir water level to fluctuate to allow for flow control variations in Los Vaqueros and Rock Slough Systems
Water Surface Elevation at MP 25.8	107.5 ft	
Pipeline Diameter	10/6.5 ft	10 ft from Neroly to Contra Loma and 6.5 ft from Contra Loma to MP 25.8

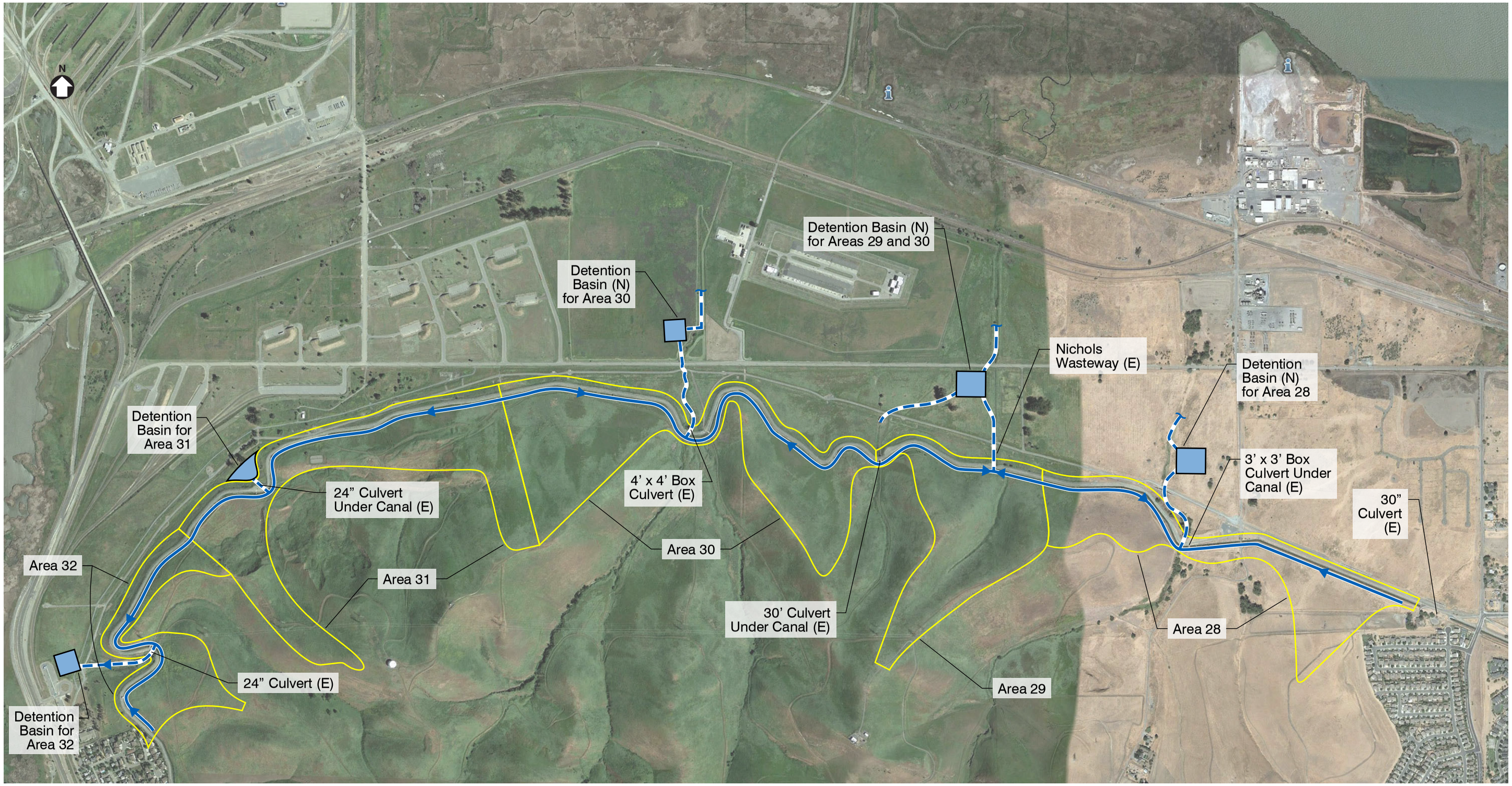

Figure 2
STORMWATER DRAINAGE PLAN FOR AREAS 28-32
MAIN CANAL DRAINAGE STUDY
CONTRA COSTA WATER DISTRICT

ccwd1013f16-9028.ai

An important item to note is that Table 1 shows the pipeline diameter between Contra Loma and MP 25.8 to be 6.5 feet. The pipeline diameter was optimized to match friction and minor losses to the available head in the reservoir. This differs from the approach in Technical Memorandum No. 2, which sought to minimize friction losses.

Another key consideration is that when demands are less than 90 cfs, the 6.5-foot diameter pipeline is capable of conveying the entire capacity of conveying untreated water to meet those demands without pumping. This would allow the District to convey untreated water without using the pump station during low demand periods.

Table 2 shows the pump design criteria for the Contra Loma Pump Station.

Table 2 Pump Design Criteria
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Design Criteria	Number	Comments
Type	Vertical Turbine	
Design Capacity	Five Pumps: 63 cfs @ 110 ft	4 + 1 (duty + standby)
Pump Model Number	Fairbanks 42SPM	24.97" impeller (26.22" max)
Pump Motor Size	1000 hp	
Pump Speed	590 rpm	

The average electrical consumption for this alternative was determined to be 55,979 kWhr per day (137 kwHr/acre-feet). This compares to an average electrical consumption of 28,103 kWhr per day for the Neroly alternative (70 kWhr/acre-ft). The following assumption was made for this calculation: Untreated Water Demand - 100 cfs for 30 percent of the year, 200 cfs for 35 percent of the year, 250 cfs for 20 percent of the year, and 372 cfs for 15 percent of the year.

DISCHARGE PIPELINE, STORMWATER DRAINAGE, SIPHONS/TUNNELS, AND PIPELINE LATERALS

The discharge pipeline alignment, stormwater drainage, siphons/tunnels, and pipeline laterals would not differ, except in diameter, from the details provided in Technical Memorandum No. 2.

TERMINAL RESERVOIR

A terminal reservoir would not be required for this alternative as the existing Contra Loma Reservoir would serve as the regulating reservoir.

CONSTRUCTION SEQUENCING

Construction of the pipeline and pump station would be as described in Technical Memorandum Nos. 1 and 2 with the following exceptions:

- Because the pump station is located at Contra Loma, as opposed to Neroly, the new pump station cannot be used to pressurize the segment of pipe between Neroly and Contra Loma. This may be an issue if construction of the first 4.6-mile long segment of pipe cannot be completed during the low water demand period, and the water demand exceeds the gravity conveyance capacity of the first portion of the pipeline (plus the capacity of the MPP). This will not be an issue if the new Rock Slough Pumping Plant and

pipeline and the Neroly blending facility bypass system are operational prior to construction of this pipeline.

- The construction of the new pump station and equalization reservoir at Contra Loma would be simpler and easier than constructing these facilities at Neroly. The MPP would not require relocation and less shoring would be required. In addition, the impacts on operations and maintenance staff would be reduced with construction at this location.

COST ESTIMATES

Cost estimates were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in April 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 4 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. For example, welded steel pipe quotes were obtained from Northwest Pipe, pump and drive estimates were escalated from the Middle River Pump Station Project, and Carollo's unit price catalog was used for pricing of earthwork. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

Cost Estimate Assumptions

The cost estimates presented here are preliminary in that they were prepared in advance of detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

1. Construction of below grade infrastructure would be accomplished via conventional open trench.
2. Groundwater along the canal is minimal.
3. Excavated material and spoils are disposed on-site.
4. The following contingencies are applied to each of the estimates:
    a. General contingency for unforeseen conditions, changes, or design details: 40 percent.

b. General conditions: 15 percent.

c. General Contractor Overhead, Profit, and Risk: 10 percent.

d. Escalation to the mid-point of construction: 2 percent per year (for three years).

e. Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).

f. Bid Market Allowance: 0 percent

g. Engineering, Legal, and Administration Fees: 20 percent.

h. Change Order Allowance: 5 percent.

Cost Estimates

The cost estimates for each improvement are indicated in Table 3.

Table 3 Capital Improvement Costs[1]
Canal Rehabilitation Feasibility Studies
Contra Costa Water District

Phase	Capital Costs (Millions of Dollars)
Contra Loma Pump Station and Reservoir	$28.8
Contra Loma Dam Inlet/Outlet Works Modifications Allowance	$2.1
6.5 ft Diameter Pipeline	$100.6
10.0 ft Diameter Pipeline	$42.2
Bypass Pipeline and Pumps	$19.3
Bypass Tunnels	$27.4
Bypass Operation (Labor, Equipment, Fuel)	$13.8
Lateral Modifications	$8.4
Subtotal (Construction Cost) [2]	**$242.6**
Design, Legal, and Administrative Fees (20%)	$48.5
Change Orders (5%)	$12.1
Total (Project Cost)	**$303.2**

Notes:
(1) Based on April dollars; ENRCCI=10,895.
(2) Includes the contingencies stated in the cost estimate assumptions section.

Cost Estimates

Table 4 summarizes the capital costs, annual O&M costs, and net present values for the two alternatives. The net present value of the future costs was estimated over 100 years because that is the expected life of the new facilities.

Table 4	Summary of Main Canal Conveyance Alternatives Canal Rehabilitation Feasibility Studies Contra Costa Water District		
Alternative	**Capital Costs ($M)**	**Annual O&M Costs[(1)] ($M)**	**Net Present Value[(2)] ($M)**
Neroly Pump Station and 8.5 ft diameter pipeline (TM 2)	320.1	1.0	364.6
Contra Loma Pump Station and 10 and 6.5 ft diameter pipelines (Main Canal Alt 5)	303.2	2.0	392.3

Notes:

(1) Includes electricity costs only as other O&M costs will be similar. Assumed rate of $0.10/kWhr.

(2) NPV based on 100 years at 2% inflation and 4% discount rate.

COMPARISON OF NEROLY AND CONTRA LOMA PUMP STATION ALTERNATIVES.

The Neroly Pump Station alternative discussed in Technical Memorandum No. 2 has the following advantages over the Contra Loma alternative:

- The Contra Loma alternative uses more electricity than the Neroly alternative at untreated water flowrates above 90 cfs. This is especially true at flowrates between 100 cf and 300 cfs. The additional electricity will cost approximately $1M more annually at an average untreated water demand of 205 cfs.
- WAPA power does not have to be wheeled through the PG&E transmission/distribution system because WAPA power is available at Neroly.
- Modifications to Contra Loma dam would not be required.
- While the capital/project cost of the two alternatives is similar, the annual electricity costs are approximately half of the costs of the Contra Loma Alternative. Therefore, the net present value of this alternative is approximately $28 M lower than the Contra Loma alternative.

The Contra Loma alternative has the following advantages over the Neroly alternative:

- The project is easier to construct than the Neroly alternative and construction will have less impact on existing facilities and operations. In addition, the location of the untreated water blending facility at Neroly will not be affected.
- Because the existing Contra Loma Reservoir will be utilized as a key feature of the Contra Loma alternative, a terminal reservoir is not required.
- The large, existing Contra Loma Reservoir enables the use of a simple and reliable control scheme for the new Contra Loma Pump Station.

Prepared By:

Colin Barrett

Appendix A – Detailed Cost Estimates

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Detailed Cost Estimate

PROJECT : Contra Loma Pumping Plant and Reservoir
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	Sitework				$3,017,832	
2	Pump Station and Reservoir				$8,996,342	
4	Substation				$1,496,218	
5	Electrical Building				$1,475,384	
	TOTAL DIRECT COST					**$14,985,776**
	Estimating Contingency	40	%	$5,994,310		
	SUBTOTAL				**$20,980,086**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$944,104		
	SUBTOTAL				**$21,924,190**	
	General Conditions	15	%	$3,147,013		
	SUBTOTAL				**$25,071,203**	
	General Contractor Overhead and Profit	10	%	$2,098,009		
	SUBTOTAL				**$27,169,212**	
	Rate of Annual Inflation	2.0	%	$1,662,973		
	SUBTOTAL				**$28,832,185**	
	ESTIMATED CONSTRUCTION COST					**$28,832,185**
	Design, Legal, and Administrative Fees	20	%	$5,766,437		
	SUBTOTAL				**$34,598,622**	
	Change Orders	5.0	%	$1,441,609		
	SUBTOTAL				**$36,040,231**	
	TOTAL PROJECT COST					**$36,040,231**

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PROJECT : Contra Loma Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Site Work

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$2,199,212
	Excavation	16963	CY	$4.00	1.00	1.200	$81,422	
	AC pavement	6000	SF	$4.00	1.00	1.200	$28,800	
	Dewatering	1	LS`	$250,000.00	1.00	1.200	$300,000	
	Pile Driver Mobilization	1	LS	$20,000.00	1.15	1.050	$24,150	
	Z-sheets for Reservoir	24800	SF	$40.00	1.15	1.050	$1,197,840	
	Walers and Bracing for Pump Station Excavation	1	LS	$400,000.00	1.15	1.050	$483,000	
	ABC for Site	1000	CY	$70.00	1.00	1.200	$84,000	
DIV. 13000								$195,648
	Flow Meter							
	Ultrasonic meter	1	EA	$50,000.00	1.18	1.200	$70,800	
	Cathodic Protection - WSP Conveyance Pipeline							
	Anode Bed (2-60lb Magnesium Anodes)	1	EA	$3,000.00	1.36	1.200	$4,896	
	Post Mounted Test Station	1	EA	$2,000.00	1.36	1.200	$3,264	
	Insulating Flange Kits - Above Grade	6	EA	$500.00	1.36	1.200	$4,896	
	Rectifier and Deep Bed Anode	1	EA	$60,000.00	1.36	1.200	$97,920	
	6" AWG Bond Cables	30	EA	$150.00	1.36	1.200	$7,344	
	72" AWG Bond Cables	5	EA	$300.00	1.36	1.200	$2,448	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.36	1.200	$4,080	
DIV. 15000								$120,000
	Miscellaneous Piping/Valves	1	LS	$100,000.00	1.00	1.200	$120,000	
DIV. 16000								$502,972
	Electrical Allowance (Based on Middle River PS Estimate)	1	AL	20.00%	1	1.050	$502,972	
TOTAL								**$3,017,832**

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PROJECT : Contra Loma Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Pump Station

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 03000								$3,274,384
	24" Base Slab	1,259	CY	$350.00	1.00	1.200	$528,889	
	30" Walls	1,556	CY	$750.00	1.00	1.200	$1,400,000	
	18" Elevated Slab - Reservoir Top Deck	944	CY	$650.00	1.00	1.200	$736,667	
	Columns	105	CY	$1,500.00	1.00	1.200	$188,496	
	Structural Concrete - Pump Base	20	CY	$500.00	1.00	1.200	$12,000	
	18" x 30" Beams	118	CY	$1,000.00	1.00	1.200	$141,667	
	Structural Concrete - Pump Suction Wetwell Fill	444	CY	$500.00	1.00	1.200	$266,667	
DIV. 05000								$131,250
	Pipe Supports	1	AL	$75,000.00	1.00	1.050	$78,750	
	Misc Metals	1	AL	$50,000.00	1.00	1.050	$52,500	
DIV. 11000								$4,008,417
	VTP, Motor and Drive - 1000hp.	5	EA	$651,775	1.00	1.230	$4,008,417	
DIV. 13000								$52,848
	Pressure Transmitters	9	EA	$1,500.00	1.27	1.180	$20,231	
	Ultrasonic Level - Hydroranger 200	2	EA	$3,000.00	1.27	1.180	$8,992	
	Cathodic Protection - Pump Barrels							
	Rectifier and Wetwell Anodes	1	LS	$20,000.00	1.00	1.050	$21,000	
	Cathodic Protection Check Out	1	LS	$2,500.00	1.00	1.050	$2,625	
DIV. 15000								$1,500,975
	Slide Gate	1	EA	$50,000.00	1.00	1.050	$52,500	
	78" Steel Pipe	50	LF	$650.00	1.00	1.050	$34,125	
	78" Depend-o-Lock Coupling	2	EA	$12,500.00	1.00	1.050	$26,250	
	78" 90 deg Elbow	1	EA	$17,500.00	1.00	1.050	$18,375	
	Allowance for 102" BFV and Valve Vault	1	AL	$200,000.00	1.00	1.050	$210,000	
	Allowance for Tie-in to Box Culvert	1	AL	$150,000.00	1.00	1.050	$157,500	
	Adder for M11 Reinforcement	1	AL	$30,000.00	1.00	1.050	$31,500	
	48" Discharge Pipe	90	LF	$450.00	1.00	1.050	$42,525	
	48" Depend-O-Lock Couplings	18	EA	$10,000.00	1.00	1.050	$189,000	
	48" Slanting Disc Check Valve	9	EA	$45,000.00	1.00	1.050	$425,250	
	48" Butterfly Valve and Actuator	9	EA	$29,000.00	1.00	1.050	$274,050	
	ARV 2"	9	EA	$2,000.00	1.00	1.050	$18,900	
	CAV 8"	4	EA	$5,000.00	1.00	1.050	$21,000	
DIV. 16000								$28,467
	Electrical Allowance (Based on Middle River PS Estimate	1	AL	0.50%	1	1.050	$28,467	
TOTAL								**$8,996,342**

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PROJECT : Contra Loma Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Substation

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 03000								$43,060
	18" Slab on Grade for Transformer	35	CY	$286.18	1.15	1.400	$15,896	
	18" Slab on Grade Edge Form	100	LF	$16.41	1.15	1.400	$2,641	
	18" Slab on Grade for Breaker/meter and Deadend Struc	21	CY	$286.18	1.15	1.400	$9,829	
	18" Slab on Grade Edge Form	125	LF	$16.41	1.15	1.400	$3,302	
	Metal Grating for Transformer Slab	205	SF	$34.52	1.15	1.400	$11,392	
DIV. 16000								$1,453,157
	#4/0 SDBC Ground Cable	1300	LF	$5.53	1.15	1.400	$11,574	
	10-foot ground rods	31	EA	$33.33	1.15	1.400	$1,664	
	Grounding connections and unlisted items @ 25%						$3,309	
	#2 XHHW	50	LF	$2.76	1.15	1.400	$222	
	#6 XHHW	100	LF	$1.36	1.15	1.400	$219	
	#10 XHHW	15600	LF	$0.76	1.15	1.400	$18,963	
	#12 XHHW	2500	LF	$0.59	1.15	1.400	$2,375	
	#14 XHHW	50	LF	$0.46	1.15	1.400	$37	
	Wire connection and unlisted items @ 15%						$3,272	
	1" GRC	20	LF	$9.26	1.15	1.400	$298	
	3/4" GRC	50	LF	$7.10	1.15	1.400	$572	
	2" PCS elbows and risers	22	EA	$175.60	1.15	1.400	$6,220	
	Conduit fittings and unlisted items @ 25%						$1,772	
	Duplex receptacle	4	EA	$105.00	1.15	1.400	$676	
	Toggle switch	3	EA	$105.00	1.15	1.400	$507	
	NiCd Battry System	1	EA	$12,000.00	1.15	1.400	$19,320	
	Substation transformer - 69kV:4.16/2.4kV, 15 MVA	1	EA	$500,000.00	1.15	1.400	$805,000	
	Substation dead-end structure	1	EA	$45,000.00	1.15	1.400	$72,450	
	SF6 Breaker	1	EA	$81,000.00	1.15	1.400	$130,410	
	Overhead Cable	300	FT	$2.25	1.15	1.400	$1,087	
	Substation disconnect	1	EA	$20,000.00	1.15	1.400	$32,200	
	Metering CT/PT	3	EA	$43,000.00	1.15	1.400	$207,690	
	Branch circuit panelboard	2	EA	$1,585.00	1.15	1.400	$5,104	
	Dry type transformer - 480:240/120V, 25 kVA	1	EA	$2,780.00	1.15	1.400	$4,476	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	2	EA	$570.00	1.15	1.400	$1,835	
	Type D luminaire - Ful cut-off 250W HPW pole-mounted	4	EA	$570.00	1.15	1.400	$3,671	
	Pole for type C - 25-foot	4	EA	$850.00	1.15	1.400	$5,474	
	Type F luminaire - Substation up-light	2	EA	$675.00	1.15	1.400	$2,174	
	Type G luminaire - sealed/gasketed	1	EA	$350.00	1.15	1.400	$564	
	Ground masts	2	EA	$9,500.00	1.15	1.400	$30,590	
	Transformer protection relay	1	EA	$5,760.00	1.15	1.400	$9,274	
	Backup overcurrent relay	1	EA	$1,500.00	1.15	1.400	$2,415	
	Lockout relay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Substation ductbank 1	1	EA	$2,026.13	1.15	1.400	$3,262	
	Substation ductbank 2	1	EA	$4,051.63	1.15	1.400	$6,523	
	Control Building	1	LS	$35,000.00	1.15	1.400	$56,350	
TOTAL								**$1,496,218**

Engineers...Working Wonders With Water™

PROJECT : Contra Loma Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 02000								$5,600
	Class II AB	67	CY	$70.00	1.00	1.20	$5,600	
DIV. 03000								$54,802
	12" Slab on Grade	44	CY	$400.00	1.00	1.20	$21,333	
	18" Perimeter Thickened Slab on Grade	60	CY	$400.00	1.00	1.20	$28,800	
	Sump for Switchgear Conduit							
	12" Slab on Grade	2	CY	$304.53	1.00	1.20	$756	
	12" Walls	6	CY	$565.08	1.00	1.20	$3,913	
DIV. 04000								$103,447
	CMU Block Walls	3600	SF	$20.01	1.00	1.20	$86,443	
	Pilaster Adder	3600	SF	$1.56	1.00	1.20	$6,739	
	Seismic Reinforcement Adder	3600	SF	$1.15	1.00	1.20	$4,977	
	Integral CMU Colour Adder	3600	SF	$1.22	1.00	1.20	$5,288	
DIV. 05000								$34,746
	Structural Steel Roof System	1500	LB	$2.30	1.00	1.20	$4,140	
	Structural Steel Angle Around Perimeter	2120	LB	$2.30	1.00	1.20	$5,851	
	Steel Roofing	1800	SF	$5.00	1.00	1.20	$10,800	
	Ladder	1	LS	$500.00	1.00	1.20	$600	
	Hatch	1	LS	$1,000.00	1.00	1.20	$1,200	
	Single Steel Door	4	EA	$907.70	1.00	1.20	$4,357	
	Double Steel Door	3	EA	$1,820.99	1.00	1.20	$6,556	
	2.5" Galvanized Steel Grating	30	SF	$34.52	1.00	1.20	$1,243	
DIV. 12000								$5,250
	Furniture Allowance	1	LS	$5,000.00	1.00	1.050	$5,250	
DIV. 13000								$369,701
	PLC and Appurtences							
	PLC Panel	1	EA	$109,524.00	1.27	1.230	$171,087	
	Shop Drawings	1	LS	$22,500.00	1.05	1.230	$29,059	
	Loop Drawings	1	LS	$27,000.00	1.05	1.230	$34,871	
	Factory Assistance Test (FAT)	1	LS	$14,850.00	1.05	1.230	$19,179	
	Training	1	LS	$17,600.00	1.05	1.230	$22,730	
	Field Installation	1	LS	$48,600.00	1.05	1.230	$62,767	
	Radio System							
	PLC Panel	1	EA	$1,500.00	1.27	1.230	$2,343	
	Surge Suppressor	2	EA	$450.00	1.27	1.230	$1,406	
	Yagi Antennas	2	EA	$700.00	1.27	1.230	$2,187	
	Antenna Cable (appx. 60 feet each)	2	EA	$480.00	1.27	1.230	$1,500	
	Pole Antenna Mounting	1	EA	$1,100.00	1.27	1.230	$1,718	
	TransNet Spread Spectrum Radio (MDS)	1	EA	$2,150.00	1.27	1.230	$3,359	
	MDS 9710 Licensed 900 MHz Radio	1	EA	$1,750.00	1.27	1.230	$2,734	
	Lot-Andrew Sure Ground - Cable Shields	1	EA	$450.00	1.27	1.230	$703	
	Lot-Modification of Tower at Transfer Pump Station	1	LS	$6,500.00	1.27	1.230	$10,154	
	Lot - site work/testing	1	LS	$2,500.00	1.27	1.230	$3,905	
DIV. 15000								$247,927
	HVAC Unit and Ducting	1	LS	$201,566.82	1.00	1.230	$247,927	
DIV. 16000								$653,911
	#4/0 SDBC Ground Cable	350	LF	$5.53	1.15	1.400	$3,116	
	10-foot ground rods	5	EA	$33.33	1.15	1.400	$268	
	Grounding connections and unlisted items @ 25%						$846	
	#10 XHHW	4600	LF	$0.76	1.15	1.400	$5,592	
	#12 XHHW	3200	LF	$0.59	1.15	1.400	$3,040	
	#14 XHHW	2900	LF	$0.46	1.15	1.400	$2,138	
	2CS Instrument cable	500	LF	$1.85	1.15	1.400	$1,489	
	CAT 5e Ethernet	100	LF	$0.78	1.15	1.400	$126	
	Wire connection and unlisted items @ 15%						$1,858	
	250kcmil 5KV	200	LF	$8.88	1.15	1.400	$2,859	
	5kV terminations	24	EA	$370.00	1.15	1.400	$14,297	
	4" PVC 40	150	LF	$19.55	1.15	1.400	$4,721	
	2" PVC 40	100	LF	$8.10	1.15	1.400	$1,304	

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PROJECT : Contra Loma Pumping Plant and Reservoir
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Electrical Building

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
	1.5" GRC	300	LF	$12.65	1.15	1.400	$6,110	
	1" GRC	50	LF	$9.26	1.15	1.400	$745	
	3/4" GRC	1500	LF	$7.10	1.15	1.400	$17,147	
	4" PCS Elbow & Riser	12	EA	$490.00	1.15	1.400	$9,467	
	2" PCS Elbow & Riser	4	EA	$175.60	1.15	1.400	$1,131	
	Conduit fittings and unlisted items @ 25%						$10,156	
	Duplex receptacle	30	EA	$105.00	1.15	1.400	$5,072	
	Toggle switch	14	EA	$105.00	1.15	1.400	$2,367	
	Dry type transformer - 480:240/120V, 37.5 kVA	1	EA	$3,560.00	1.15	1.400	$5,732	
	Pad-mount transformer - 4.16kV:480/277V, 300 kVA	1	EA	$13,565.00	1.15	1.400	$21,840	
	Electrical System Study	1	EA	$18,000.00	1.15	1.400	$28,980	
	Main 5kV switchgear SWGR-1	1	EA	$215,000.00	1.15	1.400	$346,150	
	Branch circuit panelboard	1	EA	$1,585.00	1.15	1.400	$2,552	
	Distribution panelboard DP-41	1	EA	$7,975.00	1.15	1.400	$12,840	
	Lighting Contactor	1	EA	$650.00	1.15	1.400	$1,047	
	Type A luminaire - 4' sealed/gasketed 3-lamp fluor.	22	EA	$570.00	1.15	1.400	$20,189	
	Type B luminaire - Full cut-off wall pack	6	EA	$570.00	1.15	1.400	$5,506	
	Type E luminaire - emergency/exit fixture	5	EA	$896.00	1.15	1.400	$7,213	
	Field Acceptance Tests	1	EA	$15,000.00	1.15	1.400	$24,150	
	Lockout rleay	1	EA	$1,000.00	1.15	1.400	$1,610	
	Feeder protection relay	5	EA	$2,290.00	1.15	1.400	$18,435	
	Motor protection relay	5	EA	$3,350.00	1.15	1.400	$26,968	
	Motor protection relay remote RTD monitor	5	EA	$1,290.00	1.15	1.400	$10,385	
	Bus differential relay	1	EA	$4,440.00	1.15	1.400	$7,148	
	Fire alarm system	1	EA	$12,000.00	1.15	1.400	$19,320	
TOTAL								**$1,475,384**

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Detailed Cost Estimate

PROJECT : Main Canal Pipeline - Contra Loma Option
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Brentwood, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT				SUBTOTAL	TOTAL
1	10' Diameter Welded Steel Pipeline - Conventional Trench				$21,924,290	
2	6.5' Diameter Welded Steel Pipeline - Conventional Trench				$49,144,314	
3	Siphon Lining Adder				$3,130,417	
	TOTAL DIRECT COST					**$74,199,021**
	Estimating Contingency	40	%	$29,679,608		
	SUBTOTAL				**$103,878,629**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$4,674,538		
	SUBTOTAL				**$108,553,168**	
	General Conditions	15	%	$15,581,794		
	SUBTOTAL				**$124,134,962**	
	General Contractor Overhead and Profit	10	%	$10,387,863		
	SUBTOTAL				**$134,522,825**	
	Rate of Annual Inflation	2.0	%	$8,233,873		
	SUBTOTAL				**$142,756,698**	
	ESTIMATED CONSTRUCTION COST					**$142,756,698**
	Design, Legal, and Administrative Fees	20	%	$28,551,340		
	SUBTOTAL				**$171,308,038**	
	Change Orders	5.0	%	$7,137,835		
	SUBTOTAL				**$178,445,872**	
	TOTAL PROJECT COST					**$178,445,872**

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **8.5' Diameter Pipeline** Date: **17-May-14**
Item: **102" WSP** Proj Mgr:: **CB**

DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	120.00	inches
Average **Total** Exc **Depth**	6.00	feet (Include Bed Thickness)
Length	24,393.60	feet
Trench Slope: 1 Vert. to	1.25	Horiz.
Pavement Thickness:	0.00	inches
ABC Depth:	0.00	inches
No.of Pavement Cuts	0.00	Each

CALCULATED QUANTITIES for ESTIMATE		
Liner Removal	=	731,808 sq ft
Trench Excavation	=	65,050 cu yd
Bed + Zone fill (Excludes Pipe Volume)	=	32,525 cu yd
Zone Only Fill (Excludes Pipe Volume)	=	27,104 cu yd
Bed Only Fill	=	5,421 cu yd
Backfill Above Zone	=	45,173 cu yd
Surface Restoration Area	=	731,808 sq ft
Shoring Area (Optional): Trench Shored Area	=	292,723 sq ft
Shoring Area (Optional): With 30% Toe-In	=	389,322 sq ft

INPUT VARIABLES		
Bed Depth =	6.0	in
Zone Depth Above Pipe =	6.0	in
Min. Width =	36.0	in
Side Width (per side x 2) =	24.0	in
Pit Depth =	6.0	ft
	1.0	ft

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Canal Liner Removal	731,808	SF	$0.53	$387,858	*$15.90*	
Trench Excavation	65,050	CY	$2.10	$136,604	*$5.60*	Assumed excavator used is: CAT 235 with 2 CY Bucket
Surface Restoration	731,808	CY	$0.21	$153,680	*$6.30*	Hydroseeding
Zone Only Fill	27,104	CY	$75.00	$2,032,800	*$83.33*	Imported confined material used: Cl 2 AB
Bed Only Fill	5,421	CY	$75.00	$406,560	*$16.67*	Imported confined material used: Cl 2 AB
Backfill Above Zone	45,173	CY	$5.25	$237,160	*$9.72*	Assumes relatively inexpensive backfill is availablea above
Earthwork Subtotal				$3,354,662	*$137.52*	springline
Pipe						
	24,394	LF	$761.25	$18,569,628	*$761.25*	10' Diameter WSP (Poly coated and lined)
Pipe Subtotal				$18,569,628	*$761.25*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$21,924,290**	***$898.77***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$3,288,644	*$134.82*	
Subtotal				**$25,212,934**	***$1,033.59***	
Contingency			40.0%	$10,085,173	*$413.44*	
Subtotal				**$35,298,107**	***$1,447.02***	
General Contractor Overhead, Profit & Risk			10.0%	$3,529,811	*$144.70*	
Subtotal				**$38,827,918**	***$1,591.73***	
Escalation to Mid-Point			6.0%	$2,329,675	*$95.50*	2% per year compounded over three years.
Subtotal				**$41,157,593**	***$1,687.23***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$1,852,092	*$75.93*	
Subtotal				**$43,009,684**	***$1,763.15***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$21,085,394**	***$864.38***	
TOTAL ESTIMATED CONSTRUCTION COST				**$43,009,684**	***$1,763.15***	
Engineering, Legal & Administration Fees			20.0%	$8,601,937	*$352.63*	
Owner's Reserve for Change Orders			5.0%	$2,150,484	*$88.16*	
TOTAL ESTIMATED PROJECT COST				**$53,762,106**	***$2,203.94***	

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general

The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **6.5' Diameter Pipeline** Date: **17-May-14**
Item: **78" WSP** Proj Mgr:: **CB**

DESCRIPTION	INPUT	
Pipe Diameter (Nom.)	78.00	inches
Average **Total** Exc **Depth**	4.50	feet (Include Bed Thickness)
Length	74,448.00	feet
Trench Slope: 1 Vert. to	1.25	Horiz.
Pavement Thickness:	0.00	inches
ABC Depth:	0.00	inches
No.of Pavement Cuts	0.00	Each

CALCULATED QUANTITIES for ESTIMATE		
Liner Removal	=	2,233,440 sq ft
Trench Excavation	=	113,223 cu yd
Bed + Zone fill (Excludes Pipe Volume)	=	99,264 cu yd
Zone Only Fill (Excludes Pipe Volume)	=	87,545 cu yd
Bed Only Fill	=	11,719 cu yd
Backfill Above Zone	=	137,867 cu yd
Surface Restoration Area	=	2,233,440 sq ft
Shoring Area (Optional): Trench Shored Area	=	NONE sq ft
Shoring Area (Optional): With 30% Toe-In	=	NONE sq ft

INPUT VARIABLES		
Bed Depth =	6.0	in
Zone Depth Above Pipe =	6.0	in
Min. Width =	36.0	in
Side Width (per side x 2) =	24.0	in
Pit Depth =	3.0	ft
	1.0	ft

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Canal Liner Removal	2,233,440	SF	$0.53	$1,183,723	*$15.90*	
Trench Excavation	113,223	CY	$2.10	$237,768	*$3.19*	Assumed excavator used is: CAT 235 with 2 CY Bucket
Surface Restoration	2,233,440	CY	$0.21	$469,022	*$6.30*	Hydroseeding
Zone Only Fill	87,545	CY	$75.00	$6,565,900	*$88.19*	Imported confined material used: Cl 2 AB
Bed Only Fill	11,719	CY	$75.00	$878,900	*$11.81*	Imported confined material used: Cl 2 AB
Backfill Above Zone	137,867	CY	$5.25	$723,800	*$9.72*	Assumes relatively inexpensive backfill is availablea above
Earthwork Subtotal				$10,059,114	*$135.12*	springline
Pipe						
	74,448	LF	$525.00	$39,085,200	*$525.00*	6.5' Diameter WSP (Poly coated and lined)
Pipe Subtotal				$39,085,200	*$525.00*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$49,144,314**	***$660.12***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$7,371,647	*$99.02*	
Subtotal				**$56,515,961**	***$759.13***	
Contingency			40.0%	$22,606,384	*$303.65*	
Subtotal				**$79,122,345**	***$1,062.79***	
General Contractor Overhead, Profit & Risk			10.0%	$7,912,235	*$106.28*	
Subtotal				**$87,034,580**	***$1,169.07***	
Escalation to Mid-Point			6.0%	$5,222,075	*$70.14*	2% per year compounded over three years.
Subtotal				**$92,256,655**	***$1,239.21***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$4,151,549	*$55.76*	
Subtotal				**$96,408,204**	***$1,294.97***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$47,263,890**	***$634.86***	
TOTAL ESTIMATED CONSTRUCTION COST				**$96,408,204**	***$1,294.97***	
Engineering, Legal & Administration Fees			20.0%	$19,281,641	*$258.99*	
Owner's Reserve for Change Orders			5.0%	$4,820,410	*$64.75*	
TOTAL ESTIMATED PROJECT COST				**$120,510,255**	***$1,618.72***	

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general

The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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PROJECT : CCWD - Contra Loma Option
JOB # : 9028B.00
LOCATION : Brentwood, CA
ELEMENT : Siphon Installation Adder

DATE : 5/17/2014
BY : CB
REVIEWED BY:

SPEC. NO.	DESCRIPTION	QUAN	UNIT	TOTAL UNIT COST	SUB FACTOR	LOCATION /ESCALATION FACTOR	SUBTOTAL	TOTAL
DIV. 15000								$3,130,417
	Mobilization (Cranes, confined space, etc)	1	LS	$157,500.00	1.00	1.150	$181,125	
	WSP (installation labor adder)	3000	LF	$525.00	1.15	1.000	$1,811,250	
	Grouting	3142	CY	$315.00	1.15	1.000	$1,138,042	
TOTAL								**$3,130,417**

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Todd Yamello		
Subject:	Technical Memorandum No. 5 - Loop Canal Drainage Study		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

The Loop Canal and its offshoot, the Ygnacio Canal, convey untreated water from Rock Slough and the Los Vaqueros System, via the Main Canal, by gravity to customers and the Martinez Reservoir in central Contra Costa County. The Loop Canal has been operational for more than 70 years and is approaching the end of its useful life as a water conveyance facility.

In addition to conveying untreated water from the California Delta to customers and District facilities, the Loop Canal collects and conveys stormwater runoff. Stormwater from the United State Bureau of Reclamation (USBR) property on either side of the canal drains into the canal. In addition, there are off-site properties on the upslope side of the canal that drain into the canal. The abandoned Clayton Canal also collects stormwater runoff, which ultimately drains into the Loop Canal.

The 2013 Update of the Untreated Water Facilities Improvement Program (UWFIP) presented an assessment of the upgrade and replacement alternatives for the Loop Canal. The assessment concluded that the replacement of the Loop Canal with a buried untreated water or recycled water pipeline is the most viable conveyance renewal alternative in the long term.

PURPOSE

If the District replaces the Loop Canal with a pipeline, the canal will no longer be available to collect and convey stormwater runoff. This memorandum quantifies the stormwater runoff into the Loop Canal and presents an approach for handling the stormwater after the existing canal is removed from service.

SUMMARY AND CONCLUSIONS

- If the Loop Canal is replaced by a pipeline, managing stormwater drainage from the canal property and off-site properties that drain to the canal appears feasible. The estimated cost of the stormwater facilities is $18.1 M.
- The Loop Canal receives stormwater runoff from more off-site properties than the Main Canal. The Concord Naval Weapons Station (CNWS) and Lime Ridge Open Space account for approximately 46 percent and 31 percent, respectively, of the total off-site area that drains to the Loop Canal.

- Redirecting stormwater to existing stormwater collection systems and natural drainage features (e.g. creeks) appear feasible. Because the capacities of the existing collection systems and creeks are unknown, it was assumed that detention basins, sufficient to contain runoff from wet weather event with a 100-year recurrence interval and a 24-hour duration, would be constructed, where feasible, to minimize the hydraulic impacts on the existing collection systems.
- Because the Loop Canal is located in an urban, developed area, construction of detention basins does not appear feasible at many locations. Without detention basins, more emphasis on the capacity of the existing stormwater collection systems and creeks is required, especially in areas with existing flooding issues (e.g. Grayson Creek). These collection systems and creeks need to be studied in depth during the next phase of this project. If the proposed discharge locations do not have capacity to receive additional stormwater flows, then it is likely that stormwater can be conveyed further down the Loop Canal alignment to another location.
- For the portion of the Loop Canal that passes through the CNWS, construction of detention basins will require acquisition of property and/or easements from the CNWS. Close coordination with the Navy, the City of Concord, and the CNWS developer will be required, as the Loop Canal detention basins will be located in areas of the CNWS that are planned to be developed. However, these detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure are capable of handling the increased stormwater runoff flows.
- Within the canal property, concrete lined ditches will be constructed to convey stormwater to the detention basins. The ditches will discharge to grass lined swales upstream of the detention basins to provide stormwater treatment.
- Additional investigations and modeling should be performed to analyze the capacity of the existing stormwater collection systems and natural drainage features.

DESCRIPTION OF EXISTING INFRASTRUCTURE

The Loop Canal and its offshoot, the Ygnacio Loop Canal, meander approximately 27 linear miles through an urban environment. Stretching from milepost (MP) 25.8 to MP 47.7, the Loop Canal conveys untreated water from its sources in East Contra Costa County, via the Main Canal, to customers in the Central Contra Costa County and the Martinez Reservoir. The 5.15-mile long Ygnacio Loop Canal extends the reach of the Loop Canal connecting to the Loop Canal at MP 35.3 and MP 37.7. A vicinity map of the Loop Canal is shown in Figure 1.

Prior to the construction of the Shortcut Pipeline and the Multi-Purpose Pipeline, the Loop Canal was the central conveyance facility for the District. However, in 2014, it primarily serves to provide redundancy to the Shortcut Pipeline and deliver untreated water to approximately 200 customers. Only 10 of these customers use more than 10,000 gallons per day (gpd).

The Loop Canal only provides water to customers during the dry weather season, not during the winter months. In addition, water sales are relatively low for such a lengthy canal, averaging only 0.83 million gallons per day (mgd) or 1.28 CFS. Maintaining 27 miles of canal requires a large amount of manpower and capital on an annual basis.

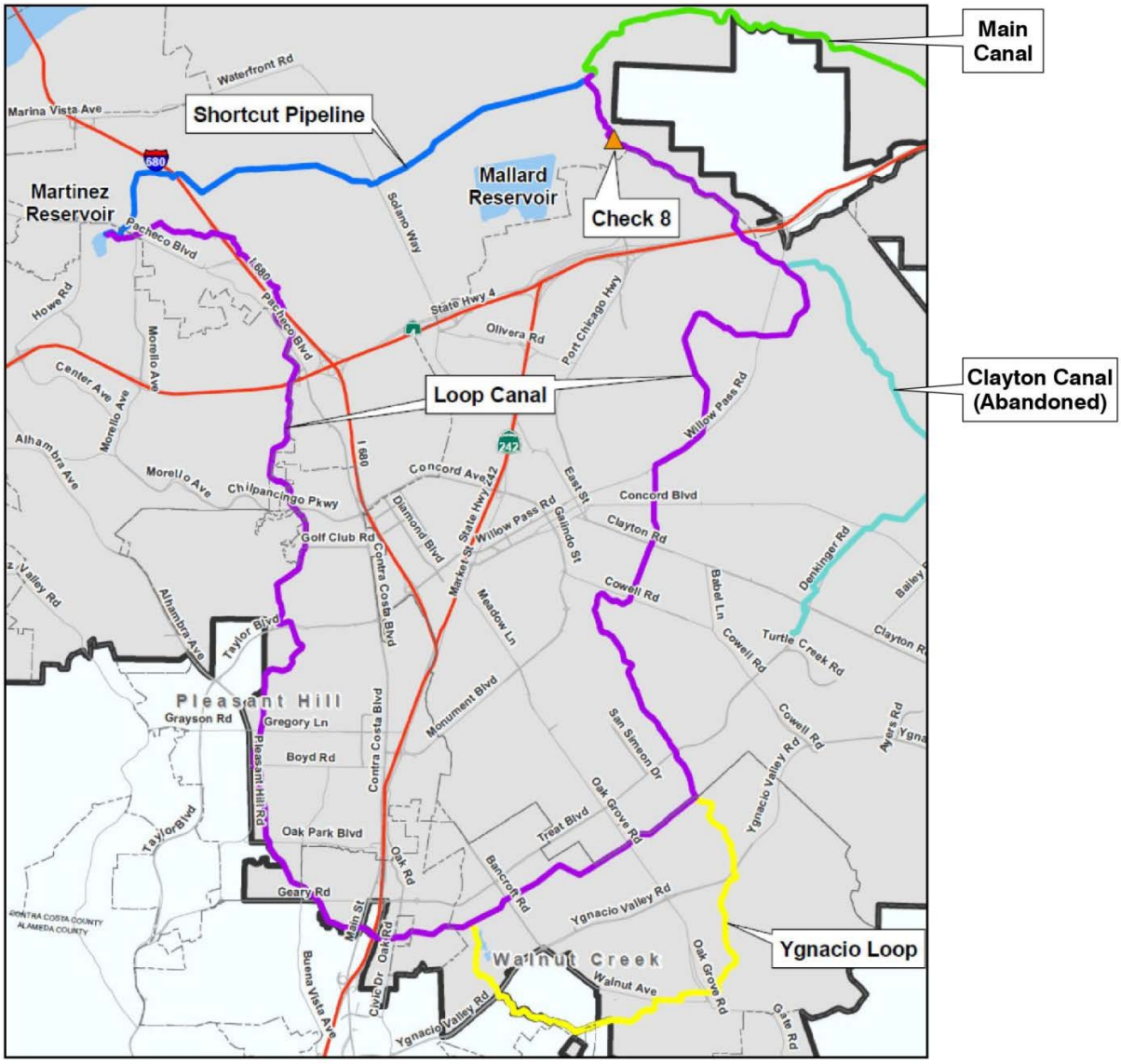

Figure 1 – Loop Canal Vicinity Map

BACKGROUND ON TECHNICAL MEMORANDUM NOs. 3 AND 6

This memorandum builds on Technical Memorandum No. 3 – Main Canal Drainage Alternatives. Technical Memorandum No. 3 provides an approach to providing conveyance and disposal of stormwater runoff once the Main Canal is replaced with a pipeline. This memorandum uses similar methods and analysis to those described in Technical Memorandum No. 3

Technical Memorandum No. 6 – Loop Canal Renewal Alternatives provides conceptual engineering of alternatives to replace the Loop Canal with an untreated water or recycled water pipeline. This Loop Canal Drainage Study Technical Memorandum complements Technical Memorandum No. 6.

SUMMARY OF 1995 CANAL DRAINAGE STUDY

In 1995, the District's Planning Department prepared a Canal Drainage Study. The study's primary purpose was to assess the potential impacts on stormwater on the water quality of the untreated water. The 1995 Canal Drainage Study identified characteristics of sites that drain to the canal and addressed the significance of drainage on Main and Loop Canal water flows and water quality. The study's key conclusions were that:

- Flooding of the Canal system is not likely to occur except under extreme rainfall events of heavy intensity and long duration.
- A storm with a high intensity and long duration has a potential to contribute as much as 68 cfs to the Main and Loop Canal flow.
- The Concord Naval Weapons Station contributes the largest volume of drainage (approximately 50% of the total drainage volume).
- There is little evidence that Canal water quality is adversely affected by Canal drainage.

While the study focused primarily on stormwater impacts on water quality in both the Main and Loop Canals, the study provided valuable information for this Loop Canal Drainage Study. Particularly of note was the list of 13 sites that drain to the Loop Canal from outside canal property. These areas were investigated in further detail during the preparation of the drainage area and runoff estimates.

SUMMARY OF 2006 STORMWATER REMEDIATION STUDY

In 2006, GEI Consultants prepared a Stormwater Remediation Study for the District. The study's primary purpose was to develop short and long term mitigation strategies to eliminate stormwater runoff into the Main and Loop Canals at eight high priority sites. The 2006 Stormwater Remediation Study provided preliminary designs as well as short and long-term costs to eliminate stormwater runoff into the Canals at these eight locations.

The study focused on providing solutions to eliminate runoff primarily to reduce the sediment load into the Canals and to protect the Canals from slope failures caused by the stormwater runoff. Only one of the eight high priority locations was located on the Loop Canal. This location included runoff from Willow Pass Road near MP 31.5. The costs for improvements to eliminate runoff from Willow Pass Road are not included in this study because the stormwater facilities proposed by this study will be designed to accommodate the runoff from this off-site location.

EXISTING STORMWATER INFRASTRUCTURE

Understanding the existing stormwater infrastructure that is located in the vicinity of the Loop Canal is important for two key reasons:

- Based on local stormwater collection system maps, it can be inferred as to whether developed and undeveloped properties on either side of the canal drain to the canal or to downstream component of the stormwater collection system.
- The local stormwater collection system may be utilized to convey stormwater from the canal property once the canal is decommissioned. Therefore, the characteristics and location of the existing local collection systems are important to defining the scope and cost of the new stormwater facilities necessary to replace the canal as a stormwater conveyance facility.

Information on the local collection systems were obtained from several sources. The District obtained stormwater collection system maps from the following Cities and Agencies (only those Cities and Agencies that pertain to the Loop Canal are listed below):

- City of Concord.
- Contra Costa County Flood Control District (City of Martinez and unincorporated areas of the County).
- City of Pleasant Hill.
- City of Walnut Creek.

In addition, the District provided a copy of the District's Untreated Water Structure Book (Structure Book). The District also provided 11 x 17 color maps of the Loop Canal, at an approximate scale of 1":40', that included milepost markers and symbols corresponding to the some of the key infrastructure noted in the structure book.

For areas where stormwater collection system maps were not available (e.g. Concord Naval Weapons Base), Google Earth Pro was used in conjunction with the Structure Book to determine the location of key culverts under the canal. By using all of these sources, a sketch of the existing stormwater collection systems was produced on top of the 11 x 17 color maps of the Loop Canal.

DRAINAGE AREAS

In order to estimate the quantity of stormwater runoff from the canal property and other properties that drain to the canal, the Loop Canal and the Ygnacio Loop Canal were divided into 23 and 6 separate stormwater drainage areas, respectively. Division of the canal into segments is beneficial because it allows stormwater from each segment of the canal to be conveyed to nearby natural or engineering drainage structures instead of being conveyed for long distances. In general, the canal segments were determined by existing barriers to stormwater runoff (e.g. siphons, hills), distance, the location of existing collection system infrastructure, or natural drainage paths (e.g. creeks, wasteways, etc)

Based on the colorized maps, information contained with the 1995 Canal Drainage Study, the 2006 Stormwater Remediation Study, and Google Earth Pro, the total area of the canal property within each area was calculated using Google Earth Pro's Polygon tool. In addition, the total areas of any offsite properties that appeared to drain to the Canal were also calculated. Elevation and 3D topography information from Google Earth Pro was also used to determine boundaries of off-site watersheds, especially for undeveloped properties adjacent to the Loop Canal, within the boundaries of the CNWS and for portions of the Lime Ridge Open Space.

While many sections of the Canal do not appear to collect stormwater from off-site properties, several notable sections that do appear to collect stormwater from off-site properties are included in Table 1. The CNWS accounts for 46 percent of the off-site property that drains to the Canal. Lime Ridge Open Space accounts for an additional 31 percent of the off-site property that drains to the Canal. Appendix A contains details on all of the canal drainage areas, including acreage for canal property and off-site properties that drain to the canal.

Table 1 Off-Site Drainage Area Summary (>10 acres)
Loop Canal Drainage Study
Contra Costa Water District

Drainage Area[(1)]	Off-Site Runoff Area (ac)	Comments
1 (MP 25.8 – MP 26.5)	58.0	Includes a large area of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal near MP 26.5.
2 (MP 26.5 – MP 27.15)	62.6	Includes a large area of runoff from the CNWS that is not drained via the existing culvert under the canal near MP 26.7.
3 (MP 27.15 – MP 27.8)	22.6	Includes a portion of the CNWS property that does not drain to an existing detention basin.
4 (MP 27.8 – MP 28.34)	14.6	Includes a portion of the CNWS property that does not drain to the natural drainage course at MP 28.07.
6 (MP 29.07 – MP 30.24)	45.8	A portion of the CNWS appears to drain to the Canal.
11 (MP 33.45 – MP 34.55)	31.3	Lime Ridge appears to drain to the canal via drain inlets along a portion of this section of the canal.
17 (MP 39.35 – MP 40.62)	15.1	Portions of residential areas in the City of Pleasant Hill appear to drain to the canal.
18 (MP 40.62 – MP 42.1)	12.9	Some residential and open space near MP 41.7 appear to drain to the canal.
22 (MP 44.7 – MP 46.5)	27.6	Includes runoff from open space and a junkyard.
YC 2 (MP 0.76 – MP 1.55)	106.0	Includes runoff from 90 acres from Lime Ridge Open Space and runoff from 15 acres from the Boundary Oaks Golf Course.

Note:

(1) All of the drainage areas are in the Loop Canal with the exception of Drainage Area YC 2, which stands for the Ygnacio Canal Drainage Area No. 2.

These percentages do not include the stormwater runoff that is collected by the abandoned Clayton Canal. The Clayton Canal is not in service but collects runoff from the CNWS. The topography around the Clayton Canal is complex and a field investigation is necessary to determine which upslope areas drain to the Canal. Since the Clayton Canal drains back to the Loop Canal, it is important to quantify the runoff into the Clayton Canal. However, as will be described later in this Technical Memorandum, two options have been developed to handle the stormwater collected by the Clayton Canal. These two options should remain viable regardless of the exact quantity of runoff from the Clayton Canal.

STORMWATER RUNOFF ESTIMATES

Stormwater runoff estimates were determined using the Rational Equation and design guidelines provided on the Contra Costa County Flood Control District's (CCCFCD) website. To

be conservative, runoff was calculated for a wet weather event, or storm, with a 100-year recurrence interval. The key assumptions for this analysis and sources for the assumptions are shown in Table 2.

Table 2 Stormwater Runoff Calculation Summary
Loop Canal Drainage Study
Contra Costa Water District

Component	Criteria	Comments/Source
Runoff Formula	Rational Formula	Q = CiA where C is the runoff coefficient, i is the rainfall intensity in in/hr and A is the runoff area in square feet.
Runoff Coefficient (C)	0.3	0.2-0.4 for open, undeveloped areas per CCCFCD runoff coefficient guidelines
Rainfall Intensity (i)	Varies between 0.93 in/hr and 1.86 in/hr	Rainfall Intensity was calculated using the average mean precipitation for the Loop Canal (15 to 18 in per annum) from CCCFCD's drawing B-166. The time of concentration (t_c) for each drainage area was then determined for each area using either the Kirpich equation or a velocity of 1.5 fps (the estimated velocity through the concrete lined ditches with a minimum slope). Using the CCCFCD's Precipitation-Duration-Frequency-Depth curves for a storm with a 100 year recurrence interval (Drawing B-162), the rainfall intensity was derived using the drawing and the time of concentration.

The peak stormwater runoff for all of the canal property and the off-site properties for a storm with a 100-year recurrence interval was determined to be 255.3 cfs (not including runoff from the Clayton Canal). Because the Loop Canal is over 27 miles long, it is unlikely that the peak runoff would occur simultaneously in all of the individual drainage areas. The runoff from each drainage area as well as the area-specific runoff characteristics (rainfaill intensity, time of concentration, etc) are included in Appendix A.

PROPOSED STORMWATER FACILITIES

The stormwater facilities described below are proposed to manage the stormwater runoff from the canal after it is decommissioned. The stormwater facilities differ somewhat from the facilities proposed for the Main Canal because the Loop Canal is located in a more urbanized area of Contra Costa County than the Main Canal. This means that constructing detention basins at most locations, especially outside of the CNWS, is not possible. Therefore, a greater emphasize on coordination with the Cities of Concord, Pleasant Hill, Martinez, Walnut Creek, Contra Costa County, and the Army Corps of Engineers will be required because the peak flows from many of the drainage areas will not be attenuated by detention basins.

Significant modeling work will be required to verify that the existing stormwater systems and natural waterways can convey the runoff without flooding or impacts to properties downstream of the canal. During the next phase of the project, modeling of each identified drainage facility should be performed to allow the impacts of the new stormwater flows on the existing infrastructure and waterways to be quantified and, if needed, mitigated. This is especially true

for waterways in Contra Costa County which are already subjected to flooding during significant wet weather events.

If a portion of the collection systems or natural waterways are found to be at capacity and unable to accept additional stormwater, it is likely that alternative discharge points can be located. For example, stormwater could be conveyed further down the canal right-of-way, via a wider and deeper concrete lined ditch, to a location that has the capacity to accept additional stormwater.

Concrete-Lined Ditches

Within the canal property, concrete lined, trapezoidal or v-shaped, ditches will be constructed to convey stormwater to the detention basins. The concrete lined ditches will likely discharge to grass lined swales upstream of the detention basins to provide stormwater treatment. In most cases, the V-ditches will be constructed with the minimum constructible slope of 0.1 percent. This minimizes the depth of the ditch in sections of the canal where the ditch conveys stormwater over long lengths of property.

The ditch cross section will vary according to the location along the canal and the corresponding runoff. However, in general, the ditch will have a width of approximately 2 ft at the water line and normal water depth of 1 ft. The concrete lined ditch will be constructed with a slip form and will be reinforced with wire mesh. The placement of the ditch within the canal property will also vary based on the existing and final topography.

Detention Basins and Grass Lined Swales

The concrete-lined ditches will drain to detention basins within each canal drainage area, where feasible. The detention basins would be designed per CCCFCD standards. The required volume of each area's detention basin is contained in Appendix A. However, unless specifically noted in the "Required New Stormwater Facilities" column in Appendix A, a detention basin is not included in the proposed stormwater facilities.

Where detention basins were found feasible, it was assumed that the detention basins would hold the entire volume of runoff for a storm with a 100-year recurrence interval and a 24-hour duration (assuming a runoff coefficient of 0.3). This is a conservative assumption that assumes the downstream stormwater collection system and natural drainage features have no available capacity.

The detention basins would have a peak water depth of 4-5 feet and be approximately one acre in size. Unlike the Main Canal, most of the detention basins cannot be shaped to fit within existing canal property because the Loop Canal right of way, in general, is narrower than that of the Main Canal. For the Loop Canal, most of the detention basins will be located at CNWS where land available. However, these detention basins will require acquisition of property or easements from the CNWS. In addition, because the Loop Canal passes through the portion of the CNWS that will be developed in the near future, close coordination with the City of Concord and the developer(s) of the CNWS is required. It should be kept in mind that these detention basins may not be required if the existing natural drainage features and stormwater conveyance infrastructure are capable of handling the increased stormwater runoff flows.

If required, grass swales could be incorporated into the design of the detention basins. The grass swales would be located between the concrete lined ditches and the detention basins and would provide treatment of the stormwater.

Connections to Existing Stormwater Collection Systems and Natural Drainage Features

For each drainage area, connections to the existing stormwater collection systems and natural drainage features appear feasible. Because the unutilized capacity of the existing collection systems and drainage features are unknown, it was assumed that detention basins would be constructed, where feasible, to minimize the hydraulic impacts on the existing collection systems. In the urban areas, where construction of detention basins is not feasible, the concrete ditches would connect directly to the existing stormwater collection systems or natural waterways.

In most cases, the detention basins and/or concrete ditches would be connected to the existing collection systems or natural drainage features by relatively short lengths of pipe, catch basins, and/or concrete lined ditches. Only the drainage areas with the largest runoff would require connection pipes larger than 12 inches in diameter. The drainage areas with the largest runoff would require pipes with a diameter of 18 to 24 inches. Initial pipe sizes and detention basin volumes are included in Appendix A.

Additional investigations and modeling should be performed to analyze the capacity of the existing stormwater collection systems and natural drainage features prior to designing the stormwater management facilities.

Examples of Stormwater Facilities

Two examples of the proposed stormwater facilities are shown in Figure 2 (Drainage Areas 4, 5, and 6) and Figure 3 (Ygnacio Canal Drainage Area 2). These locations were selected as examples because they present unique challenges that could not be solved with a more standardized approach. Information on drainage areas not shown in Figures 2 and 3 is included in Appendix A.

Drainage Areas 4, 5, and 6

Drainage Areas 4, 5, and 6 span a stretch of the Loop Canal from MP 27.8 (near Highway 4) to MP 30.24 (within the CNWS). These three drainage areas contain several key features:

- The Seal Creek Wasteway, which discharges to Mt. Diablo Creek at MP 29.1.
- The abandoned Clayton Canal Pump Station at MP 28.38, which serves as the terminus for any stormwater that drains down abandoned Clayton Canal.
- A 42-inch storm drain culvert that that passes under the Loop Canal at MP 28.0. The 42-inch culvert drains a natural water course which is tributary to Mt. Diablo Creek.

Stormwater from Clayton Canal could be routed either to the Seal Creek Wasteway or to the existing 42-inch culvert. It is likely that construction of a detention basin would be required for either option to attenuate the runoff from the Clayton Canal.

To accommodate the stormwater runoff from the canal property and the other off-site runoff upslope from these drainage areas, stormwater from Drainage Area 4 (section of Loop Canal between Highway 4 and Willow Pass Rd) will be directed to the existing 42” culvert. Stormwater from Drainage Area 5 (Loop Canal between Willow Pass Rd and Seal Creek Wasteway) and

Drainage Area 6 (Loop Canal between Seal Creek Wasteway and MP 30.24) will be directed via the existing Seal Creek Wasteway to Mt Diablo Creek.

Ygnacio Canal Drainage Area 2

Ygnacio Canal Drainage Area 2 serves as a collection point for runoff from 90 acres of the Lime Ridge Open Space, 15 acres of the Boundary Oaks Golf Club, and 1 acre of Ygnacio Valley Rd. Currently the runoff is conveyed from the collection point near MP 0.9, over four miles to the terminus of the Ygnacio Canal to the Loop Canal. This large runoff area and the limited capacity of the Ygnacio Canal has resulted in flooding of the canal during past wet weather events. Instead of conveying stormwater all the way around the canal to the Loop Canal (and ultimately to the Walnut Creek flood conveyance structure), one option is to construct a 24-36" diameter stormwater pipe between MP 0.9 and Pine Creek, which is located approximately 1800 linear feet west from MP 0.9. The new stormwater pipe would replace an existing City of Walnut Creek stormdrain located under a sidewalk on the south edge of Ygnacio Valley Rd. This solution would significantly the risk of flooding of the Ygnacio Canal both now and in the future.

COST ESTIMATES

Cost estimates for the new facilities were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in April 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

STORM WATER FACILITIES NEAR MP 28.0 - 29.1

FIGURE 2

CONTRA COSTA WATER DISTRICT
LOOP CANAL DRAINAGE STUDY

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STORM WATER FACILITIES NEAR YGNACIO LOOP CANAL MP 1.0

FIGURE 3

CONTRA COSTA WATER DISTRICT
LOOP CANAL DRAINAGE STUDY

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Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 5 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

Cost Estimate Assumptions

The cost estimates presented here are preliminary in that they were prepared in advance of detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

1. Unit costs for concrete lined ditches were escalated from unit prices contained within the 1999 USBR Canal-Lining Demonstration Project Year 7 Durability Report.
2. Costs for dry detention basins were escalated from a cost equation published by the EPA on their NPDES-Stormwater website.
3. Construction of below grade infrastructure would be accomplished via conventional open trench.
4. Groundwater along the canal is minimal.
5. Excavated material and spoils are disposed on-site.
6. The following contingencies are applied to each of the estimates:
    a. General contingency for unforeseen conditions, changes, or design details: 40 percent.
    b. General conditions: 15 percent.
    c. General Contractor Overhead, Profit, and Risk: 10 percent.
    d. Escalation to the mid-point of construction: 2 percent per year (for three years).
    e. Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).
    f. Bid Market Allowance: 0 percent
    g. Engineering, Legal, and Administration Fees: 20 percent.
    h. Change Order Allowance: 5 percent.

Cost Estimates

The cost estimates for each improvement are indicated in Table 3. Detailed cost estimates are included in Appendix B.

Table 3 Capital Improvement Costs[1] Loop Canal Drainage Study Contra Costa Water District

Phase	Capital Costs (Millions of Dollars)
Concrete Lined Ditches	$6.0
Detention Basins[2]	$2.5
Connections to Existing Stormwater Systems[3]	$3.6
Subtotal (Construction Cost) [2]	**$12.1**
Design, Legal, and Administrative Fees (20%)	$2.4
Special Engineering Studies[4]	$3.0
Change Orders (5%)	$0.6
Total (Project Cost)	**$18.1**

Notes:

(1) Based on April 2014 dollars; ENRCCI=10,895.
(2) Does not include the cost of land acquisition and/or easements at the CNWS.
(3) Does not include connection fees to existing local stormwater collection systems.
(4) Placeholder for the engineering studies required to verify capacity of the existing stormwater collection systems and creeks.

Prepared By:

Colin Barrett

Appendix A – Loop Canal Drainage Area Details

Appendix A - Details on each Drainage Area, Stormwater Runoff Calculations, and Description of New Stormwater Management Facilities
Loop Canal Drainage Study - Loop Canal
Contra Costa Water District

Drainage Area Characteristics					Details on Proposed Stormwater Drainage Connections and Comments			Stormwater Runoff Calculations								General Infrastructure Sizing			
Area ID	MP Start	MP End	Canal Property Drainage Area (ac)	Off-site Watershed Area (ac)	Proposed Stormwater Drain Connection	Required New Stormwater Facilities	Comments	Mean Annual Rainfall (in)	Total Rainfall for 100 year-24 hr storm (in)	Longest Distance to Drain (ft)	Tc (via 1.5 ft/sec waterway)	Tc (via Kirpich Equation)	Intensity (in/hr)	Runoff Coefficient	Peak Runoff, cfs (w/o Detention Basin)	Pipe Size (Diameter in inches)	Detention Basin Volume (cf)	Detention Basin, width (ft) (assumes square shape)	Detention Basin Water Depth (ft)
1	25.8	26.5	3.3	58.0	Drain back (north) to creek at MP 25.55	Upsize existing 24" culvert. Add new CB. Earthwork and detention basin.	Need to check downstream capacity of CCCSD SD under Port Chicago Hwy and the RR ROW. Includes a large area of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal near MP 26.5.	15	4.5	5016	55.73	78.77	1.08	0.3	19.79	15.00	300,298	245	5
2	26.5	27.15	7.6	62.6	Drain to existing 30" culvert under canal at MP 26.97	New CB and detention basin on CNWS property/future development.	Verify Capacity of existing pipeline. Build detention basin Near MP 27.0. Coordinate with City of Concord and developer to locate space for detention basin. Includes a large area of runoff from the Concord Naval Weapons Station (CNWS) that is not drained via the existing culvert under the canal near MP 26.7.	15.5	4.7	2481.6	27.57	45.82	1.63	0.3	34.37	18.00	359,324	268	5
3	27.15	27.8	6.7	22.6	Drain to existing 30" culvert under canal at MP 27.6.	New CB and detention basin on CNWS property/future development.	Refer to Area 2 comments. Most of upstream naval base area is drained to detention basin on CNWS property upslope from canal and/or to concrete ditches which convey the stormwater to a 30" SD under the canal near MP 27.6. There is an extremely large drainage area from the naval property that appears to drain to canal at MP 27.7. It is assumed that the stormwater is captured by the CNWS's stormwater collection system prior to this point. This should be confirmed.	15.5	4.7	2376	26.40	44.31	1.70	0.3	14.95	12.00	149,643	173	5
4	27.8	28.34	3.7	14.6	Drain to existing 18 and/or 42" SD near MP 28.	New CB and detention basin on CNWS property/future development.	Includes a portion of the CNWS property that does not drain to the natural drainage course at MP 28.07. Existing SD appears to drain to natural drainage course west of canal. Verify capacity of existing pipes and build detention basin. Coordinate with CNWS developer.	15.5	4.7	1795.2	19.95	35.71	1.86	0.3	10.23	12.00	93,557	137	5
5	28.34	29.07	10.4	0.0	Drain to Mt Diablo Creek at MP 29.07	Use Existing Seal Creek WW and detention basin.	Naval base area upslope and upstream of MP 28.5 appears to drain to ditch and stormdrain that crosses canal near MP 28.5. The remainder of the upslope naval base is assumed to drain to Mt. Diablo Creek. The Clayton Canal drains to this section of the Loop Canal. Runoff from the Clayton Canal is not included in these calculations.	15.5	4.7	3854.4	42.83	64.31	1.33	0.3	4.15	12.00	53,194	103	5
6	29.07	30.24	15.4	45.8	Drain to Mt Diablo Creek at MP 29.07	Use Existing Seal Creek WW and detention basin.	It appears the upslope area of the naval base collects in a low spot at MP29.2 and is drained via a pipe across the canal to Mt Diablo Creek. It appears that the remainder of the downstream area of the CNWS drains to the canal. It is assumed that willow pass road does not drain to the canal.	15.5	4.7	6177.6	68.64	92.48	1.01	0.3	18.46	15.00	313,379	250	5
7	30.14	30.84	4.7	0.0	Drain to City of Concord Ditch at MP 30.85	Catchbasin and manhole. Build detention basin.	It appears the upstream naval base is drained via a ditch or natural slope to storm drains that cross canal near MP 30.52 and MP 30.6.	15.5	4.7	3696	41.07	62.27	1.39	0.3	1.95	12.00	23,974	69	5
8	30.84	31.62	8.4	7.8	Drain to the City of Concord ditch that runs parallel, and adjacent, to the canal.	50' pipeline and detention basin	Includes 5 acres of upstream land per 1995 canal report and 2000 ft of Willow Pass Rd.	16	5.2	2059.2	22.88	39.69	1.70	0.3	8.26	12.00	91,461	135	5
9	31.62	32.9	10.9	3.9	Drain to Galindo Creek at MP 32.9 via exsting WW	WW modifications	Verify Galindo Creek conveyance capacity. Includes 3.9 acres of off-site land per 1995 Canal Drainage report.	16	5.2	6758.4	75.09	99.10	0.96	0.3	4.26	12.00	83,835	129	5
10	32.9	33.45	4.3	0.0	Drain back to Galindo Creek WW at MP 32.9	Earthwork/Canal Fill	N/A	16	5.2	2904	32.27	51.71	1.43	0.3	1.83	12.00	24,111	69	5

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Loop Canal Drainage Study - Loop Canal
Contra Costa Water District

Drainage Area Characteristics					Details on Proposed Stormwater Drainage Connections and Comments			Stormwater Runoff Calculations								General Infrastructure Sizing			
11	33.45	34.55	9.6	31.3	Drain to existing City of Concord 21" SD at MP 34.3. SD conveys water short distance to Pine Creek	Catchbasin and possible upsizing of 21" SD	Lime Ridge Open Space appears to drain to canal via drain inlets from MP 33.45 to MP33.85. In addition, older residences and open land near MP 34.1 appear to drain to canal. Verify capacity of existing SD and Pine Creek.	16	5.2	4488	49.87	72.31	1.20	0.3	14.76	12.00	231,599	215	5
12	34.55	35.28	6.8	0.0	Drain to Pine Creek at MP 35.28	Catchbasin and short pipeline	Verify capacity of Pine Creek.	16.5	5.4	3854.4	42.83	64.31	1.29	0.3	2.64	12.00	40,179	90	5
13	35.28	36.37	7.5	0.0	Drain to City of Walnut Creek 72-inch SD/Ditch at MP 36.37	Catchbasin and short pipeline.	City of Concord may own/operate the SD ditch. City of Walnut creek owns 72-inch SD. No room for a detention basin.	16.5	5.4	5755.2	63.95	87.57	1.05	0.3	2.36	12.00	43,943	94	5
14	36.37	37.46	9.2	0.0	Drain to City of Walnut Creek 48" SD at MP 37.47	Catchbasin and short pipeline.	No room for detention basin. Check capacity of 48" SD.	17	5.5	5755.2	63.95	87.57	1.06	0.3	2.94	12.00	55,275	105	5
15	37.46	38.52	6.4	0.0	Drain to Walnut Creek Flood Conveyance Structure at MP 37.85	Earthwork only	Check capacity of flood structure. Drainage will include Ygnacio Loop drainage.	17.5	5.6	3537.6	39.31	60.20	1.45	0.3	2.80	12.00	39,200	89	5
16	38.52	39.35	6.7	9.2	Drain to City of Walnut Creek 54" SD at MP 39.29.	Catchbasin and short pipeline.	Per 1995 Drainage Study, a portion of 1st avenue drains to the canal. This runoff should be routed to the twin 54" City of Walnut Creek SDs that cross under 1st aveue at MP 39.04.	18	5.85	4065.6	45.17	67.01	1.33	0.3	6.33	12.00	101,228	142	5
17	39.35	40.62	10.3	15.1	Drain to Murderer's Creek at MP 40.4.	Catchbasin and short pipe.	ACOE is studying solutions to Murderer's Creek flooding issues. Include additional flows from canal in ACOE solution. Portions of Pleasant Hill residential areas appear to drain directly to canal.	19.5	5.9	5544	61.60	85.08	1.19	0.3	9.05	12.00	163,109	181	5
18	40.62	42.1	12.9	12.9	Drain to Grayson Creek via existing WW at MP 41.56	Modifications to WW	ACOE is studying solutions to Grayson Creek flooding issues. Include additional flows from canal in ACOE solution. Some areas near MP 41.7 appear to drain to canal.	18.5	5.8	4963.2	55.15	78.13	1.25	0.3	9.68	12.00	162,835	180	5
19	42.1	43.4	14.5	0.0	Drain to unknown creek at MP 43.4.	Catchbasin and pipe.	Check capacity of unknown Creek.	18.5	5.8	6864	76.27	100.29	1.06	0.3	4.63	12.00	91,785	135	5
20	43.4	44.3	6.2	4.1	Drain to Pacheco WW at MP 44.0	Modifications to WW	Check capacity of Pacheco Creek. Includes 4.1 acres of residential runoff per 1995 Canal Drainage Study.	18	5.7	3168	35.20	55.30	1.47	0.3	4.55	12.00	64,210	113	5
21	44.3	44.7	3.7	0.0	Connect to 48" CCCFCD at MP 44.7	Catchbasin, manhole, and 430' pipe.	Check capacity of 48" SD	17	5.5	2112	23.47	40.47	1.74	0.3	1.92	12.00	22,065	66	5
22	44.7	46.5	12.3	27.6	Drain to Sante Fe WW at MP 46.2.	Modifications to WW	Check capacity of Sante Fe Creek. Includes off-site slope near MP 44.85, portion of junkyard near MP 46.3, and large western facing slopes at MP 45.8 and 46.4.	17	5.5	7920	88.00	111.97	0.93	0.3	11.18	12.00	239,044	219	5
23	46.5	47.7	2.9	9.2	Drain to City of Martinez SD at 47.4	Diversion Box under/near Pacheco Blvd.	Check capacity of existing SD. Consider expanding detention basin to the north. Includes southern facing slope on hill near MP 47.1 and northern facing slope near MP 47.63.	16	5.2	4752	52.80	75.56	1.36	0.3	4.94	12.00	68,380	117	5

Appendix A - Details on each Drainage Area, Stormwater Runoff Calculations, and Description of New Stormwater Management Facilities
Loop Canal Drainage Study - Ygnacio Canal
Contra Costa Water District

Drainage Area Characteristics					Details on Proposed Stormwater Drainage Connections and Comments			Stormwater Runoff Calculations								General Infrastructure Sizing			
Area ID	MP Start	MP End	Canal Property Drainage Area (ac)	Off-site Watershed Area (ac)	Proposed Stormwater Drain Connection	Required New Stormwater Facilities	Comments	Mean Annual Rainfall (in)	Total Rainfall for 100 year-24 hr storm (in)	Longest Distance to Drain (ft)	Tc (via 1.5 ft/sec waterway)	Tc (via Kirpich Equation)	Intensity (in/hr)	Runoff Coefficient	Peak Runoff, cfs (w/o Detention Basin)	Pipe Size (Diameter in inches)	Detention Basin Volume (cf)	Detention Basin, width (ft) (assumes square shape)	Detention Basin Water Depth (ft)
1	0	0.76	0.7	1.6	Drain back to Pine Creek flood channel.	See Loop Canal Area 12.	See Loop Canal Area 12 comments. Limited runoff in this area because canal is a pipeline for majority of area. Runoff is limited to short canal that feeds Ygnacio Pump Station.	17	5.5	4012.8	44.59	66.34	1.35	0.3	0.93	12.00	13,750	52	5
2	0.76	1.55	4.5	106.0	Construct larger SD to replace small City of Walnut Creek SD between canal at MP 0.95 and Pine Creek where it crosses under Ygnacio Valley Rd. SD will be located in sidewalk area on south side of Ygnacio Valley Rd.	New 1,800 LF stormdrain pipeline, catchbasin, manholes, and discharge structure.	Verify Capacity of existing SD pipeline and Pine creek.	17	5.5	3168	35.20	55.30	1.48	0.3	49.14	24.00	661,562	364	5
3	1.55	2.2	4.5	2.3	Drain to Pine Creek at MP 2.2.	New CB and short pipeline.	Verify capacity of Pine Creek. Includes some off-site runoff from backyards and parkland near MP 1.65 and 1.8.	17	5.5	3432	38.13	58.81	1.42	0.3	2.91	12.00	40,975	91	5
4	2.2	2.95	3.7	0.0	Drain to WC 30" SD at MP 2.94 or 48" SD at MP 2.7.	New CB, short pipeline, and manhole.	Verify capacity of existing SD. Connect to SD with more capacity.	17	5.5	3960	44.00	65.66	1.36	0.3	1.50	12.00	22,000	66	5
5	2.95	3.9	5.2	3.4	Drain to WC 30" SD at MP 3.9	New CB, short pipeline, and manhole.	Verify capacity of WC 30" SD. Includes runoff from numerous residences that appear downslope of WC storm drains/catchbasins.	18	5.7	5016	55.73	78.77	1.18	0.3	3.08	12.00	53,865	104	5
6	3.9	5.15	3.8	2.1	Drain to Loop Canal, which will drain to Walnut Creek Flood Conveyance Structure.	N/A	Refer to Loop Canal Area 15. Includes runoff from hill near MP 3.94	18	5.7	6600	73.33	97.31	0.98	0.3	1.72	12.00	36,338	85	5

Appendix B – Cost Estimates

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Detailed Cost Estimate

PROJECT : Concrete Lined Stormwater
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Concord, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	3.5' x 3.5' x 1' Trapezoidal Concrete Lined Ditches (Unit Prices per USBR Literature)	912,384	SF	$2.53	$2,306,102	
2	5' x 5' x 1.5' Trapezoidal Concrete Lined Ditches (Unit Prices per USBR Literature)	327,888	SF	$2.53	$828,755	
	TOTAL DIRECT COST					**$3,134,857**
	Estimating Contingency	40	%	$1,253,943		
	SUBTOTAL				**$4,388,800**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$197,496		
	SUBTOTAL				**$4,586,296**	
	General Conditions	15	%	$658,320		
	SUBTOTAL				**$5,244,616**	
	General Contractor Overhead and Profit	10	%	$438,880		
	SUBTOTAL				**$5,683,496**	
	Rate of Annual Inflation	2.0	%	$347,875		
	SUBTOTAL				**$6,031,372**	
	ESTIMATED CONSTRUCTION COST					**$6,031,372**
	Design, Legal, and Administrative Fees	20	%	$1,206,274		
	SUBTOTAL				**$7,237,646**	
	Change Orders	5.0	%	$301,569		
	SUBTOTAL				**$7,539,215**	
	TOTAL PROJECT COST					**$7,539,215**

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Detailed Cost Estimate

PROJECT : Detention Ponds
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Concord, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	Area 1 Detention Basin	300,298	CF	$0.9	$255,657	
2	Area 2 Detention Basin	359,324	CF	$0.8	$293,329	
3	Area 3 Detention Basin	149,643	CF	$1.0	$149,950	
4	Area 4 Detention Basin	93,557	CF	$1.1	$104,640	
5	Area 5 Detention Basin	53,194	CF	$1.3	$67,899	
6	Area 6 Detention Basin	313,379	CF	$0.8	$264,145	
7	Area 7 Detention Basin	23,974	CF	$1.5	$36,875	
8	Area 8 Detention Basin	91,461	CF	$1.1	$102,839	
	TOTAL DIRECT COST					**$1,275,336**
	Estimating Contingency	40	%	$510,134		
	SUBTOTAL				**$1,785,470**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$80,346		
	SUBTOTAL				**$1,865,816**	
	General Conditions	15	%	$267,821		
	SUBTOTAL				**$2,133,637**	
	General Contractor Overhead and Profit	10	%	$178,547		
	SUBTOTAL				**$2,312,184**	
	Rate of Annual Inflation	2.0	%	$141,524		
	SUBTOTAL				**$2,453,708**	
	ESTIMATED CONSTRUCTION COST					**$2,453,708**
	Design, Legal, and Administrative Fees	20	%	$490,742		
	SUBTOTAL				**$2,944,450**	
	Change Orders	5.0	%	$122,685		
	SUBTOTAL				**$3,067,135**	
	TOTAL PROJECT COST					**$3,067,135**

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Detailed Cost Estimate

PROJECT : Connections to Existing Stormwater Systems
Contra Costa Water District - Canal Rehabilitation/Feasibility Studies
JOB # : 9028B.00
LOCATION : Concord, CA

ESTIMATED MIDPOINT OF CONSTRUCTION : 5/17/2017
COST ESTIMATE PREPARATION DATE : 5/17/2014
BY : CB

ITEM	ELEMENT	QUANTITY	UNIT	UNIT PRICE	SUBTOTAL	TOTAL
1	Area 1	1	AL	$10,500.0	$10,500	
2	Area 2	1	AL	$15,750.0	$15,750	
3	Area 3	1	AL	$0.0	$0	
4	Area 4	1	AL	$10,500.0	$10,500	
5	Area 5	1	AL	$10,500.0	$10,500	
6	Area 6	1	AL	$0.0	$0	
7	Area 7	1	AL	$21,420.0	$21,420	
8	Area 8	1	AL	$16,800.0	$16,800	
9	Area 9	1	AL	$5,250.0	$5,250	
10	Area 10	1	AL	$0.0	$0	
11	Area 11	1	AL	$15,750.0	$15,750	
12	Area 12	1	AL	$40,950.0	$40,950	
13	Area 13	1	AL	$40,950.0	$40,950	
14	Area 14	1	AL	$40,950.0	$40,950	
15	Area 15	1	AL	$5,250.0	$5,250	
16	Area 16	1	AL	$40,950.0	$40,950	
17	Area 17	1	AL	$40,950.0	$40,950	
18	Area 18	1	AL	$0.0	$0	
19	Area 19	1	AL	$40,950.0	$40,950	
20	Area 20	1	AL	$0.0	$0	
21	Area 21	1	AL	$124,110.0	$124,110	
22	Area 22	1	AL	$0.0	$0	
23	Area 23	1	AL	$105,000.0	$105,000	
24	YC - Area 1	1	AL	$0.0	$0	
25	YC - Area 2	1	AL	$1,212,750.0	$1,212,750	
26	YC - Area 3	1	AL	$15,330.0	$15,330	
27	YC - Area 4	1	AL	$40,950.0	$40,950	
28	YC - Area 5	1	AL	$40,950.0	$40,950	
28	YC - Area 6	1	AL	$0.0	$0	
	TOTAL DIRECT COST					**$1,896,510**
	Estimating Contingency	40	%	$758,604		
	SUBTOTAL				**$2,655,114**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$119,480		
	SUBTOTAL				**$2,774,594**	
	General Conditions	15	%	$398,267		
	SUBTOTAL				**$3,172,861**	
	General Contractor Overhead and Profit	10	%	$265,511		
	SUBTOTAL				**$3,438,373**	
	Rate of Annual Inflation	2.0	%	$210,456		
	SUBTOTAL				**$3,648,829**	
	ESTIMATED CONSTRUCTION COST					**$3,648,829**
	Design, Legal, and Administrative Fees	20	%	$729,766		
	SUBTOTAL				**$4,378,594**	
	Change Orders	5.0	%	$182,441		
	SUBTOTAL				**$4,561,036**	
	TOTAL PROJECT COST					**$4,561,036**

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TECHNICAL MEMORANDUM

Project Name:	Canal Rehabilitation Feasibility Studies	**Date:**	May 17, 2014
Client:	Contra Costa Water District (District)	**Project No:**	9028B.00
Prepared By:	Colin Barrett, Registered Civil Engineer No. 69706		
Reviewed By:	Todd Yamello		
Subject:	Technical Memorandum No. 6 – Loop Canal Renewal Alternatives		
Distribution:	C. Hentz, J. Linden		

BACKGROUND

The Loop Canal and its offshoot, the Ygnacio Canal, convey untreated water from Rock Slough and the Los Vaqueros System, via the Main Canal, by gravity to customers and the Martinez Reservoir in central Contra Costa County. The Loop Canal has been operational for more than 70 years and is approaching the end of its useful life as a water conveyance facility.

The primary purpose of the Loop Canal is to convey untreated water from the California Delta to customers and District facilities. Prior to the construction of the Shortcut Pipeline and the Multi-Purpose Pipeline, the Loop Canal was the central conveyance facility for the District. However, in 2014, it primarily serves to provide redundancy to the Shortcut Pipeline and deliver untreated water to approximately 200 customers. Of these 200 customers, only 10 use more than 10,000 gallons per day (gpd). In addition, water sales are relatively low for such a lengthy canal, equaling only 0.83 million gallons per day (mgd) or 1.28 cubic feet per second (cfs). Maintaining the 27-mile Loop Canal requires a large amount of manpower and capital on an annual basis. Consequently, the District is looking at alternatives to conveying untreated water through the Loop Canal in order reduce its operational costs

The 2013 Update of the Untreated Water Facilities Improvement Program (2013 UWFIP) presented an assessment of the upgrade and replacement alternatives for the Loop Canal. The assessment presented eight renewal alternatives and sub-alternatives. Four of those alternatives were selected for further study:

- Alternative 2 – Decommission Canal and Provide Redundancy to Shortcut Pipeline.
- Alternative 3 – Convert Loop Canal to Untreated Water Pipeline (from Check 8 to MP 42.0).
- Alternative 3A – Convert Loop Canal to Untreated Water Pipeline (from Check 8 to Martinez Reservoir).
- Alternative 5A – Convert Loop Canal to Recycled Water Pipeline Using Turnout from Existing Recycled Water Pipelines from CCCSD to Loop Canal.

Key to this study is that the selected renewal alternative must provide redundancy to the Shortcut Pipeline, as the Loop Canal does now. Accordingly, all of the alternatives include measures to provide 27.5 cfs of untreated water to the Shell Refinery, via Martinez Reservoir. In the event that the Shortcut Pipeline is out of service, the City of Martinez would be supplied with treated water from the District's treated water distribution system, instead of untreated water from Martinez Reservoir.

PURPOSE

The purpose of this memorandum is to further refine the most feasible alternatives from the UWFIP. This study refines the hydraulics, facility sizing, and cost estimates for these alternatives.

BACKGROUND ON THE SHORTCUT PIPELINE ALTERNATIVES DEVELOPED DURING THE 2013 UWFIP

Currently, if the Shortcut Pipeline is taken out of service for planned or unplanned maintenance, the District is capable of providing untreated water to its customers that draw from the Martinez Reservoir by conveying water through the Loop Canal. The importance of providing redundancy to the Shortcut Pipeline was emphasized during the unplanned, emergency shutdown of the Shortcut Pipeline in 2013 to repair a leak in the Shortcut Pipeline. In addition, if the capacity of the Shortcut Pipeline is exceeded by customer water demands, the Loop Canal can be used to convey additional untreated water to these customers. Three alternatives were developed during the preparation of the 2013 UWFIP to provide redundancy to the Loop Canal.

Alternative A – Upgrade Existing Recycled Water Distribution System

The District currently owns a network of unused recycled water and water pipelines located northeast of Mallard Reservoir. The recycled water pipeline network consists of a variety 10 to 30-inch diameter steel and asbestos cement concrete pipelines. The analysis performed for the 2013 UWFIP estimated that the total cost of upgrading the existing pipe network to convey 27.5 cfs to the Shell Refinery would be $14 million. This alternative is shown in Figure 1.

Alternative B – New Pipeline and Pump Station from Mallard Reservoir to Loop Canal

Alternative B consists of an approximately 2-mile pipeline from Mallard Reservoir to the western end of the Loop Canal. A low lift pump station with a capacity of approximately 30 cfs would be built just west of the Reservoir to lift water from the reservoir into the canal. The canal, decommissioned to the east of the connection point, would allow untreated water from Mallard Reservoir to flow by gravity to the Martinez Reservoir. This system would allow the Shortcut Pipeline to be taken out of service for planned or unplanned maintenance. The cost of this sub-alternative was estimated to be $18.5 million.

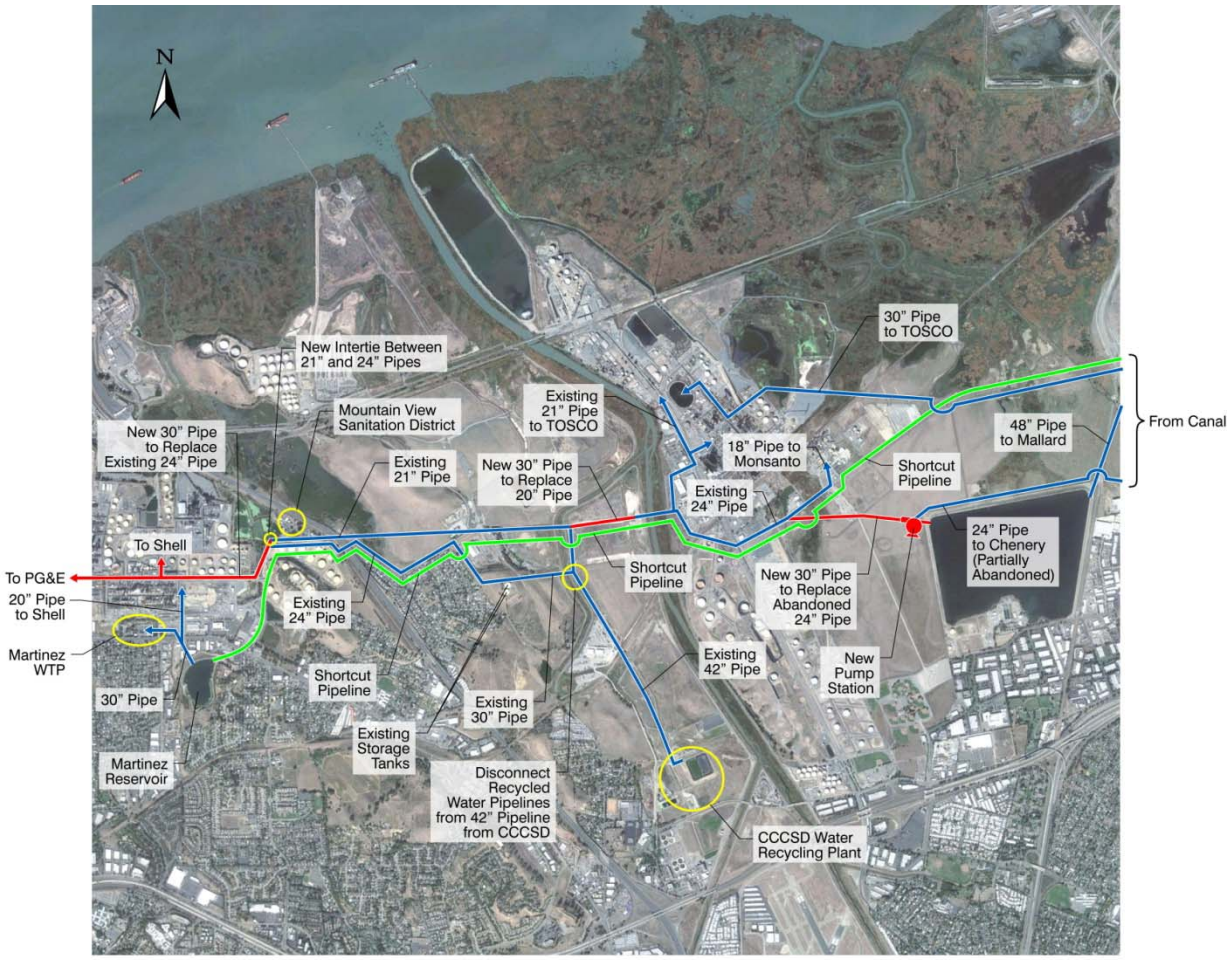


Figure 1 – Shortcut Redundancy Alternative A (from UWFIP)

Alternative C – New Pipeline from Check 8 to Martinez Reservoir (via Loop Canal ROW)

The third alternative, in the event the Loop Canal is decommissioned, is to provide a pipeline around the entire loop (approximately 22 miles). To overcome the friction losses from the lengthy pipeline, a 36 to 42-inch diameter pipeline is required to convey 27.5 cfs to the Martinez Reservoir. This assumes that the pipeline will be pressurized either by a future Main Canal pipeline or via a new pump station located near Check 8. This alternative is the same as Loop Canal Alternative 3A, which replaces the Main Canal with a new untreated water pipeline from MP 25.8 to the Martinez Reservoir. This alternative is discussed later in this report.

ADDITIONAL ANALYSIS OF THE ALTERNATIVES TO PROVIDE REDUNDANCY TO THE SHORTCUT PIPELINE

While the UWFIP found Alternative A to be the lowest cost alternative, Alternative A has the following disadvantages:

- Alternative A relies on use of existing pipelines that have not been used in more than 35 years. The condition of the pipelines is unknown, which increases the cost uncertainty for this alternative. In addition, by the time this project is implemented, the pipelines will be 40 years old, which will significantly decrease the useful life of the new facilities.

- The pipeline essentially parallels the Shortcut Pipeline. Similar to the Shortcut Pipeline, the existing and upgraded portions of the pipeline network would be located in an environmentally sensitive area. Locating the pipe system in an environmentally sensitive area makes construction, operation, and maintenance difficult and expensive.
- This alternative requires modifications to CCCSD's 42-inch recycled water pipeline, which may not be acceptable to CCCSD.

For these reasons, this study focused on additional conceptual engineering for Alternatives B and C. These alternatives are more likely to provide the District with a long term, reliable untreated water conveyance system.

Alternative B – New Pump Station and Pipeline from Mallard Reservoir to the Loop Canal.

As discussed above, this alternative includes a new pump station at Mallard Reservoir that would lift water from the Reservoir through a new pipeline to the Loop Canal. The new pipeline would connect to the Loop Canal just east of Interstate 680 near MP 45.69. Because the Mallard Reservoir supply pipeline and the Reservoir itself would be used to convey untreated water to within 2 miles of the western section of the Loop Canal, redundancy to the Shortcut Pipeline can be provided with a relatively short section of new pipeline

As part of this study, the pipeline route was refined and a conceptual design for the pump station was developed. Figure 2 depicts the pump station location and the pipeline route. Figure 3 shows a cross-section of the pump station.

The pump station would be located on the dry side of the western embankment of the Mallard Reservoir. The pump station would be located approximately halfway between the north and south embankments to allow the pump station to draw from a relatively deep section of the reservoir, as shown in Figure 2. The white contour lines in Figure 2 show the approximate elevation contours of the bottom of the reservoir.

The new pipeline would be routed west southwest across the open field to the west of the Reservoir, to the Tesoro Refinery. The pipeline would pass through an area of the Tesoro Refinery that contains above ground petroleum storage tanks. After passing under a Tesoro Refinery railroad siding, the pipeline would proceed through a small hill located just to the east of Walnut Creek. In the past, above ground petroleum storage tanks were located on this hill but they have been removed. The height of the hill (~120 feet +/-) presents some hydraulic issues in that the hill is the highest point along the pipeline route. It would be preferable if the pipeline could be installed at a lower elevation, possibly by installing the pipe with a deep open cut through the hill or tunneling under the hill. A tunnel is required under Walnut Creek, so the tunnel could be extended to the eastern side of the hill, if Tesoro does not allow the hill to be open cut.

Figure 2 – Shortcut Redundancy Alternative B

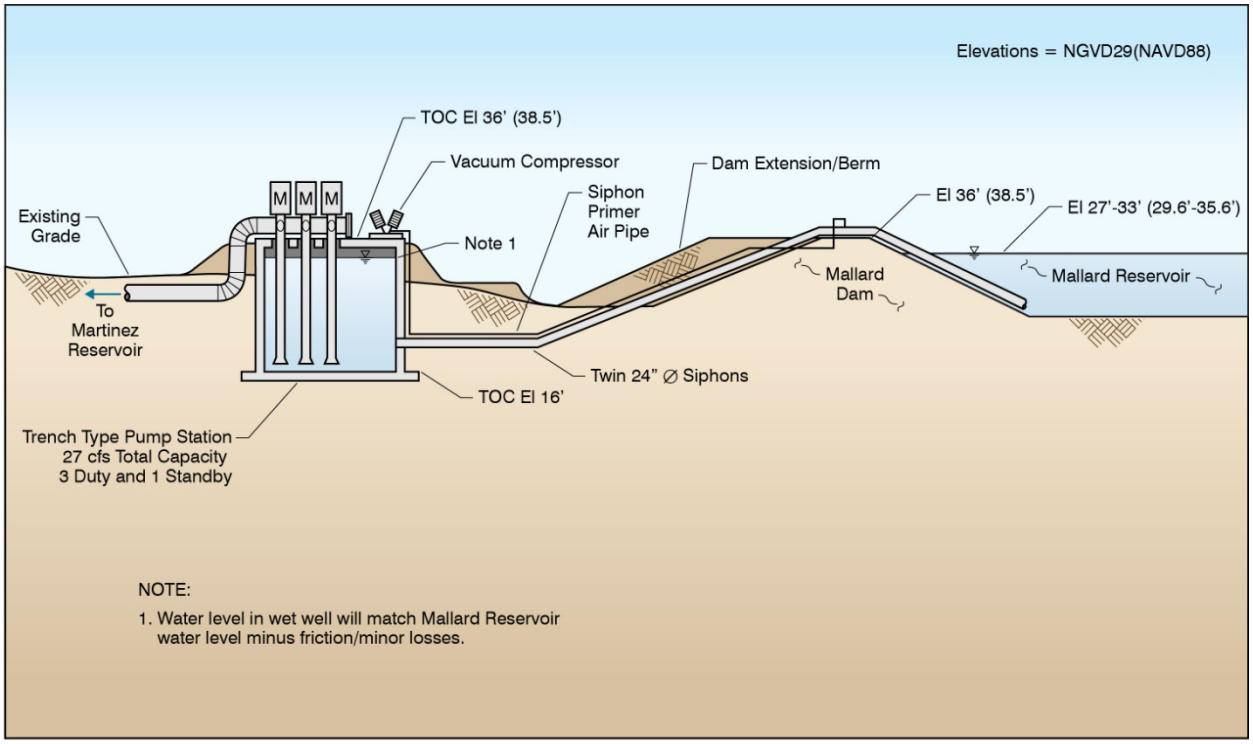


Figure 3 – Loop Canal Redundancy Alternative B – Cross Section of New Pump Station

The tunnel under Walnut Creek could be installed with horizontal directional drilling. After surfacing on the west bank of Walnut Creek, the pipeline would pass through CCCSD property (requiring an easement). The pipeline would pass north of the CCCSD recycled water treatment facility, before passing under, or over, CCCSD's 72-inch outfall and 42-inch recycled water pipelines. The pipeline would continue west, pass around a small hill and enter a residential neighborhood in the City of Martinez. The pipeline would be installed under Emshee Lane and would connect to the Loop Canal after passing through a draw at the western end of Emshee Lane. From there, untreated water would flow by gravity for 2 miles to the Martinez Reservoir. A significant portion of this section of the Canal has already been converted to a gravity pipeline/siphon.

The new pump station would draw from the Mallard Reservoir using a siphon that would supply water to the pump station wet well. The advantage of a siphon is that a new suction pipeline would not have to be installed through the Mallard Dam. A siphon is preferable because excavation through the dam would likely require the reservoir to be drained or via the use of a large, temporary cofferdam.

A pair of 24-inch diameter siphon pipelines can be installed over the dam embankment, similar to the irrigation siphon that is installed at the Middle River Pump Station. The dam embankment would be extended over and around the siphon pipelines to allow vehicle access on top of the dam to remain. The siphons would be primed with a vacuum air compressor.

The reinforced concrete, trench type pump station would be installed west of the reservoir. The elevation of top of the wet well would equal or exceed that of the dam embankment to prevent flooding in the event of a siphon control failure. In the event that the siphon flowrate exceeded that of the pump station flowrate, the siphon flowrate would gradually decline to zero as the wet well water level rose to match the water level in the reservoir.

The pump station would include the following features:

- Four vertical turbine pumps, each with a capacity of approximately 9.1 cfs. The pump station would be configured with three duty pumps plus one standby pump for a firm capacity of approximately 27.5 cfs.
- The pump station could be controlled based on the water level in Martinez Reservoir or controlled based on flowrate.
- Electricity would be provided either by a new feed from Bollman WTP or a new substation near the pump station. This analysis assumes that a new medium voltage feed from Bollman WTP would be provided to the new pump station. A transformer and switchboard would be provided.
- The electrical equipment and PLC would be provided in a prefabricated enclosure.
- A magnetic flow meter would be installed on the pump station discharge pipeline, in a vault.
- A hydropneumatic surge vessel is not included in the layout. While a surge analysis is not within the scope of work for this study, a surge analysis should be completed during the preliminary design of the project.

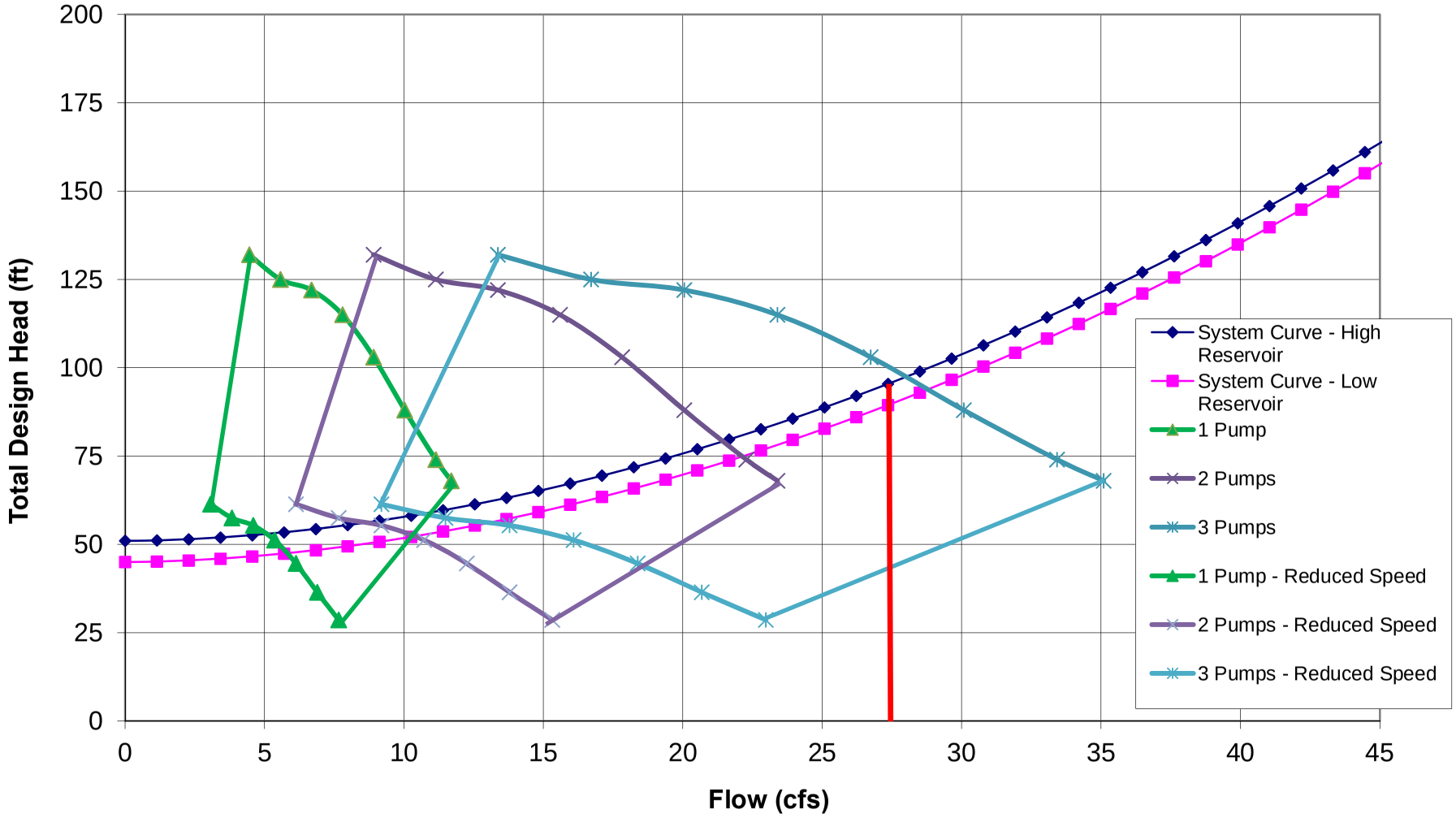
An initial assessment of the system hydraulics, including system curves, was prepared. The system curves are shown on Figure 4. The system curves are based on the high and low water elevations in the reservoir and a static water level in the Loop Canal at MP 45.69. The pump curves for the selected pumps are also shown in Figure 4. Figure 4 shows that the pumps, if

equipped with variable frequency drives (VFDs), are capable of providing 5 to 27.5 cfs at all of the anticipated operating points. Other key design criteria are including in Table 1.

Table 1 Shortcut Pipeline Redundancy Alternative B: Design Criteria
Loop Canal Renewal Alternatives
Contra Costa Water District

Design Criteria	Number	Comments
Hazen Williams C-factor	120	Based on cement mortar lined steel or ductile iron piping.
Water Surface Elevation in Mallard Reservoir	27 to 33 ft	Based on discussions with District staff for Mallard Reservoir Improvements Project
Water Surface Elevation in Loop Canal	78 ft	At MP 45.69
Pipeline Diameter	30 inches	Selected to minimize both construction costs and friction losses.
Pump Station Firm Capacity	27.5 cfs at TDH of 90 to 95 ft	TDH = Total Design Head (Static + friction and minor losses). Efficiency is 85.8% at this design point.
Pump Station Minimum Capacity	6 cfs at TDH of 48 to 53 ft	1 Pump at 70% Speed
Pump Type	Vertical Turbine	
Pump Station Configuration	3 + 1 (duty + standby)	
Pump Model No.	Fairbanks 19B.1 (2 Stage)	13.875” impeller (14.36” max)
Pump Motor Size	125 hp	Max power on curve is 120 hp.
Pump Speed	1180 rpm	

Figure 4 - Shortcut Pipeline Alternative B
Pump Station System and Pump Curves



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Alternative C – New Pipeline from Check 8 to Martinez Reservoir (via Loop Canal ROW)

This alternative, which consists of conveying untreated water in a pipeline within the existing Loop Canal from MP 25.8 to the Martinez Reservoir, is the same as Loop Canal Renewal Alternative 3A. Alternative 3A will be discussed below.

SUMMARY OF SHORTCUT PIPELINE REDUNDANCY ALTERNATIVES

Because the Shortcut Redundancy Alternatives complement, and overlap with, the Loop Canal renewal alternatives, they will be compared and evaluated together with the Loop Canal Renewal Alternatives.

BACKGROUND ON THE CANAL RENEWAL ALTERNATIVES DEVELOPED DURING THE 2013 UWFIP

Eight conveyance alternatives were developed and evaluated in the 2013 Update to the UWFIP. These alternatives are summarized in Table 2.

Updated Alternative 2 – Abandon Loop Canal and Convert Loop Canal Customers to Treated Water

This alternative consists of decommissioning the entire Loop Canal and switching all of the untreated water customers to treated water. This alternative would be paired with Shortcut Pipeline Redundancy Alternative B. Figure 5 depicts this alternative.

The Loop Canal would be filled with soil and landscaped to allow the canal right of way converted to a linear park. It is assumed that the linear park would be ceded to, or maintenance agreements established with, other entities such as the EBRPD or the Cities along the Canal. Facilities would be provided to control stormwater runoff as discussed in Technical Memorandum No. 5 – Loop Canal Drainage Study.

Siphons would be sealed for public safety. Siphon seals could take the form of permanent caps at each end of the siphon (to allow for future use as utility corridors) or abandonment via controlled low strength material (CLSM).

Because existing untreated water customers would be converted to treated water, additional demands will be placed on the treated water distribution system. The scope of this study does not include modeling of the affects of these additional customers on the existing treated water distribution system. However, a high level assessment of the customers was performed. This high level assessment should be confirmed with modeling of the treated water distribution system.

Table 2 Summary of UWFIP Loop Canal Conveyance Alternatives Loop Canal Renewal Alternatives Contra Costa Water District			
Alternative	**Description**	**NPV[(2)] ($M)**	**Comments**
1 Status Quo	The Loop Canal would be replaced-in-kind within the next 20 to 30 years.	60.6	An open water conveyance canal through an urban environment is not viable in the long term due to high maintenance costs, liability, water losses, etc. Refer to 2013 UWFIP for additional information.
2 Decommission Canal and Provide Redundancy to Shortcut Pipeline via Alternative A	The Loop Canal would be demolished and untreated water Customers would be provided treated water.	26.8	**This alternative appears viable and was selected for further evaluation**. Shortcut Redundancy Alternative A will be replaced with Alternative B for the reasons discussed previously.
3 Convert Loop Canal to Untreated Water Pipeline and Provide Redundancy to Shortcut Pipeline via Alternative A	The Loop Canal would be replaced with a pipeline from Check 8 to the westernmost customer on the Loop Canal. A pump station would be installed near Check 8 to pressurize the pipeline.	55.5	**This alternative appears viable and was selected for further evaluation.** Shortcut Redundancy Alternative A will be replaced with Alternative B for the reasons discussed previously.
3A Convert Loop Canal to Untreated Water Pipeline (from Check 8 to Martinez Reservoir)	The Loop Canal would be replaced with a pipeline from Check 8 to the westernmost customer on the Loop Canal. A pump station would be installed near Check 8 to pressurize the pipeline.	58.0	**This alternative appears viable and was selected for further evaluation.**
4 Convert Loop Canal to Recycled Water Canal and Provide Redundancy to Shortcut Pipeline via Alternative A	The Loop Canal would be left in its current state but would be supplied with recycled water from CCCSD. A turnout from CCCSD's planned recycled water pipeline to the CNWS would be used to supply recycled water to the pipeline.	79.2	An open water conveyance canal through an urban environment is not viable in the long term due to high maintenance costs, liability, water losses, etc. Refer to 2013 UWFIP for additional information. In addition, this alternative is dependent on CCCSD extending a recycled water pipeline to the CNWS. The timeline for this pipeline is unclear.

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Table 2 Summary of UWFIP Loop Canal Conveyance Alternatives
Loop Canal Renewal Alternatives
Contra Costa Water District

Alternative	Description	NPV[(2)] ($M)	Comments
4A Convert Loop Canal and Martinez Reservoir to Recycled Water	Similar to Alternative 4 except that Martinez Reservoir would be converted from an untreated water to a recycled water reservoir. Redundancy to the Shortcut Pipeline is not required because Shell could be supplied recycled water directly from CCCSD if the Shortcut Pipeline is out of service.	72.5	Not feasible until CCCSD adds nitrification process. This alternative assumes that the Shell Refinery would be supplied with recycled water and the City of Martinez would be supplied with treated water from the District's treated water distribution system.
5 Convert Loop Canal to Recycled Water Pipeline and Provide Redundancy to Shortcut Pipeline via Alternative A	Similar to Alternative 3, except that the pipeline would be supplied by CCCSD's future recycled water pipeline. The HDPE pipeline would stretch from the CCCSD turnout to the westernmost customer on the Loop Canal.	56.4	Not studied in further detail because this alternative uses Shortcut Redundancy Alternative A.
5A Convert Loop Canal to Recycled Water Pipeline Using Existing Recycled Water Pipelines. Provide Redundancy to Shortcut Pipeline via Alternative B	The Loop Canal would be replaced with a pipeline from CCCSD. Recycled water would be pumped through the new pipeline to the easternmost customer on the Loop Canal in Concord.	64.4	**This alternative appears viable and was selected for further evaluation.** This Alternative is similar to Alternative 5 but uses Shortcut Redundancy Alternative B instead of Alternative A. For this study, this option was modified slightly, to pump recycled water from CCCSD directly to the Canal instead of using the existing recycled water pipelines.

Note: Net present value (NPV) estimates were are from the 2013 UWFIP. The NPVs are based on 50 yr life cycle at 2% inflation and 4% discount rate.

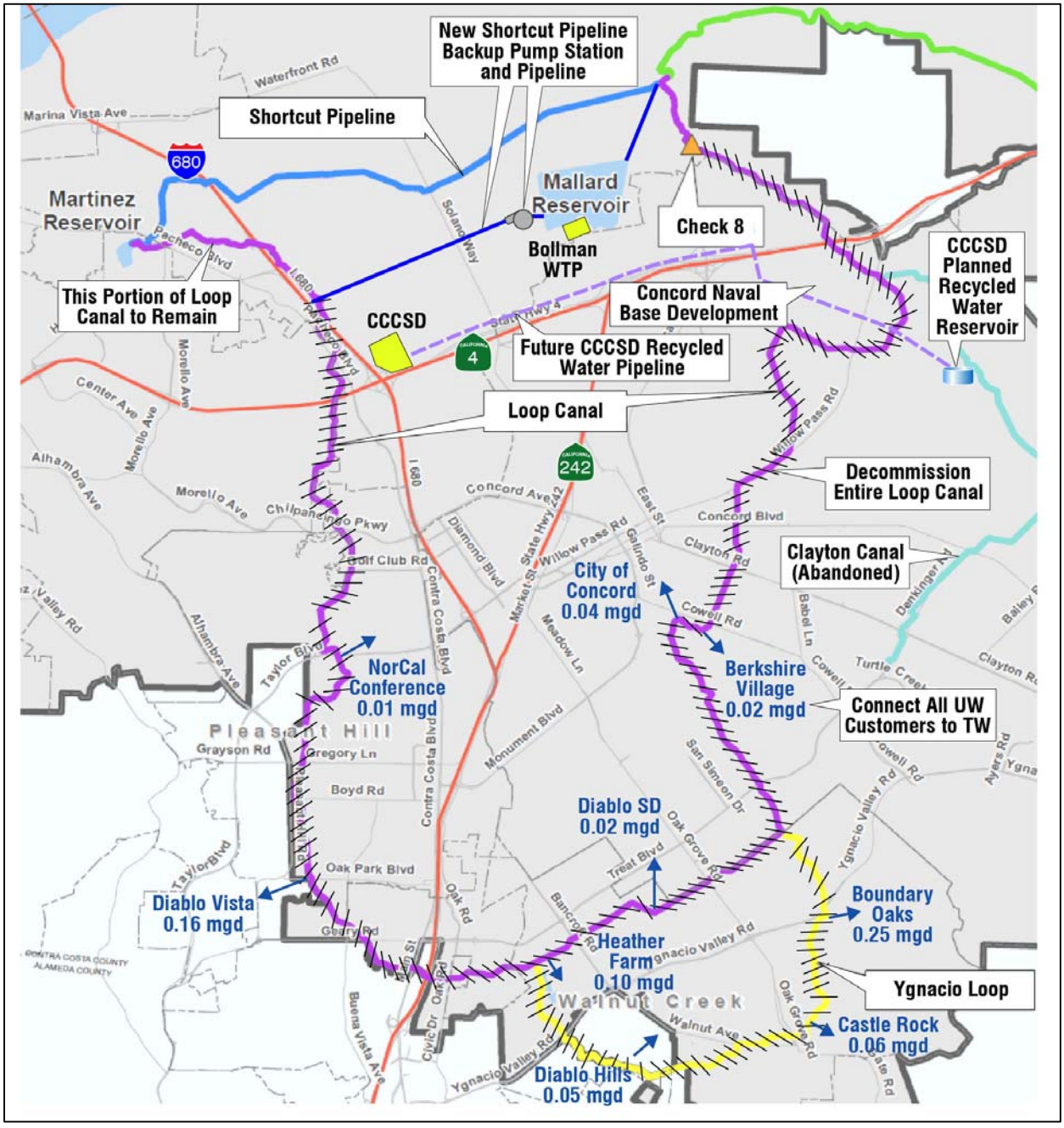


Figure 5 – Loop Canal Alternative 2 – Canal is Decommissioned and Treated Water Provided to Untreated Water Customers

Fortunately, demand from untreated water customers along the Loop Canal is limited (refer to Chapter 5 of the 2013 UWFIP for a complete demand analysis). Only five customers use more than 50,000 gpd on an average day. In addition, it is likely safe to assume that fire flow for these customers is already provided by the treated water distribution system. Therefore, transmission mains and laterals as well as treated water storage reservoirs, are already sized to convey and store fire flows for these customers. However, these customers may have an impact on the distribution systems ability to meet peak day demands and pressure requirements in non-fire

scenarios. Major customers that demand more than 50,000 gpd of treated water are listed below:

- Boundary Oaks Golf Course (average daily demand – 250,000 gpd). The Boundary Oaks Golf Course is located adjacent to 3 MG Newhall Reservoir in Pressure Zone 2. The Newhall Reservoir is supplied with treated water from the San Miguel Pump Station, via a 24-inch main. The San Miguel Pump Station has a total capacity of approximately 19,000 gpm. Because the reservoir is located in near proximity to the golf course, it is unlikely that the additional demand will have a negative impact on pressures for distribution system customers in the vicinity. Approximately 500 feet of 12-inch pipe would be require to connect the existing golf course turnout to Zone 2 of the treated water distribution system.
- Diablo Vista (160,000 gpd) – The Diablo Vista neighborhood is centered between the Diablo Hills (4 MG) and Taylor (7.5 MG) reservoirs in Pressure Zone 1. A 24-inch main runs parallel to the canal along this portion of the Loop Canal. Because Diablo Vista is not located in close proximity to a reservoir, modeling should be performed to confirm that the 24-inch pipeline has sufficient capacity to convey water to Diablo Vista. One potential solution, if there is a capacity issue, would be to place the nearby Pleasant Hill Reservoir and Pump Station back in service. Only a relatively short lateral would be required to connect the existing turnout to the existing treated water distribution system (100 feet of 12-inch pipe was assumed).
- Heather Farms (100,000 gpd) – Heather Farms is located in relatively close proximity to the Diablo Hills Reservoir (4 MG) and a nearby 24-inch main in Pressure Zone 1. Consequently, pressure and storage issues are not expected. 250 feet of 12-inch pipe was assumed to be necessary to connect the existing turnout to the treated water distribution system. .
- Castle Rock (60,000 gpd) – The Castle Rock Homeowners Association is located in Pressure Zone 3 and would be supplied with treated water from the Castle Rock Reservoir (0.5 MG), the 600 gpm Comistas Pump Station, and a nearby 12-inch main. Because the Castle Rock Reservoir and Comistas Pump Station are relatively small, modeling should be performed to determine if upgrades are necessary to the distribution system in this area. An allowance is provided in the cost estimate to account for these improvements, if necessary.
- Diablo Hills Golf Course (50,000 gpd) – The Diablo Hills Golf Course would likely be supplied by the Diablo Hills reservoir (4 MG) and a nearby 24 inch main. 250 feet of 12-inch pipe was assumed to be necessary to connect the turnout to the 24 inch main. Depending on the pressure requirements, this golf course may need to be supplied with treated water from Pressure Zone 2. This is not likely to be an issue as the 4,000 gpm Ygnacio Treated Water Pump Station is located in close proximity.

The major advantages of this alternative are:

- O&M and maintenance costs for the Loop Canal and Loop Canal ROW, as well as future capital costs for canal upgrades, are eliminated.
- Conserves untreated water by eliminating flat rate customers, seepage, and evaporative losses from the canal.

The major disadvantages of this alternative are:

- Treated water distribution system improvements may be required.

- Treated water would be used for irrigation, which is not uncommon in California, but is not a preferred use of treated water from a sustainability perspective.

Updated Alternative 3 – Convert Loop Canal to a Pipeline

Alternative 3 consists of replacing the Loop Canal with a pipeline to meet the demand from the Loop Canal's existing untreated water customers. The pipeline would stretch from upstream of Check 8 to the westernmost customer on the Loop Canal. A pump station would be installed near Check 8 to pressurize the pipeline. A gravity storage tank could be installed at a higher elevation (e.g., Lime Ridge) to provide gravity storage and simplify pump controls. Alternatively, a large hydropneumatic vessel would be installed near the pump station.

Because the Loop Canal would no longer be available to provide supplemental untreated water conveyance capacity to Martinez Reservoir, this alternative would be paired with Shortcut Pipeline Redundancy Alternative B. Figure 6 depicts this alternative.

The new Loop pipeline would likely be constructed of PVC or HDPE, because pressures are not particularly high and to minimize cost. The pipeline would be constructed of several different diameters, sized to meet peak hour flows. Existing customers on the Loop Canal would be converted to pressurized connections with meters. Magnetic flow meters would be required since untreated water contains stringy materials and sediment.

The majority of the untreated water customers are located at elevations of 80 to 100 feet. However, customers on the Ygnacio Canal are located at an elevation of 160 – 180 feet. To provide service with a single pressure zone, untreated water would be provided at a minimum pressure of 40 psig for the lower elevation customers and 10 psig for the higher elevation customers. Lower elevation customers would likely not require additional pumping at their connections but the higher elevation customers would use their own pumps to distribute untreated water on their properties, as they currently do.

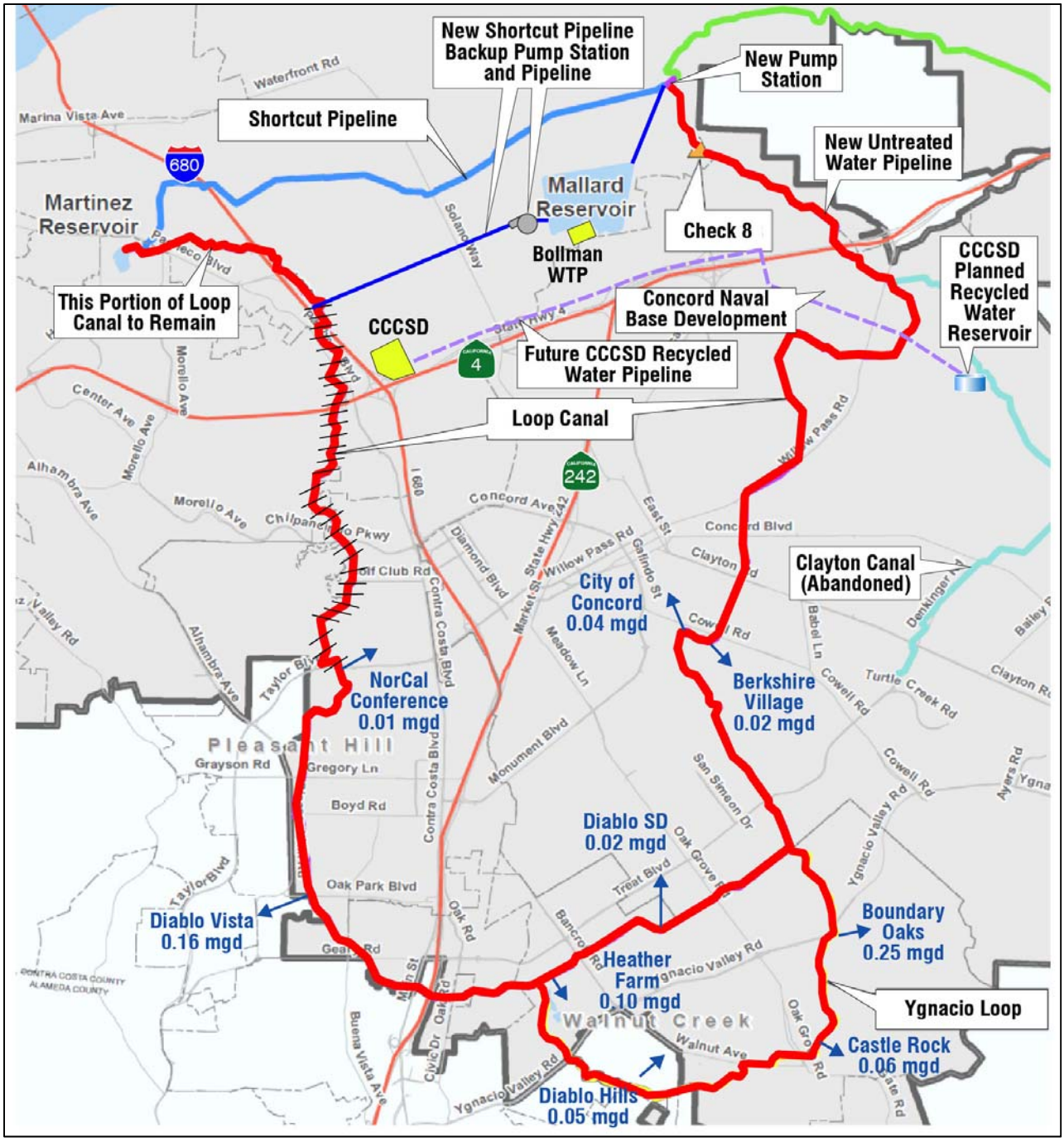


Figure 6 – Loop Canal Redundancy Alternative B – Cross Section of New Pump Station

An EPANET model was created for this alternative to provide preliminary sizing the untreated water pipeline and pump station, based on the pressures discussed above. Table 3 shows the pipeline lengths and nominal diameters for this alternative.

Table 3	Alternative 3 – Untreated Water Distribution System Pipeline Requirements Loop Canal Renewal Alternatives Contra Costa Water District	
Pipeline Diameter (in)	**Length (ft)**	**Location**
30	37,200	Along Loop Canal ROW from MP 25.8 to Gallindo Creek Wasteway.
24	13,000	Along Loop Canal ROW from Gallindo Creek Wasteway to start of Ygnacio Loop
18	31,800	Along Loop Canal ROW from start of Ygnacio Loop to Diablo Vista. Along Ygnacio Canal ROW from start of Ygnacio Loop to Boundary Oaks Golf Course (assumes that existing Ygnacio Canal 18-inch pipeline in Lime Ridge is re-used).
14	5,200	Along Ygnacio Canal ROW from Boundary Oaks Golf Course to Castle Rock HOA.
12	57,300	Along Ygnacio Canal ROW from Castle Rock HOA to Loop Canal ROW and along Loop Canal ROW from Diablo Vista to NorCal Conference Center.

As mentioned previously, the pump station would be located near Check 8. Table 4 provides design criteria for the pump station. The pump station would include the following features:

- Three vertical turbine pumps, each with a capacity of approximately 5.5 cfs. The pump station would be configured with two duty pumps plus one standby pump for a firm capacity of approximately 11 cfs.
- Electricity would be provided by a new substation near the pump station.
- The electrical lineup and PLC would be provided in a prefabricated enclosure.
- A magnetic flow meter would be installed on the pump station discharge pipeline, in a vault.

Potential sites for storage tanks were surveyed using District provided infrastructure maps and Google Earth. Due to the urban environment and the need for elevated storage, storage tank sites were limited. Initially, the Newhall Reservoir site looked promising but the elevation of the available property on the site is fairly high (>325 ft) and would be uneconomical to pump to on a daily basis. The Lime Ridge Open Space has several potential storage tank sites but the terrain varies widely and obtaining buy in from stakeholders to construct a tank in the dedicated open space would be difficult.

Table 4 Alternative 3 – Pump Station Design Criteria Loop Canal Renewal Alternatives Contra Costa Water District		
Design Criteria	**Number**	**Comments**
Hazen Williams C-factor	120	C-factor of 120 may be conservative for HDPE pipe, but the EPANET model did not incorporate minor losses so 120 should be acceptable for this level of analysis.
Minimum Distribution System Pressure	10 to 40 psig	10 psig for customers along Ygnacio Canal. 40 psig for customers along Loop Canal.
Water Surface Elevation in Loop Canal	107 ft	At MP 25.8
Pipeline Diameter	Varies between 12 and 30 inches	Selected to minimize both construction costs and friction losses.
Pump Station Firm Capacity	11 cfs at TDH of 160 ft	TDH = Total Design Head (Static + friction and minor losses)
Pump Type	Vertical Turbine	
Pump Station Configuration	2 + 1 (duty + standby)	
Pump Model No.	Fairbanks 18H.1 (4 Stage)	12.6875” impeller (13.7” max)
Pump Motor Size	125 hp	Max power on curve is 124 hp.
Pump Speed	1180 rpm	

The best location to construct a tank appears to be on existing District property at the site of the Lime Ridge Reservoirs. At this location, the District already owns the property and public access is already restricted. In addition, the District holds easements between the Canal ROW and the site of the Lime Ridge Reservoirs, which would allow a pipeline to be installed between the new untreated water pipeline and the new reservoir. This reservoir site is also at the right elevation (~ 220 ft) to provide 40 psig of pressure to the Loop Canal customers. Figure 7 shows the location of the proposed reservoir. The existing hill to the northeast of the existing Lime Ridge Reservoirs would be cut back to allow the new tank to fit on the site.

The new reservoir will be likely be a welded steel tank. The required reservoir volume is estimated at approximately 400,000 gallons. This volume would be sufficient to meet demands during off-peak periods and to provide enough equalization volume to minimize rapid fluctuations in the pump flowrates. 400,000 gallons can be achieved with a 50-55 ft diameter tank with a side wall depth of 25 to 30 feet.

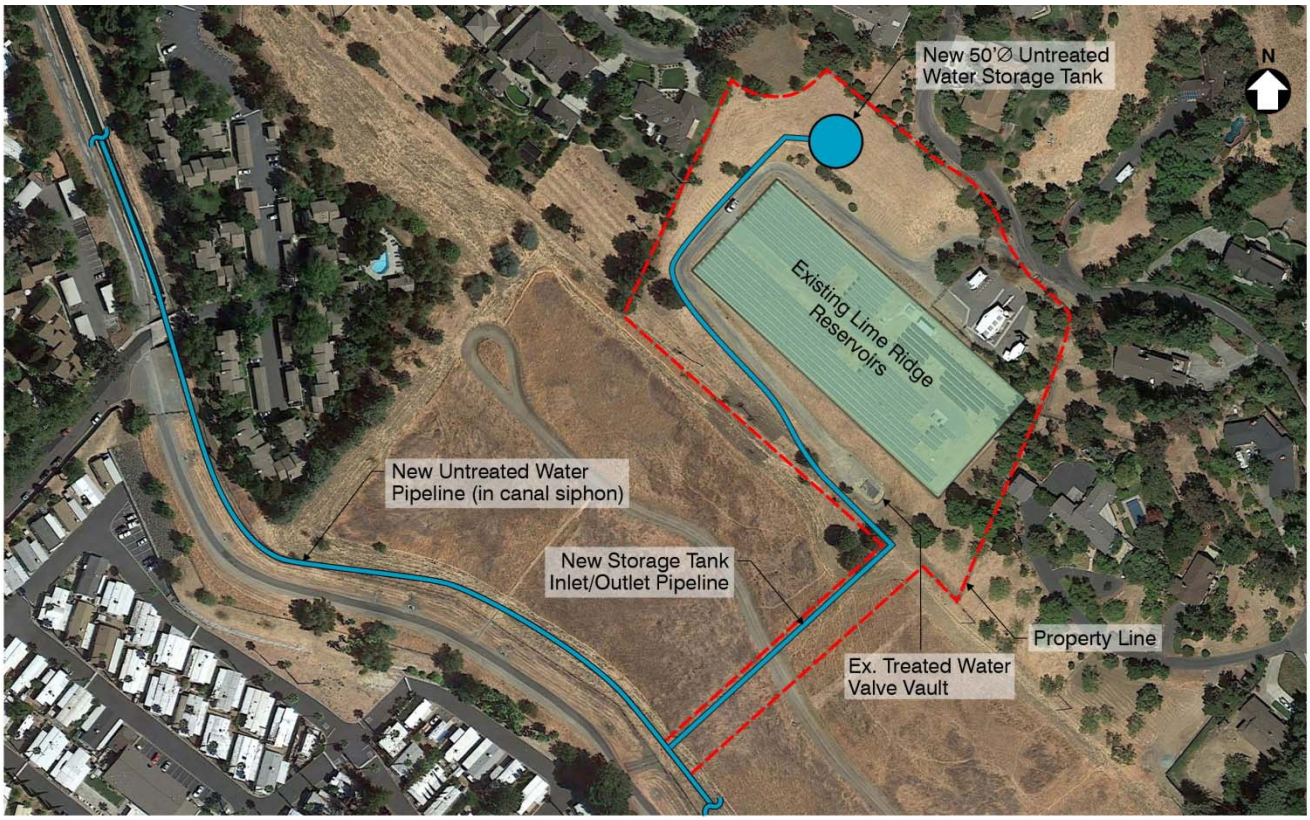


Figure 7 Loop Canal Redundancy Alternative B – Cross Section of New Pump Station

In addition to the features described above, the existing canal trail would continue to be available for public access and maintained by EBRPD. A portion of the canal bottom would be filled in with soil and landscaped to protect the PVC/HDPE pipeline. Siphons would be sealed for public safety reasons as discussed previously.

The advantages of this alternative include the following:

- The new untreated water pump station size and pipeline diameter/length are minimized.
- Operations and maintenance costs, as well as future capital costs for canal upgrades, are reduced significantly because pump station and pipeline maintenance is relatively minimal for new facilities.
- Continued untreated water service to existing customers.

The disadvantages of this alternative include the following:

- Moderately high capital cost (refer to the cost section).

Updated Alternative 3A – Convert Loop Canal to a Piped Untreated Water Conveyance System (to Martinez Reservoir)

This alternative is the same as Alternative 3 except that the pipeline would be extended to the Martinez Reservoir and Shortcut Pipeline Redundancy Alternative B would not be required. The pipeline and pump station would also be upsized to enable it to provide 27.5 cfs to the Shell Refinery in the event that the Shortcut Pipeline is out of service. This alternative is shown in Figure 8.

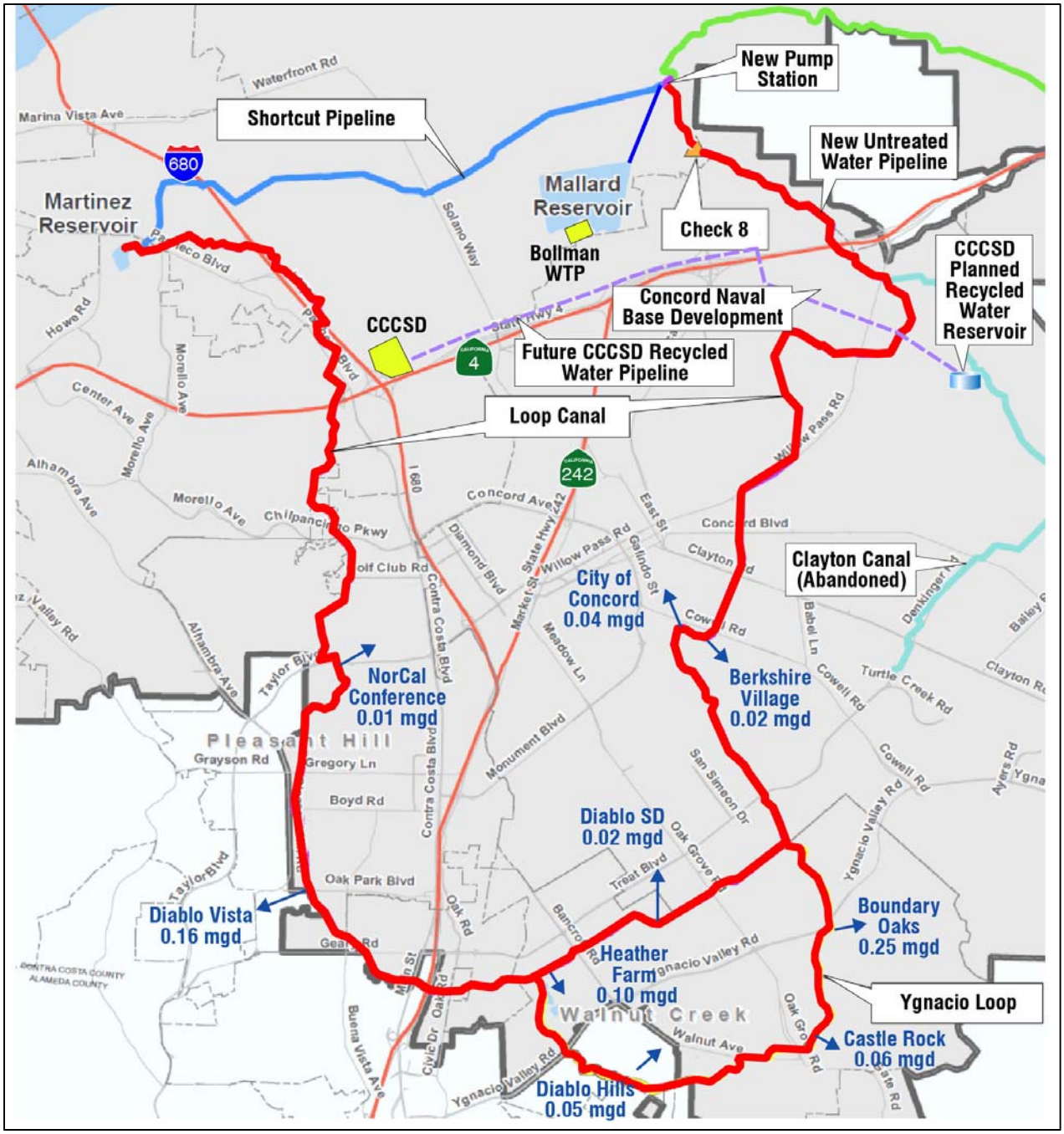


Figure 8 Alternative 3A – Replace Loop Canal with a Pipeline to Martinez Reservoir

This alternative is essentially the same as Shortcut Pipeline Redundancy Alternative C, except that service is provided to untreated water customers along the pipeline and in a new pipeline along the Ygnacio Loop Canal ROW.

Like Alternative 3, the pipeline diameters were selected based on an EPANET model for this alternative. The pipeline diameters and lengths are shown in Table 5 below. As shown in the Table, significantly larger pipeline diameters and longer pipeline lengths are required for this alternative than for Alternative 3. However, this alternative does not require the installation of Shortcut Pipeline Redundancy Alternative B.

Table 5	Alternative 3A – UW Distribution System Pipeline Requirements Loop Canal Renewal Alternatives Contra Costa Water District	
Pipeline Diameter (in)	**Length (ft)**	**Location**
42	50,000	Along Loop Canal ROW from MP 25.8 to start of Ygnacio Loop.
36	79,400	Along Loop Canal ROW from start of Ygnacio Loop to Martinez Reservoir.
24	1,150	New Lime Ridge Reservoir inlet/outlet pipeline.
18	6,300	Along Ygnacio Canal ROW from start of Ygnacio Loop to Boundary Oaks Golf Course (assumes that existing Ygnacio Canal 18-inch pipeline in Lime Ridge is re-used).
14	5,200	Along Ygnacio Canal ROW from Boundary Oaks Golf Course to Castle Rock HOA.
12	15,700	Along Ygnacio Canal ROW from Castle Rock HOA to Loop Canal ROW.

The pump station for this alternative would be similar to the pump station in Alternative 3, but it would include a second, larger set of pumps to allow the untreated water customers along the Loop Canal and the Shell Refinery to be supplied with water if the Shortcut Pipeline is out of service. A conceptual site plan for the pump station is shown in Figure 9.

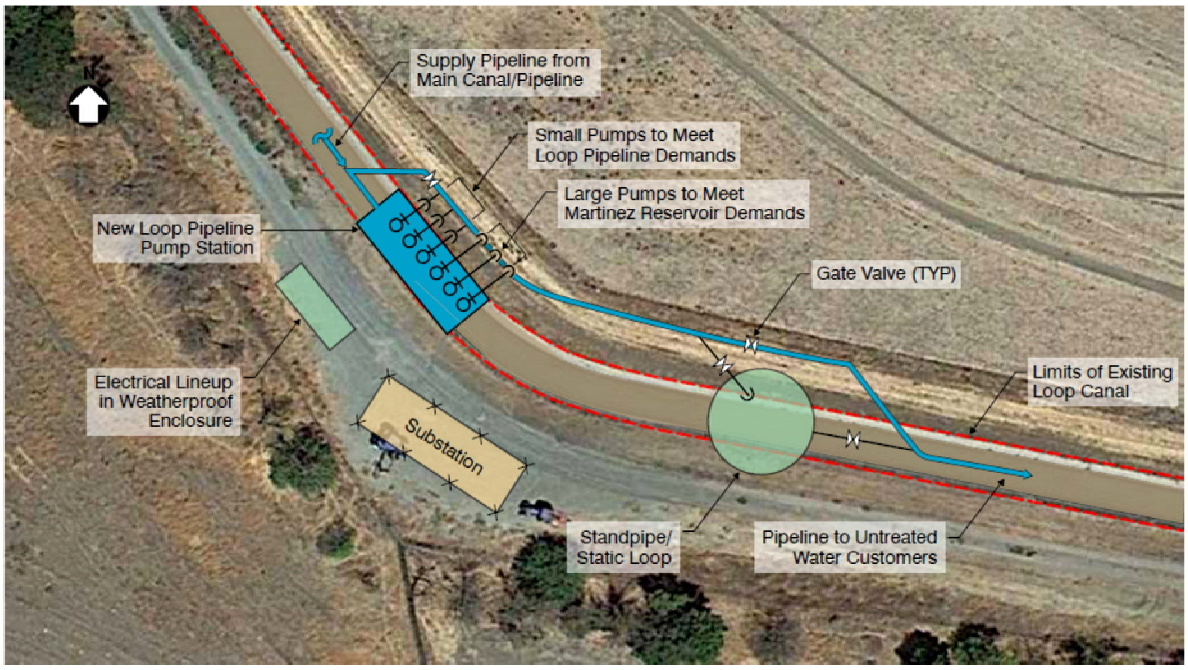


Figure 9 Loop Canal Redundancy Alternative B – Cross Section of New Pump Station

The pump station site shown in Figure 9 is located at a bend in the Loop Canal near MP 26.75. Due to the bend in the Canal at this location, the ROW is wider than the typical Canal ROW. This allows extra space for the electrical equipment and substation. Another benefit of this location is that the slope of the hill on the non-operations side of the canal is only 10 percent, which is less steep than many sites along this section of the Canal. The relatively minimal slope

reduces the risk of landslides and simplifies the design of temporary shoring during construction.

As shown in the site plan, the trench type pump station would be aligned with the existing Loop Canal ROW. The Canal would be filled with soil to allow for the supply and discharge pipelines to be installed as well as to provide vehicle/personnel access around the pump station. The site also allows for installation of a standpipe or hydropneumatic vessel, if the Lime Ridge Storage Tank site is found infeasible.

However, a standpipe or gravity storage tank site at this location is not preferable because it would limit the delivery pressure in the untreated water pipeline, as the site elevation is only 115 feet. In addition, a booster pump station would be required for customers along the Ygnacio Loop (possibly the existing Ygnacio lift station could be upgraded). A hydropneumatic vessel would be preferable to a standpipe but would necessitate more precise control of the pumps in response to demand fluctuations.

Table 6 presents the design criteria for this alternative.

The advantages of this alternative include the following:

- O&M costs, as well as future capital costs for canal upgrades, are reduced significantly because the pump station and pipeline maintenance are relatively minimal.
- Continued untreated water service to existing customers.
- Only one pump station is required to provide service to the Loop and provide redundancy to the Shortcut Pipeline.

The disadvantages of this alternative include the following:

- Higher pumping costs than Alternative 3 due to the long pipeline to the Martinez Reservoir.
- Highest capital cost:(refer to cost estimate section).

Table 6 Pump Station Design Criteria - Alternative 3A Loop Canal Renewal Alternatives Contra Costa Water District		
Design Criteria	**Number**	**Comments**
Hazen Williams C-factor	120	C-factor of 120 may be conservative for HDPE pipe, but the EPANET model did not incorporate minor losses so 120 should be acceptable for this level of analysis.
Minimum Distribution System Pressure	10 to 40 psig	10 psig at the Martinez Reservoir and customers along Ygnacio Canal. 40 psig for customers along Loop Canal.
Water Surface Elevation in Loop Canal	107 ft	At MP 25.8
Pipeline Diameter	Varies between 12 and 42 inches	Selected to minimize both construction costs and friction losses.
Pump Station Firm Capacity	39 cfs at TDH of 185 ft	11.5 cfs + 27.5 cfs = 39 cfs. TDH = Total Design Head (Static + friction and minor losses).
Pump Type	Vertical Turbine	
Pump Station Configuration	Low Flow Pumps: 2 duty + 1 standby High Flow Pumps: 2 duty + 1 standby	
High Flow Pump Model No.	Fairbanks 30E.1 (3 Stage)	20.0625” impeller (21.4” max)
High Flow Pump Motor Size	500 hp	Max power on curve is 464 hp.
High Flow Pump Speed	880 rpm	
Low Flow Pump Model No.	Fairbanks 18H.1 (4 Stage)	12.6875” impeller (13.7” max)
Low Flow Pump Motor Size	125 hp	Max power on curve is 124 hp.
Low Flow Pump Speed	1180 rpm	

Updated Alternative 5A – Convert Loop Canal to Piped Recycled Water System (Supplied from Existing Recycled Water Distribution System)

Similar to Alternatives 3 and 3A, with Alternative 5A the Loop Canal would be replaced with an HDPE pipeline, except that the pipeline would be supplied with recycled water from CCCSD. A new pump station would be constructed at CCCSD to pressurize the pipeline. A short segment of pipe, approximately 3800 feet, would connect the pump station to the new Loop pipeline. Recycled water would flow through the new pipeline in the reverse direction of Canal flow to the easternmost customer on the existing Loop Canal in Concord. This alternative would incorporate Shortcut Redundancy Alternative B.

The Shortcut Redundancy Alternative pipeline and the recycled water pipeline would be installed in the same pipeline corridor. Similar to Alternatives 3 and 3A, a gravity storage tank would still be installed at Lime Ridge. The pump station would also be similar to Alternative 3 but would be located at/near CCCSD. Figure 10 depicts this alternative. Table 7 shows the pipeline diameters and lengths. Table 8 shows the design criteria for the pump station.

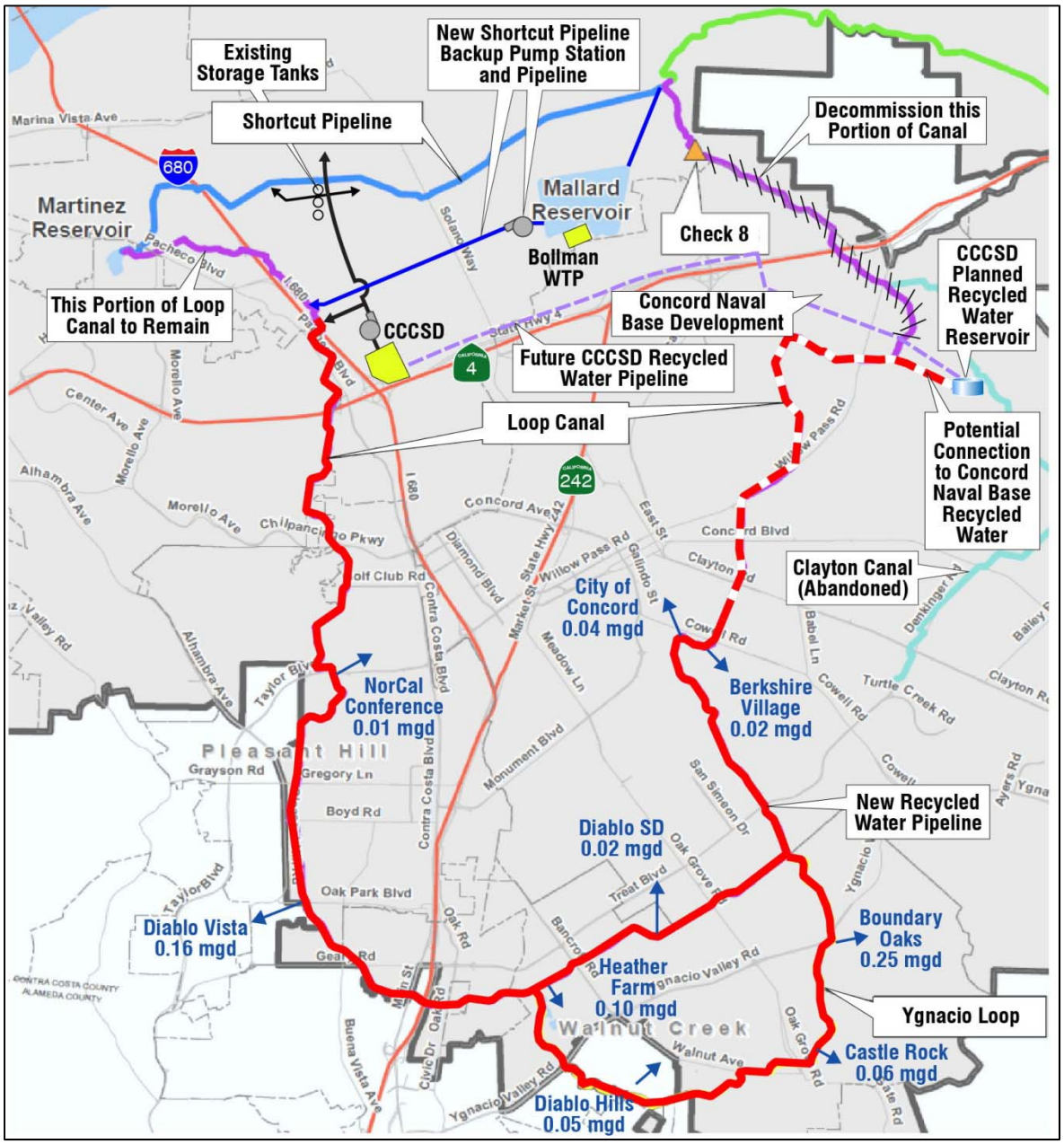


Figure 10 Alternative 5A – Replace Loop Canal with Pipeline from CCCSD

Table 7 Alternative 5A – Untreated Water Distribution System Pipeline Requirements Loop Canal Renewal Alternatives Contra Costa Water District		
Pipeline Diameter (in)	**Length (ft)**	**Location**
30	21,000	Along Loop Canal ROW from MP 45.7 to start of Ygnacio Loop to Norcal Conference Center
24	35,400	Along Loop Canal ROW from Norcal Conference Center to start of Ygnacio Loop.
18	12,000	Along Ygnacio Canal ROW from start of Ygnacio Loop to Boundary Oaks Golf Course (assumes that existing Ygnacio Canal 18-inch pipeline in Lime Ridge is re-used). Along Loop Canal ROW from start of Ygnacio Loop to new storage tank at Lime Ridge.
14	5,200	Along Ygnacio Canal ROW from Boundary Oaks Golf Course to Castle Rock HOA.
12	15,700	Along Ygnacio Canal ROW from Castle Rock HOA to Loop Canal ROW.

Table 8 Pump Station Design Criteria - Alternative 5A Loop Canal Renewal Alternatives Contra Costa Water District		
Design Criteria	**Number**	**Comments**
Hazen Williams C-factor	120	C-factor of 120 may be conservative for HDPE pipe, but the EPANET model did not incorporate minor losses so 120 should be acceptable for this level of analysis.
Minimum Distribution System Pressure	10 to 40 psig	10 psig at the Martinez Reservoir and customers along Ygnacio Canal. 40 psig for customers along Loop Canal.
Water Surface Elevation in Loop Canal	79 ft	At MP 45.7
Pipeline Diameter	Varies between 12 and 30 inches	Selected to minimize both construction costs and friction losses.
Pump Station Firm Capacity	11 cfs at TDH of 266 ft	TDH = Total Design Head (Static + friction and minor losses).
Pump Type	Vertical Turbine	
PS Configuration	2 duty + 1 standby	
Low Flow Pump Model No.	Fairbanks 18H.2 (5 Stage)	13.78” impeller (13.88” max)
Low Flow Pump Motor Size	250 hp	Max power on curve is 202 hp.
Low Flow Pump Speed	1180 rpm	

Initially the Loop Pipeline would only extend to the furthest major customer on the Canal (Berkshire Village near Gallindo Creek Wasteway). However, in the future the pipeline could extend all the way into the CNWS development.

Similar to Alternatives 3 and 3A, existing irrigation customers on the Loop Canal would be converted to pressurized recycled water connections with meters. The Castle Rock Water Company would be converted to treated water as they would not be able to treat recycled water for potable water use.

The existing canal trail would continue to be available for public access and maintained by EBRPD. A portion of the canal bottom would be filled in with soil and landscaped to protect the HDPE pipeline. Siphons would be sealed for public safety reasons.

The advantages of this alternative include the following:

- This alternative can be implemented in a phased approach with Alternative 3. For example, the untreated water pipeline can be constructed and then it can be converted to recycled water at a later date.
- This project could be implemented independently of the CNWS base conversion and be used to help the District meet its 2020 water conservation goals.
- If interagency agreements can be reached between the District, CCCSD, and the CNWS developer, this option becomes more attractive. The reason for this is that this alternative would eliminate the need for a second pipeline from CCCSD to CNWS. Therefore, the funds for that project could be applied to this project, lowering the cost to the District.
- The District has the option of providing recycled water to only the large irrigation users while the residential customers can be converted to treated water. This would lessen the amount of Staff time the District would have to spend on regulatory compliance.
- Conserves untreated water by converting customers to recycled water.
- The project could be implemented in the near future if desired to help the District meet its 2020 water conservation goals.

The disadvantages of this alternative include the following:

- Moderately high capital cost.
- Since the highest demand customers are further away from CCCSD than from MP 25.8, recycled water must be conveyed over a longer distance. Therefore, pumping costs will be greater for this alternative than Alternatives 3 and 3A.
- The recycled water would have to be purchased from CCCSD at a rate of approximately $200 per acre-foot. Currently, the cost of delivering an acre-foot of untreated water is $50 to $80 per acre-foot. Therefore, an annual cost increase of $111,000 to $140,000 would have to be absorbed by the District or passed on to customers.

General Characteristics of New Loop Pipeline

For alternatives 3, 3A, and 5A, the new loop canal pipeline will be installed within the existing canal alignment. The new pipeline will have the following advantages over the existing canal. The pipeline will:

- Significantly increase the reliability of the Districts untreated water conveyance system as the pipeline is not at risk to ground movement/slope instability.
- Increase the water quality; untreated water quality degradation from groundwater seepage, algae and nuisance weeds is eliminated.
- Eliminate risk to life safety from intentional or unintentional trespass.

- Significantly reduce water loss due to seepage and evaporation.
- Eliminate risk of contamination from hazardous chemical spills or intentional sabotage.
- Provide a new community benefit because the East Bay Regional Parks District (EBRPD) public access recreational trail can be expanded and improved.

The pipeline will be installed within the existing canal. Only the largest diameter pipelines (Alternative 3A) would require excavation at the base of the canal. Because the cross section of the canal property changes along the canal length, two typical trench sections were prepared to show how the new pipeline would be constructed within the existing canal alignment. Refer to Figures 11 and 12.

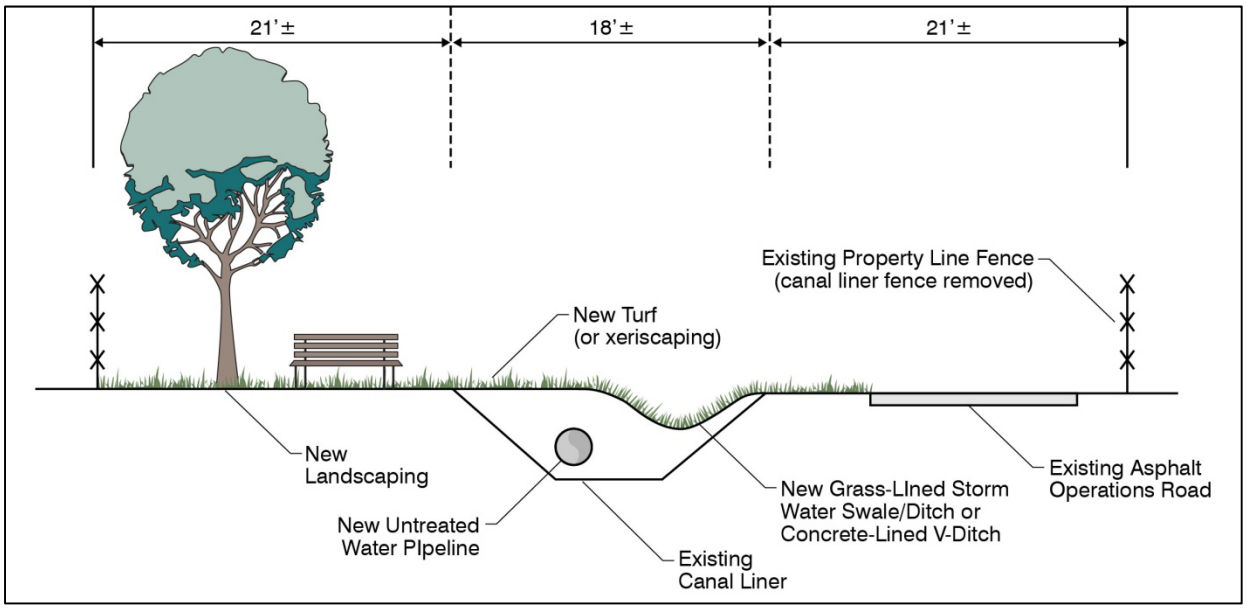


Figure 11 – Pipeline Installed in the Loop Canal at MP 35.5

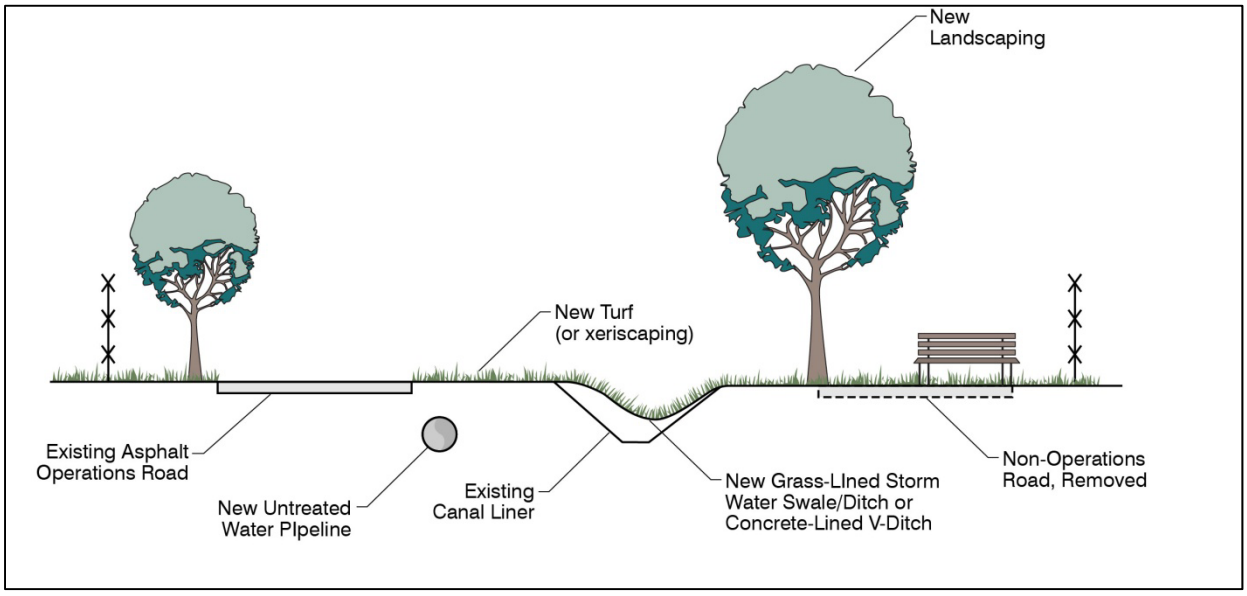


Figure 12 – Pipeline Installed in the Ygnacio Canal at MP 1.5

Aggregate base rock would be trucked in to provide bedding and backfill material. For backfill above the springline, native soils would be used for backfill. A key consideration during the design of the new pipeline will be locating inexpensive sources of backfill materials.

Stormwater Drainage

The trench sections shown in Figures 11 and 12 allow for the construction of stormwater drainage ditches along the pipeline alignment. The conveyance of stormwater runoff from nearby properties is a key consideration for the canal to pipeline conversion. Stormwater drainage from the Loop Canal is discussed in more detail in Technical Memorandum No. 5.

Pipeline Laterals

The Loop Canal has many laterals that provide water to untreated water customers. In addition, there are many unmetered customers that draw directly from the canal with small diameter suction pipelines. When a new pipeline is constructed, each lateral will need to be modified to accommodate the new pipeline, which may operate in both a pressurized and gravity modes.

For existing, unmetered, residential customers a small diameter lateral (3/4 to 1.5 inches) would be installed for each customer. The District will have to make a decision on whether backflow preventers are necessary, as backflow preventers will significantly reduce the delivery pressure. Because the new pipeline will not be conveying potable water, a low headloss check valve may be suitable to minimize the risk of backflow into the pipeline.

For larger untreated water customers, three methods of regulating and metering flow to each customer are proposed. Depending on the nature of each customers' facilities, one of the options described below may be well suited to each customer.

- Option 1- Decrease the diameter of each customers' lateral to account for the higher untreated water delivery pressure. A smaller diameter lateral, magnetic flow meter, and isolation valve would be provided for each customer.
- Option 2- Throttling valve with flowmeter: The existing lateral would be directly connected to the pipeline. The new connection would include an electrically actuated butterfly valve and a magnetic flow meter sized to allow the customer to draw the quantity of untreated water that they require over the full range of pipeline operating pressures. The throttling valve would regulate the flowrate through the lateral based on either the level in the customer's storage basin or the flowrate through the flowmeter. The PLC at the new Loop Pipeline Pump Station would control the throttling valve. The PLC would be connected to the throttling valve and flow meter with a new fiber optic communications cable that would be installed parallel to the new pipeline.
- Option 3 - Altitude Valve: If the customers have a storage tank or basin, the existing lateral would be directly connected to the new pipeline. The lateral would be provided with a gate valve for isolation and a magnetic flow meter. An altitude valve would be installed on the lateral at the customers' storage tank or basin. The altitude valve would regulate flow into the storage tank or basin by opening and closing based on the position of a float or integral pressure sensor in storage tank or basin.

During preliminary design, a survey of the untreated water customers' facilities should be performed to determine the appropriate type of flow regulation for each customer.

Construction Sequencing

Unlike the Main Canal, the Loop Canal can be taken off-line during low demand periods. For this reason, the sequencing of the construction of a Loop Canal Renewal Project is much simpler than the Main Canal. This section describes one approach for constructing the Loop Canal Renewal Project Alt. 3. The approach is summarized in the Workplan shown in Figure 13.

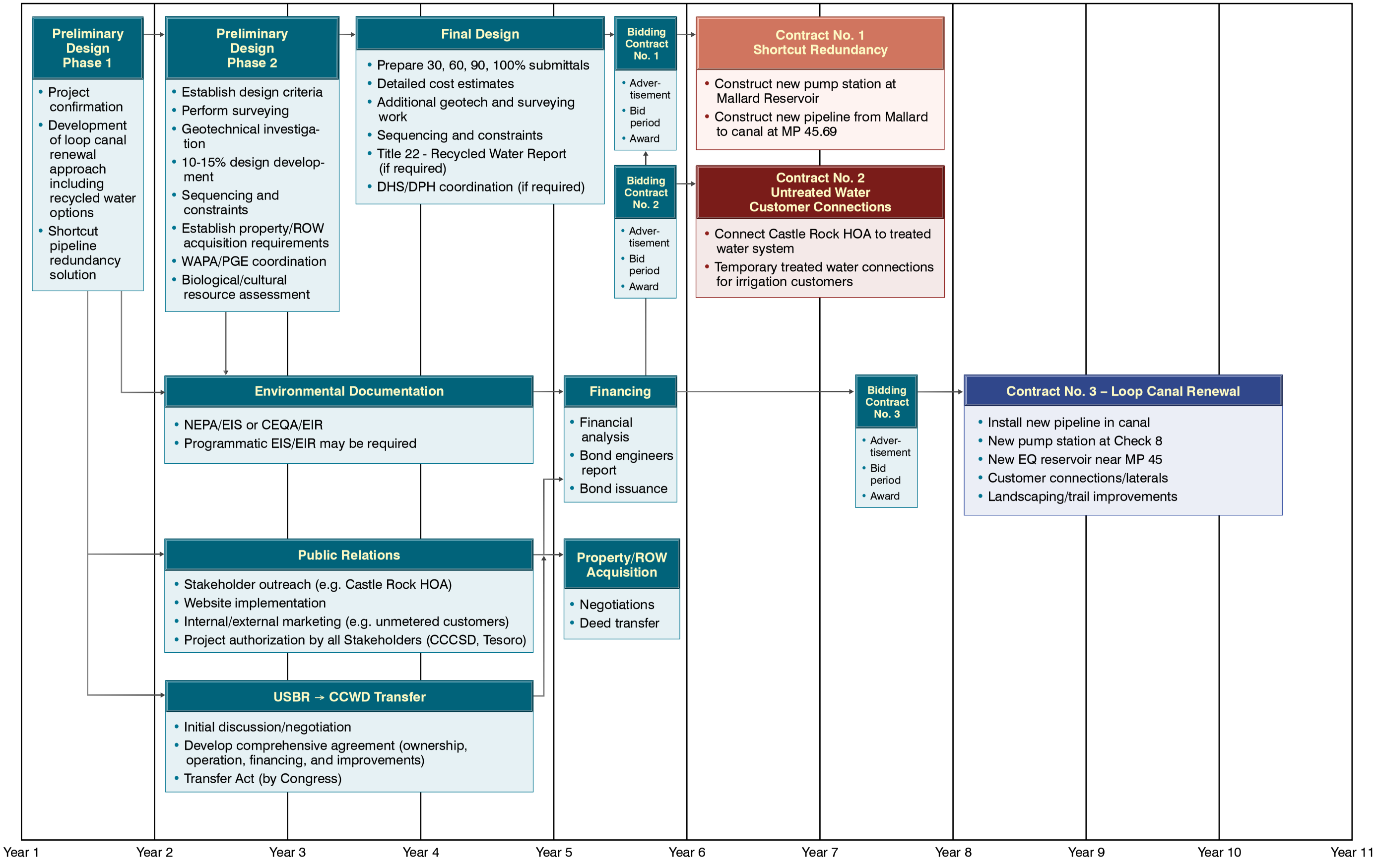
Phase 1:

Construct Shortcut Pipeline Redundancy Alternative B and provide temporary treated water connections to each of the treated water customers. Shortcut Pipeline Redundancy Alternative B will take approximately 18 to 24 months to construct. Towards the end of that construction project the untreated water customers will be provided with temporary connections to the treated water system to provide water during the construction of the new loop pipeline and pump station.

Phase 2:

The construction of the pump station and storage tank will take approximately 18 to 24 months. The production rate for an HDPE pipeline of this diameter is estimated to be approximately 300 linear feet per day, assuming that only one fusing machine is utilized. However, the pipeline production rate will vary greatly based on the pipeline diameter. For the purpose of this study, an 18 to 24-month construction period should be suitable for the pipeline as well.

FIGURE 13: LOOP CANAL REMOVAL PROJECT IMPLEMENTATION PLAN



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Cost Estimates

Cost estimates were based on conceptual design criteria and several assumptions. The final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this memorandum.

The estimates presented in this memo are in April 2014 dollars (ENR San Francisco Construction Cost Index = 10,895). The American Association of Cost Engineers (AACE) has developed the following guidelines:

Type of Estimate	Anticipated Accuracy
Level 4/5 Estimate (Master Plans)	+50% to -30%
Level 2/3 Estimate (Predesign Report)	+30% to -15%
Level 1 Estimate (Pre-Bid)	+15% to -5%

The estimates presented within this memorandum are considered a Level 4 estimate. The cost estimates were developed using a combination of quantity takeoffs, unit prices, and bid prices for past projects. Allowances for contractor overhead and profit, inflation, sales tax, engineering (design and construction-related), legal, and administration were added to the construction cost estimates.

Cost Estimate Assumptions

The cost estimates presented here are preliminary in that they were prepared in advance of detailed engineering effort, without geotechnical information, and without the benefit of knowing the environmental mitigation measures that would be required at each of the sites. As such, the following assumptions apply to the cost estimates presented here:

1. Construction of below grade infrastructure would be accomplished via conventional open trench, where necessary.
2. Groundwater along the canal is minimal.
3. Excavated material and spoils are disposed on-site.
4. An inexpensive source of fill can be obtained for the canal backfill.
5. The following contingencies are applied to each of the estimates:
    a. General contingency for unforeseen conditions, changes, or design details: 40 percent.
    b. General conditions: 15 percent.
    c. General Contractor Overhead, Profit, and Risk: 10 percent.
    d. Escalation to the mid-point of construction: 2 percent per year (for five years).
    e. Sales tax on materials: 9.0 percent on 50 percent of the estimated items (assuming that materials, which are taxable, comprise 50 percent of the estimated costs).
    f. Bid Market Allowance: 0 percent
    g. Engineering, Legal, and Administration Fees: 20 percent.

h. Change Order Allowance: 5 percent.

Cost Estimate Summary

The cost estimates for each improvement are indicated in Table 9. Detailed cost estimates are included in the Appendix.

**Table 9 Summary of Loop Canal Conveyance Alternatives
Canal Rehabilitation Feasibility Studies
Contra Costa Water District**

Alternative	Capital Costs[(1)(2)] ($M)
2 Decommission Canal and Provide Redundancy to Shortcut Pipeline via Alternative B	41.1
3 Convert Loop Canal to Untreated Water Pipeline and Provide Redundancy to Shortcut Pipeline via Alternative B	72.8
3A Convert Loop Canal to Untreated Water Pipeline (from Check 8 to Martinez Reservoir)	102.6
5A Convert Loop Canal to Recycled Water Pipeline Using Existing Recycled Water Pipelines. Provide Redundancy to Shortcut Pipeline via Alternative B	63.1

Notes:
(1) The costs above do not include the $21 M required to provide stormwater conveyance facilities when the canal is removed. Refer to TM No. 5.
(2) Based on April 2014 dollars; ENRCCI=10,895.

Items for Further Consideration and Study

- Conduct user group workshop with District to discuss alternatives and select preferred alternative.
- In the event that Alternative 2 is selected as the preferred alternative, perform a treated water production and distribution system capacity study.
- Once the pump selection is finalized, a surge analysis should be performed to verify that measures to mitigate hydraulic transients are not required.
- Initiate discussions to determine CCCSD's schedule for addition of nitrification and determine if there is interest in providing recycled water to customers via a Loop pipeline.
- Investigate condition of unused recycled water distribution system.

Prepared By:

Colin Barrett

APPENDIX

DETAILED COST ESTIMATES

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Detailed Cost Estimate

PROJECT : SHORTCUT PIPELINE REDUNDANCY ALTERNATIVE B - NEW PS AND PIPELINE FROM MALLARD TO LOOP CANAL
CONTRA COSTA WATER DISTRICT UWFIP
JOB # : 9028B.00
LOCATION : CONTRA COSTA COUNTY, CALIFORNIA

ESTIMATED MIDPOINT OF CONSTRUCTION : 4/9/2019
COST ESTIMATE PREPARATION DATE : 4/9/2014
BY : CB

ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	NEW 30" HDPE/PVC PIPELINE (SEE TRENCH QUANTITY TAKEOFF)	1	AL	$2,583,786	$2,583,786	
2	BORING, CASING, AND PITS UNDER SLOUGH	1,000	LF	$2,000	$2,000,000	
3	ADDER FOR EXCAVATION THROUGH HILL ON TESORO REFINERY	68,519	CY	$5	$342,593	
4	ADDER FOR CCCSD PIPE CROSSING	1	AL	$200,000	$200,000	
5	TRENCH SHORING ALLOWANCE	1	LS	$500,000	$500,000	
6	INTERCONNECT TO CANAL (INCLUDES DISCHARGE STRUCTURE)	1	LS	$100,000	$100,000	
7	30" BASE SLAB FOR PUMP STATION	74	CY	$350	$25,926	
8	24" CONCRETE WALLS FOR PUMP STATION	142	CY	$750	$106,667	
9	18" ELEVATED SLAB FOR PUMP STATION	24	CY	$650	$15,600	
10	MALLARD RESERVOIR PUMPS - VERTICAL TURBINE (125 HP)	4	EA	$162,500	$650,000	
11	MALLARD RESERVOIR PUMP STATION 16" BFV VALVES	4	EA	$6,500	$26,000	
12	MALLARD RESERVOIR PUMP STATION 16" CHECK VALVES	4	EA	$32,500	$130,000	
13	MALLARD RESERVOIR PUMP STATION SIPHONS (WSP)	600	LF	$307	$184,080	
14	MALLARD RESERVOIR MAG METER VAULT	1	AL	$100,000	$100,000	
12	PUMP STATION CIVIL IMPROVEMENTS (EARTHWORK, PAVING, ETC)	1	AL	$200,000	$200,000	
13	MALLARD RESERVOIR PS E&IC (35% OF PUMP STATION COST)	1	AL	$503,395	$503,395	
	TOTAL DIRECT COST					**$7,668,047**
	Estimating Contingency	40	%	$3,067,219		
	SUBTOTAL				**$10,735,265**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$483,087		
	SUBTOTAL				**$11,218,352**	
	General Conditions	15	%	$1,610,290		
	SUBTOTAL				**$12,828,642**	
	General Contractor Overhead and Profit	10	%	$1,073,527		
	SUBTOTAL				**$13,902,168**	
	Rate of Annual Inflation	2.0	%	$1,446,949		
	SUBTOTAL				**$15,349,117**	
	ESTIMATED CONSTRUCTION COST					**$15,349,117**
	Design, Legal, and Administrative Fees	20	%	$3,069,823		
	SUBTOTAL				**$18,418,941**	
	Change Orders	5.0	%	$767,456		
	SUBTOTAL				**$19,186,396**	
	TOTAL PROJECT COST					**$19,186,396**

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CONCEPTUAL PIPELINE MODEL - TYPE "1" TRENCH - CONFINED / URBAN

Version 2.0-4

QUANTITY CALCULATIONS:

TYPE 1 TRENCH

Proj Name/No: **Alternative B** Date: **09-Apr-14**
Item: **30" PVC** Proj Mgr:: **CB**

DESCRIPTION	INPUT		
Pipe Diameter (Nom.)	30.00	inches	
Average **Total** Exc **Depth**	6.00	feet	(Include Bed Thickness)
Length	11,500.00	feet	
Trench Slope: 1 Vert. to	1.00	Horiz.	
Pavement Thickness:	0.00	inches	
ABC Depth:	0.00	inches	
No.of Pavement Cuts	0.00	Each	

CALCULATED QUANTITIES for ESTIMATE			
Liner Removal	=	345,000	sq ft
Trench Excavation	=	11,926	cu yd
Bed + Zone fill (Excludes Pipe Volume)	=	15,333	cu yd
Zone Only Fill (Excludes Pipe Volume)	=	14,375	cu yd
Bed Only Fill	=	958	cu yd
Backfill Above Zone	=	21,296	cu yd
Surface Restoration Area	=	345,000	sq ft
Shoring Area (Optional): Trench Shored Area	=	115,000	sq ft
Shoring Area (Optional): With 30% Toe-In	=	152,950	sq ft

INPUT VARIABLES		
Bed Depth =	6.0	in
Zone Depth Above Pipe =	6.0	in
Min. Width =	36.0	in
Side Width (per side x 2) =	24.0	in
Pit Depth =	5.0	ft
	1.0	ft

= For driven solid shoring

ESTIMATED COSTS:

DESCRIPTION	QTY	UNIT	$/UNIT	TOTAL	*$/LF*	COMMENTS
Earthwork	(Important Note: Not all of the quantities generated above will be used in your estimate. See "Example".)					
Canal Liner Removal	0	SF	$0.50	$0	*$0.00*	
Trench Excavation	11,926	CY	$2.01	$23,971	*$2.08*	Assumed excavator used is: CAT 235 with 2 CY Bucket
Surface Restoration	345,000	CY	$0.20	$69,000	*$6.00*	Hydroseeding
Zone Only Fill	14,375	CY	$70.00	$1,006,250	*$87.50*	Imported confined material used: Cl 2 AB
Bed Only Fill	958	CY	$70.00	$67,083	*$5.83*	Imported confined material used: Cl 2 AB
Backfill Above Zone	21,296	CY	$5.00	$106,481	*$9.26*	Assumes relatively inexpensive backfill is availablea above
Earthwork Subtotal				$1,272,786	*$110.68*	springline
Pipe						
	11,500	LF	$114.00	$1,311,000	*$114.00*	30"Diameter PVC or HDPE pipeline
Pipe Subtotal				$1,311,000	*$114.00*	
Miscellaneous						Items may include Valve Boxes, Manholes, etc.
				$0	*$0.00*	
				$0	*$0.00*	
Miscellaneous Subtotal				$0	*$0.00*	
TOTAL DIRECT COST:				**$2,583,786**	***$224.68***	
						Include/exclude adders as needed for report (except as noted)
Indirect Costs						
General Conditions			15.0%	$387,568	*$33.70*	
Subtotal				**$2,971,354**	***$258.38***	
Contingency			40.0%	$1,188,542	*$103.35*	
Subtotal				**$4,159,895**	***$361.73***	
General Contractor Overhead, Profit & Risk			10.0%	$415,990	*$36.17*	
Subtotal				**$4,575,885**	***$397.90***	
Escalation to Mid-Point			6.0%	$274,553	*$23.87*	2% per year compounded over three years.
Subtotal				**$4,850,438**	***$421.78***	
Sales Tax (Based on 9% on 50% of subtotal)			4.5%	$218,270	*$18.98*	
Subtotal				**$5,068,708**	***$440.76***	
Bid Market Allowance			0.0%	$0	*$0.00*	
TOTAL INDIRECT COST:				**$2,484,922**	***$216.08***	
TOTAL ESTIMATED CONSTRUCTION COST				**$5,068,708**	***$440.76***	
Engineering, Legal & Administration Fees			20.0%	$1,013,742	*$88.15*	
Owner's Reserve for Change Orders			5.0%	$253,435	*$22.04*	
TOTAL ESTIMATED PROJECT COST				**$6,335,885**	***$550.95***	

Disclaimer: The calculated **quantities** represent "reasonable quantities to perform the work" in Bank Measure. They are not intended to provide "absolute" or "exact" volumes. The execution of earthwork is highly variable due to the unknowns of soil conditions and contractors procedures. The calculated quantities are intended to be used as a general guide ONLY for the basis of the scope of work under consideration. The **cost estimate** herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor,

professional opinion of discrete costs at the time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

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Detailed Cost Estimate

PROJECT : ALTERNATIVE 2 - ABANDON LOOP CANAL AND CONVERT CUSTOMERS TO TW
CONTRA COSTA WATER DISTRICT UWFIP
JOB # : 9028B.00
LOCATION : CONTRA COSTA COUNTY, CALIFORNIA

ESTIMATED MIDPOINT OF CONSTRUCTION : 4/9/2019
COST ESTIMATE PREPARATION DATE : 4/9/2014
BY : CB

ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	SAFETY IMPROVEMENTS (E.G. SEAL SIPHONS W/ PERMANENT STEEL CAPS AT EACH END)	37	EA	9,704	$359,048	
2	CANAL FILL (ASSUMES FILL IS FOUND INEXPENSIVELY)	380,160	CY	8	$2,851,200	
3	LANDSCAPING (10% OF CANAL ROW)	901,692	SF	3.00	$2,705,076	
4	HYDROSEEDING (90% OF CANAL ROW)	8,115,228	SF	0.20	$1,623,046	
5	TW SYSTEM IMPROVEMENTS - BOUNDARY OAKS (12" LATERAL)	500	LF	144	$72,000	
6	TW SYSTEM IMPROVEMENTS - DIABLO VISTA (12" LATERAL)	100	LF	144	$14,400	
7	TW SYSTEM IMPROVEMENTS - HEATHER FARMS (12" LATERAL)	250	LF	144	$36,000	
8	TW SYSTEM IMPROVEMENTS - CASTLE ROCK	1	AL	500,000	$500,000	
9	TW SYSTEM IMPROVEMENTS - DIABLO HILLS GC	250	LF	144	$36,000	
10	MAJOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	10	EA	21,625	$216,250	
11	MINOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	30	EA	4,100	$123,000	
	TOTAL DIRECT COST					**$8,536,020**
	Estimating Contingency	40	%	$3,414,408		
	SUBTOTAL				**$11,950,427**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$537,769		
	SUBTOTAL				**$12,488,197**	
	General Conditions	15	%	$1,792,564		
	SUBTOTAL				**$14,280,761**	
	General Contractor Overhead and Profit	10	%	$1,195,043		
	SUBTOTAL				**$15,475,804**	
	Rate of Annual Inflation	2.0	%	$1,610,734		
	SUBTOTAL				**$17,086,538**	
	ESTIMATED CONSTRUCTION COST					**$17,086,538**
	Design, Legal, and Administrative Fees	20	%	$3,417,308		
	SUBTOTAL				**$20,503,845**	
	Change Orders	5.0	%	$854,327		
	SUBTOTAL				**$21,358,172**	
	Convert Castle Rock HOA to TW	9.0	EA	$65,000	$585,000	
	Shortcut Pipeline Redundancy Alternative B	1.00	EA	$19,186,396	$19,186,396	
	TOTAL PROJECT COST					**$41,129,568**

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Detailed Cost Estimate

PROJECT : ALTERNATIVE 3 - CONVERT LOOP CANAL TO UW PIPELINE
CONTRA COSTA WATER DISTRICT UWFIP
JOB # : 9028B.00
LOCATION : CONTRA COSTA COUNTY, CALIFORNIA

ESTIMATED MIDPOINT OF CONSTRUCTION : 4/9/2019
COST ESTIMATE PREPARATION DATE : 4/9/2014
BY : CB

ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	NEW 30" HDPE/PVC PIPELINE	37,200	LF	$114	$4,240,800	
2	NEW 24" HDPE/PVC PIPELINE	13,000	LF	$76	$982,800	
3	NEW 18" HDPE/PVC PIPELINE	31,800	LF	$44	$1,411,920	
4	NEW 14" HDPE/PVC PIPELINE	5,200	LF	$31	$162,240	
5	NEW 12" HDPE/PVC PIPELINE	57,300	LF	$29	$1,650,240	
6	PIPE BEDDING	64,222	CY	$70	$4,495,556	
7	BACKFILL ABOVE PIPE (ASSUMES INEXPENSIVE FILL IS LOCATED)	267,593	CY	$8	$2,140,741	
8	LANDSCAPING (10% OF CANAL ROW)	901,692	SF	3.00	$2,705,076	
9	HYDROSEEDING (90% OF CANAL ROW)	8,115,228	SF	0.20	$1,623,046	
10	21" BASE SLAB FOR LOOP PUMP STATION	19	CY	$350	$6,806	
11	18" CONCRETE WALLS FOR LOOP PUMP STATION	32	CY	$750	$23,958	
12	18" ELEVATED SLAB FOR LOOP PUMP STATION	7	CY	$650	$4,333	
13	LOOP PUMPS - VERTICAL TURBINE (125 HP)	3	EA	$130,000	$390,000	
14	LOOP PUMP STATION 12" BFV VALVES	3	EA	$5,200	$15,600	
15	LOOP PUMP STATION 12" CHECK VALVES	3	EA	$19,500	$58,500	
16	LOOP PUMP STATION MAG METER	1	AL	$30,000	$30,000	
17	PUMP STATION CIVIL IMPROVEMENTS (EARTHWORK, PAVING, ETC)	1	AL	$100,000	$100,000	
18	LOOP PS E&IC (35% OF PUMP STATION COST)	1	AL	$220,219	$220,219	
19	LIME RIDGE STORAGE TANK (0.4 MG)	1	LS	$825,000	$825,000	
20	MAJOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	10	EA	21,625	$216,250	
21	MINOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	30	EA	4,100	$123,000	
	TOTAL DIRECT COST					**$21,426,084**
	Estimating Contingency	40	%	$8,570,434		
	SUBTOTAL				**$29,996,518**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,349,843		
	SUBTOTAL				**$31,346,361**	
	General Conditions	15	%	$4,499,478		
	SUBTOTAL				**$35,845,839**	
	General Contractor Overhead and Profit	10	%	$2,999,652		
	SUBTOTAL				**$38,845,491**	
	Rate of Annual Inflation	2.0	%	$4,043,070		
	SUBTOTAL				**$42,888,560**	
	ESTIMATED CONSTRUCTION COST					**$42,888,560**
	Design, Legal, and Administrative Fees	20	%	$8,577,712		
	SUBTOTAL				**$51,466,272**	
	Change Orders	5.0	%	$2,144,428		
	SUBTOTAL				**$53,610,701**	
	Shortcut Pipeline Redundancy Alternative B	1.0	LS	$19,186,396	$19,186,396	
	TOTAL PROJECT COST					**$72,797,097**

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Detailed Cost Estimate

PROJECT : ALTERNATIVE 3A- CONVERT CANAL TO UW PIPELINE FROM CHECK 8 TO MARTINEZ RESERVOIR
CONTRA COSTA WATER DISTRICT UWFIP
JOB # : 9028B.00
LOCATION : CONTRA COSTA COUNTY, CALIFORNIA

ESTIMATED MIDPOINT OF CONSTRUCTION : 4/9/2019
COST ESTIMATE PREPARATION DATE : 4/9/2014
BY : CB

ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	NEW 42" HDPE/PVC PIPELINE	50,000	LF	$198	$9,900,000	
2	NEW 36" HDPE/PVC PIPELINE	79,400	LF	$160	$12,672,240	
3	NEW 24" HDPE/PVC PIPELINE	1,150	LF	$76	$86,940	
4	NEW 18" HDPE/PVC PIPELINE	6,300	LF	$44	$279,720	
5	NEW 14" HDPE/PVC PIPELINE	5,200	LF	$31	$162,240	
6	NEW 12" HDPE/PVC PIPELINE	15,700	LF	$29	$452,160	
7	PIPE BEDDING	105,167	CY	$70	$7,361,667	
8	BACKFILL ABOVE PIPE (ASSUMES INEXPENSIVE FILL IS LOCATED)	199,537	CY	$8	$1,596,296	
9	LANDSCAPING (10% OF CANAL ROW)	901,692	SF	3.00	$2,705,076	
10	HYDROSEEDING (90% OF CANAL ROW)	8,115,228	SF	0.20	$1,623,046	
11	24" BASE SLAB FOR LOOP PUMP STATION	56	CY	$350	$19,444	
12	24" CONCRETE WALLS FOR LOOP PUMP STATION	178	CY	$750	$133,333	
13	18" ELEVATED SLAB FOR LOOP PUMP STATION	33	CY	$650	$21,667	
14	LOOP PUMPS - VERTICAL TURBINE (125 HP)	3	EA	$130,000	$390,000	
15	LOOP PUMPS - VERTICAL TURBINE (500HP)	3	EA	$390,000	$1,170,000	
15	LOOP PUMP STATION 24" BFV VALVES	3	EA	$15,600	$46,800	
16	LOOP PUMP STATION 24" CHECK VALVES	3	EA	$48,750	$146,250	
15	LOOP PUMP STATION 12" BFV VALVES	3	EA	$5,200	$15,600	
16	LOOP PUMP STATION 12" CHECK VALVES	3	EA	$19,500	$58,500	
17	MALLARD RESERVOIR MAG METER VAULT	1	AL	$100,000	$100,000	
18	PUMP STATION CIVIL IMPROVEMENTS (EARTHWORK, PAVING, ETC)	1	AL	$125,000	$125,000	
19	LOOP PS E&IC (35% OF PUMP STATION COST)	1	AL	$779,308	$779,308	
20	LIME RIDGE STORAGE TANK (0.4 MG)	1	LS	$825,000	$825,000	
21	MAJOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	10	EA	21,625	$216,250	
22	MINOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	30	EA	4,100	$123,000	
	TOTAL DIRECT COST					**$41,009,537**
	Estimating Contingency	40	%	$16,403,815		
	SUBTOTAL				**$57,413,352**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$2,583,601		
	SUBTOTAL				**$59,996,953**	
	General Conditions	15	%	$8,612,003		
	SUBTOTAL				**$68,608,956**	
	General Contractor Overhead and Profit	10	%	$5,741,335		
	SUBTOTAL				**$74,350,291**	
	Rate of Annual Inflation	2.0	%	$7,738,438		
	SUBTOTAL				**$82,088,729**	
	ESTIMATED CONSTRUCTION COST					**$82,088,729**
	Design, Legal, and Administrative Fees	20	%	$16,417,746		
	SUBTOTAL				**$98,506,474**	
	Change Orders	5.0	%	$4,104,436		
	SUBTOTAL				**$102,610,911**	
	TOTAL PROJECT COST					**$102,610,911**

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Detailed Cost Estimate

PROJECT : ALTERNATIVE 5A - CONVERT LOOP CANAL TO RW PIPELINE PUMPED FROM CCCSD
CONTRA COSTA WATER DISTRICT UWFIP
JOB # : 9028B.00
LOCATION : CONTRA COSTA COUNTY, CALIFORNIA

ESTIMATED MIDPOINT OF CONSTRUCTION : 4/9/2019
COST ESTIMATE PREPARATION DATE : 4/9/2014
BY : CB

ITEM	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
1	NEW 30" HDPE/PVC PIPELINE	21,000	LF	$114	$2,394,000	
2	NEW 24" HDPE/PVC PIPELINE	35,400	LF	$76	$2,676,240	
3	NEW 18" HDPE/PVC PIPELINE	12,000	LF	$44	$532,800	
4	NEW 14" HDPE/PVC PIPELINE	5,200	LF	$31	$162,240	
5	NEW 12" HDPE/PVC PIPELINE	15,700	LF	$29	$452,160	
6	PIPE BEDDING	39,689	CY	$70	$2,778,222	
7	BACKFILL ABOVE PIPE (ASSUMES INEXPENSIVE FILL IS LOCATED)	165,370	CY	$8	$1,322,963	
8	LANDSCAPING (10% OF CANAL ROW)	901,692	SF	3.00	$2,705,076	
9	HYDROSEEDING (90% OF CANAL ROW)	8,115,228	SF	0.20	$1,623,046	
10	21" BASE SLAB FOR CCCSD PUMP STATION	19	CY	$350	$6,806	
11	18" CONCRETE WALLS FOR CCCSD PUMP STATION	32	CY	$750	$23,958	
12	18" ELEVATED SLAB FOR CCCSD PUMP STATION	7	CY	$650	$4,333	
13	CCCSD PUMPS - VERTICAL TURBINE (250 HP)	3	EA	$227,500	$682,500	
14	CCCSD PUMP STATION 12" BFV VALVES	3	EA	$5,200	$15,600	
15	CCCSD PUMP STATION 12" CHECK VALVES	3	EA	$19,500	$58,500	
16	CCCSD PUMP STATION MAG METER	1	AL	$30,000	$30,000	
17	PUMP STATION CIVIL IMPROVEMENTS (EARTHWORK, PAVING, ETC)	1	AL	$100,000	$100,000	
18	CCCSD PS E&IC (35% OF PUMP STATION COST)	1	AL	$322,594	$322,594	
19	LIME RIDGE STORAGE TANK (0.4 MG)	1	LS	$825,000	$825,000	
20	MAJOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	10	EA	21,625	$216,250	
21	MINOR LATERAL IMPROVEMENTS - METER AND GATE VALVE	30	EA	4,100	$123,000	
22	TW SYSTEM IMPROVEMENTS - CASTLE ROCK	1	AL	500,000	$500,000	
	TOTAL DIRECT COST					**$17,555,288**
	Estimating Contingency	40	%	$7,022,115		
	SUBTOTAL				**$24,577,403**	
	Sales Tax on 50% of Subtotal Above	9.00	%	$1,105,983		
	SUBTOTAL				**$25,683,386**	
	General Conditions	15	%	$3,686,610		
	SUBTOTAL				**$29,369,997**	
	General Contractor Overhead and Profit	10	%	$2,457,740		
	SUBTOTAL				**$31,827,737**	
	Rate of Annual Inflation	2.0	%	$3,312,656		
	SUBTOTAL				**$35,140,394**	
	ESTIMATED CONSTRUCTION COST					**$35,140,394**
	Design, Legal, and Administrative Fees	20	%	$7,028,079		
	SUBTOTAL				**$42,168,472**	
	Change Orders	5.0	%	$1,757,020		
	SUBTOTAL				**$43,925,492**	
	Shortcut Pipeline Redundancy Alternative B	1.0	LS	$19,186,396	$19,186,396	
	TOTAL PROJECT COST					**$63,111,889**