SYSTEM OPTIMIZATION REVIEW OF SHAFTER-WASCO IRRIGATION DISTRICT

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ABSTRACT

As part of a larger system optimization review (SOR) that GEI Consultants, Bookman-Edmonston Division (GEI) conducted for the Poso Creek Integrated Regional Water Management Plan Region (Region), a portion of the budget was used to conduct a focused SOR to evaluate the Shafter-Wasco Irrigation District (SWID). GEI met with SWID's General Manager and System Operator with the goal to document their ideas on ways to improve the SWID system, prior to the retirement of the System Operator. The SOR assessed SWID's potential for managing their available water supplies more effectively and for improvements to their distribution facilities to maximize deliveries of neighboring districts' available surface water. The finding of the SOR documented internal and external opportunities for SWID to advance their current and future water management practices.

INTRODUCTION AND BACKGROUND

Shafter-Wasco Irrigation District (SWID), located in the southern portion of the San Joaquin Valley, California, receives Federal water from the Central Valley Project (CVP) via the Friant-Kern Canal (Figure 1). The District encompasses about 34,000 acres, of which about 30,000 acres are irrigated.

SWID's source of surface water supply is the Friant Division of the CVP, which develops its supply from the San Joaquin River, with storage provided by Millerton Lake. The water is transported to SWID through the Friant-Kern Canal. The surface water supply is used conjunctively with the underlying groundwater. SWID's contract entitlement consists of 50,000 acre-feet of Class 1 water and 39,600 acre-feet of Class 2 water, for a total of 89,600 acre-feet. The long-term average surface water supply available to the district is estimated at 69,000 acre-feet. The Class 1 water is storable (for use within a given year) and is considered a firm water supply. The Class 2 water supply is non-storable water and must be used when it is available.

The SWID system is a gravity system which delivers water using two turnouts from the Friant- Kern Canal. Water from the turnouts flows west supplying SWID's distribution systems called the "North" and "South" System (Figure 1). The two turnouts from the Friant- Kern Canal are located in North Kern Water Storage District. The northern turnout is the main line for the North System and the southern turnout is the main line for

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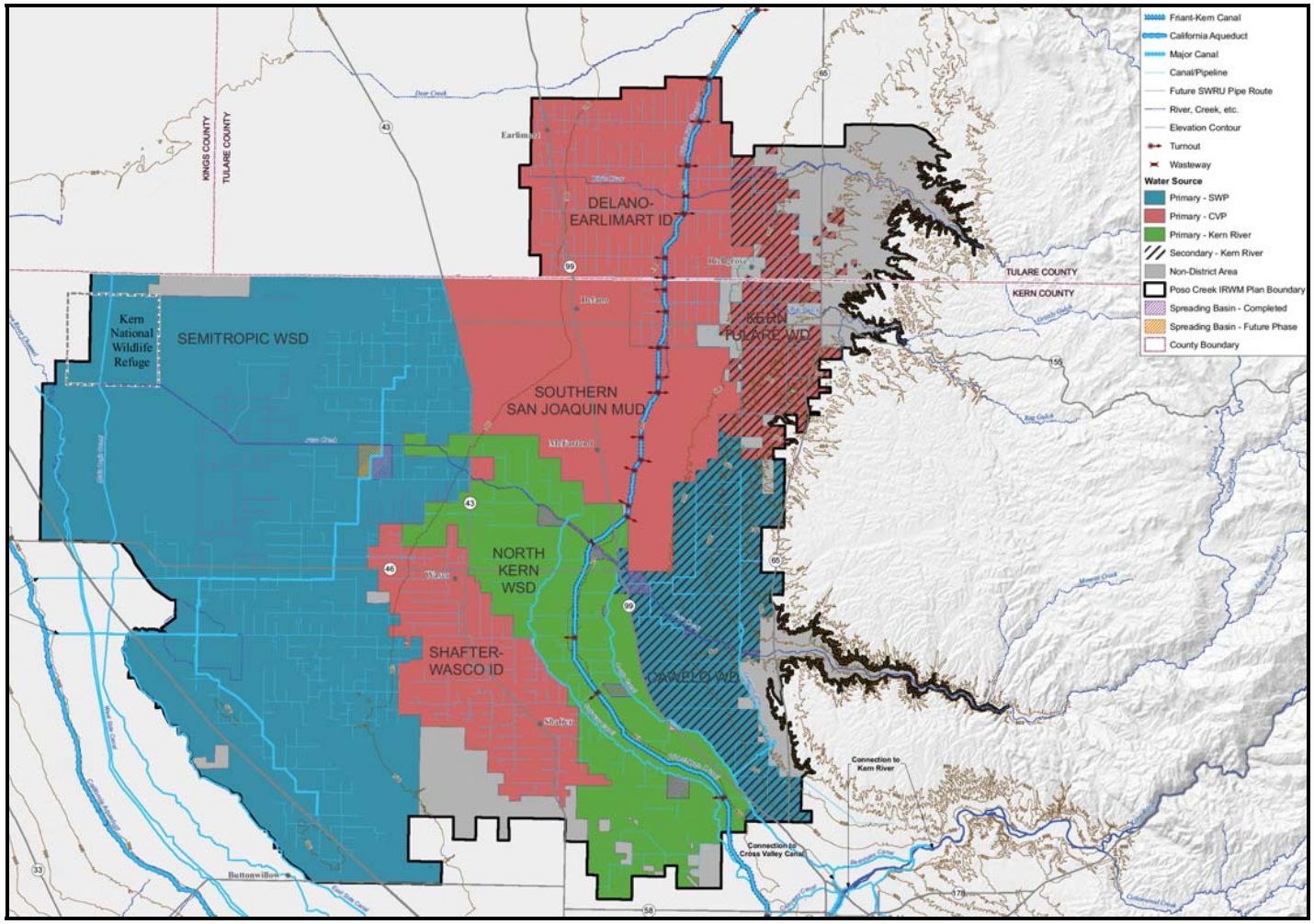

Figure 1. Shafter-Wasco Irrigation District and Neighboring Districts

the South System. Each turnout has a practical capacity of approximately 200 cfs.

SWID's primary purpose is to contract for the importation of water from the Friant Division of the CVP. It has the additional responsibility of conjunctively managing surface water and groundwater supplies to ensure an adequate water supply for water users.

As part of the system optimization review (SOR) specially conducted for Shafter-Wasco Irrigation District (SWID), GEI Consultants, Bookman-Edmonston Division (GEI), met with SWID's General Manager and System Operator to document their ideas on ways to improve the SWID system prior to the retirement of the System Operator. The SOR assessed SWID's potential for managing their available water supplies more effectively and for improvements to their distribution facilities to maximize deliveries of neighboring districts' available surface water.

Internally, SWID is addressing system modernization by adding isolation valves and replacing farm turnouts. The lack of isolation valves puts SWID and its users in a vulnerable position during times of maintenance or repairs. The old farm turnouts make delivery of water a time-consuming and hazardous task.

The SOR identified projects that would interconnect SWID with its neighboring districts (Semitropic Water Storage District and North Kern Water Storage District) for the purpose of increasing water banking and exchanges. The projects include:

- SWID/North Kern North Interconnection
- SWID/North Kern South Interconnection
- SWID/Semitropic Existing Interconnection
- SWID/Semitropic Madera Ave. Interconnection
- SWID/Semitropic Kimberlina Road Interconnection
- Multi-District Conveyance Facility

Previously in 2008, GEI completed an evaluation of the existing interconnection between SWID and Semitropic to identify any design modifications that would allow the interconnection to operate at a higher capacity. The findings included herein considered the details found in the 2008 evaluation.

OPERATIONAL ISSUES

Isolation Valves

A major issue with the SWID system is its lack of isolation valves along the pipeline main of its North and South Systems. Some of the existing valves on the main lines are worn-out and need to be replaced. Installation of additional isolation valves in strategic locations along the main line would minimize the number of users shut down during maintenance or repairs, allowing for a more reliable operation of the system. Ideal locations of new valves were not determined as part of the SOR. SWID will consider and

evaluate new valve locations depending on known conditions, operational procedures, and budget. There are however, several valves along the main line of the North System that are known to be non-operational and need to be replaced.

Additional valves along certain laterals of the system would also help make the system more reliable. Existing valves are generally located at the beginning of each lateral. This allows for each lateral to be shut down independently of other laterals. However, some laterals can reach up to two miles in length; many laterals also have multiple sub-laterals. Maintenance or repairs along a lateral could potentially require shutting down the entire lateral. SWID will consider and evaluate ideal locations for additional valves as part of their long-term system improvements.

Farm Turnouts

Modernizing existing farm turnouts such as those shown in Figure 2 would allow for a more efficient operation. Currently, once an order for any specific amount of water has been placed, the system operator must open the turnout valve then climb up a ladder to read the water meter at the top of the turnout riser located inside the standpipe (Figure 3). To discharge the correct amount of water the operator must read the meter then adjust the valve accordingly, this guess-and-check procedure of calibration requires several iterations of climbing up and down the ladder to read the meter and adjust the valve. New farm turnouts, as shown in Figure 4 and Figure 5, have the turnout riser and water meter located outside the standpipe. With this configuration the operator can easily adjust the valve while reading the meter, greatly reducing the amount of time it takes to calibrate the turnout; this configuration also eliminates the hazard of climbing up and down a ladder.

Figure 2. Existing Farm Turnout Standpipe

Figure 3. Water Meter at Top of Turnout Riser Located within the Standpipe

Figure 4. Turnout Riser Located Outside of the Standpipe with Easily Accessible Meter

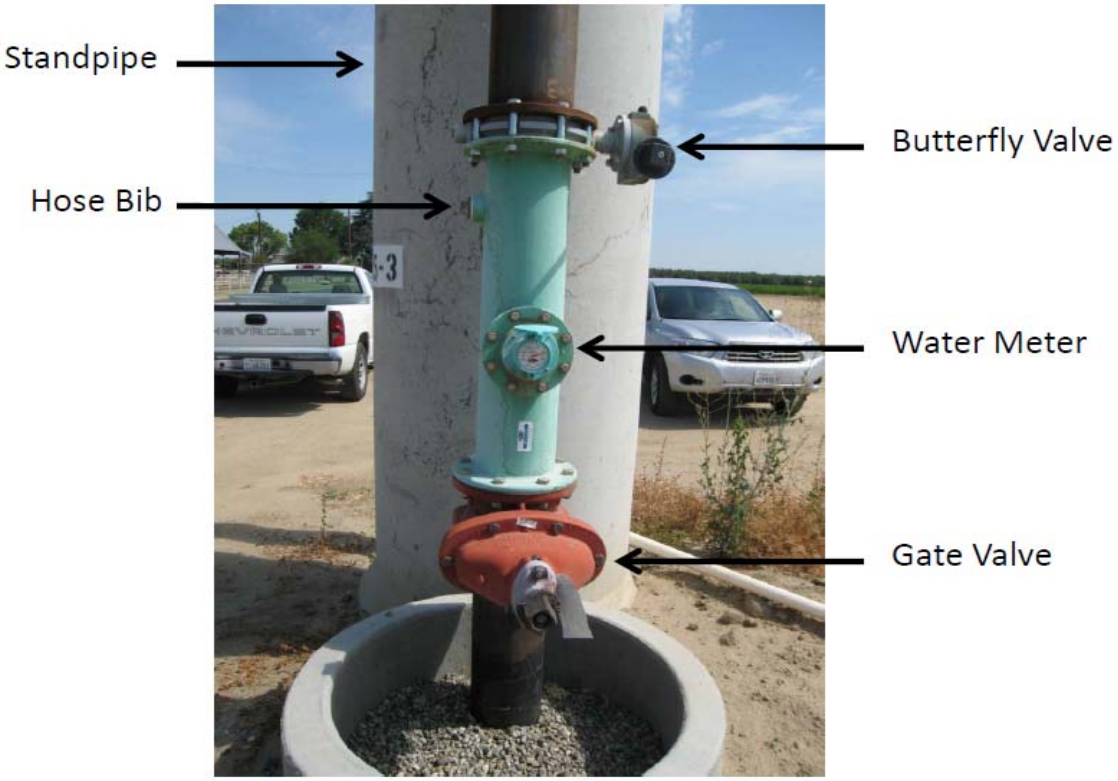

Figure 5. Modernized Farm Turnout with Gate Valve, Water Meter, Hose Bib, and Butterfly Valve

Old turnouts are slowly being phased out as the District began replacing and modernizing turnouts starting in 2006. Turnouts that have priority for replacement are ones that are leaky due to worn-out valves and ones that have high standpipe heights. The cost of replacing the turnouts is about $10-$12K per turnout. SWID will continue to replace turnouts as funding allows.

Findings and Recommendations for Modernization

With local funding, the District's priority is to continue to replace and modernize existing farm turnouts and add isolation valves. The District will evaluate grant programs to help fund system modernization; including Reclamation's grant programs that pay up to 50-percent for water saving and system efficiency measures.

EVALUATION OF EXISTING AND FUTURE CONVEYANCE BETWEEN DISTRICTS

Table 1 shows projects which are either existing, under construction, or proposed, that involve the interconnection of SWID with neighboring districts. Each project would allow for water exchanges between districts, increasing flexibility to SWID's system.

Table 1. SWID Interconnections

Project	Size	East-West Capacity (Gravity)	West-East Capacity (Pumping)	Project Status
SWID/North Kern North Interconnection	60" Connection Facilities	100 cfs	75 cfs	Under Construction
SWID/North Kern South Interconnection	48" Pipeline	50 cfs	50 cfs	Ready for Construction
SWID/Semitropic Existing Interconnection	36" Pipeline	>25 cfs	25 cfs	Existing
SWID/Semitropic Madera Ave. Interconnection	36" Pipeline	50 cfs	50 cfs	Planning/Preliminary Design
SWID/Semitropic Kimberlina Road Interconnection	60" Pipeline	75 cfs	75 cfs	Planning/Preliminary Design
Multi-District Conveyance Facility	84" Pipeline / New Canal	300 cfs	300 cfs	Planning/Preliminary Design

SWID/North Kern North Interconnection

A project nearing completion is the North Interconnection between SWID and North Kern that connects North Kern's Calloway Canal to SWID's North System (Lateral 134.4) (See Figure 6). The connection consists of approximately 180 ft of 48-inch diameter pipe and 120 ft of 24-inch diameter pipe, both with a pumped capacity of 75 cfs. The connection allows bi-directional delivery of water between SWID and North Kern.

In a wet year, when there are surplus supplies available off of the Friant-Kern Canal, the facility would be run in a mode of delivery into the Calloway Canal. From there, supplies can be delivered to the North Kern's direct and in-lieu recharge facilities. Also, in a wet year, if there are any supplies available to North Kern that may be delivered to USBR designated excess lands, this facility is a means of moving such water into Shafter Wasco's north system. In a dry year, the facility may be used to deliver North Kern deepwell produced water to SWID. Deliveries would be made either in return of a prior year Shafter-Wasco banked supply or for North Kern to delivery off-peak season water in exchange for peak season water for energy and supply management purposes. This project is currently under construction at an estimated cost of $650,400.

SWID/North Kern South Interconnection

Another interconnection project between North Kern and SWID is the South Interconnection that would connect North Kern's 8-5 ditch to SWID's South System (Lateral 137.2) via a 50cfs pipeline.

This project would allow Kern-Tulare Water District to convey its Kern River Water through the Calloway Canal and deliver it to SWID. In exchange, SWID's Friant water can then be delivered to Kern-Tulare. Without the project, Kern-Tulare delivers its 23,000 acre-feet per year of Kern River through an exchange with Arvin-Edison. This exchanged incurs a 20% loss to Kern-Tulare. Completion of the project will allow Kern-Tulare to exchange water with SWID and reduce losses to Kern-Tulare by 4,600 acre-feet per year. At this time, SWID cannot deliver its CVP water to lands within its service area designated as Excess under Reclamation Law. Therefore, this demand of approximately 15,000 acre-feet must be pumped from the groundwater basin. Once the project is completed, SWID will be able to take delivery of Kern River Water and banked groundwater directly from North Kern. The short term benefit of delivering non-CVP water in-lieu of pumping groundwater is the savings in energy charges. In the long term, the project saves groundwater for use in dry years and helps to off-set for regional groundwater overdraft which has been exasperated by San Joaquin River settlement. This project would also allow North Kern to deliver water stored in its groundwater directly to SWID. In exchange, SWID's Friant water can then be delivered directly to any CVP Contractor along the Friant-Kern or Madera Canal. This project significantly enhances North Kern's ability to complete exchanges of surface water supplies.

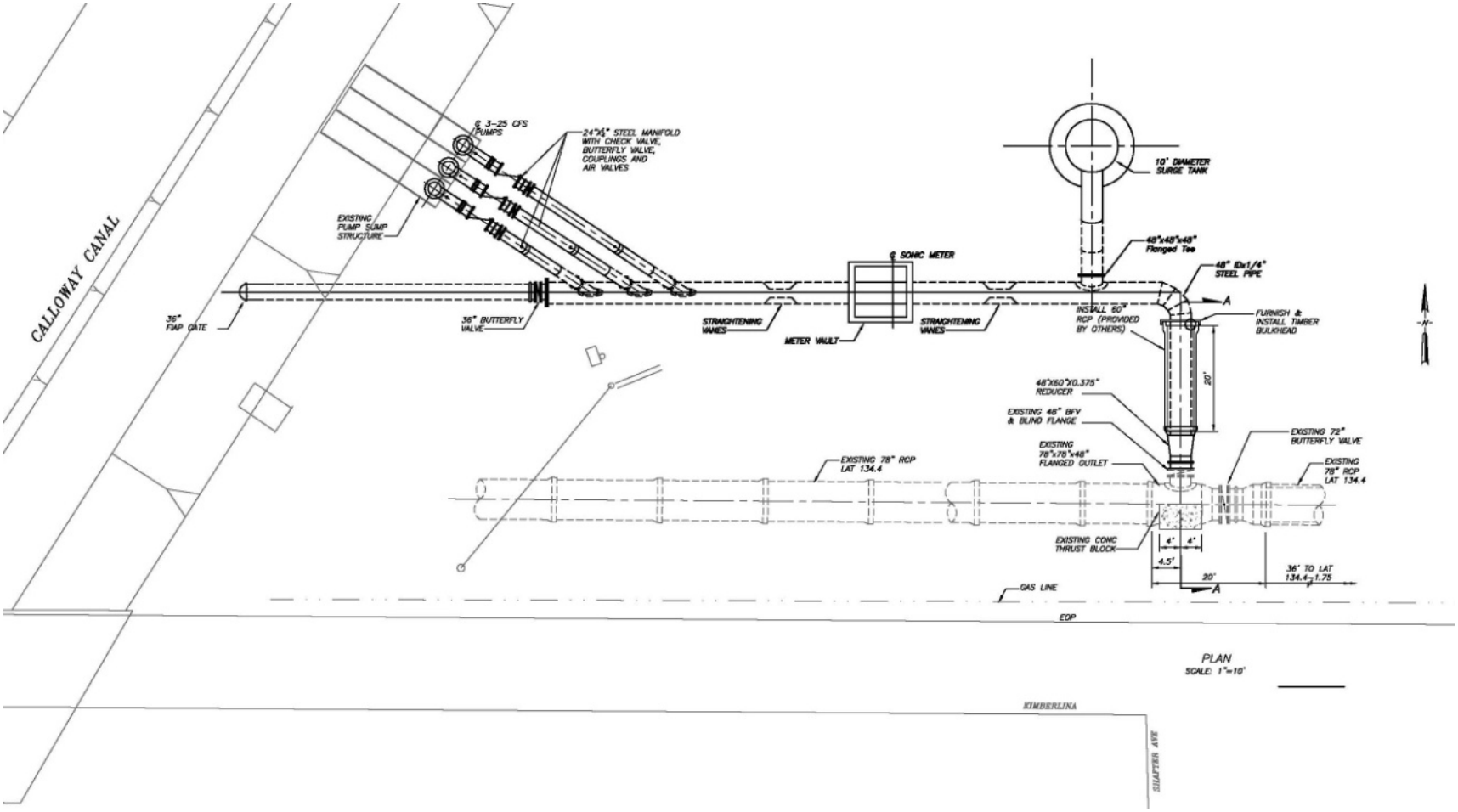

Figure 6. North Interconnection Between North Kern's Calloway Canal and Shafter-Wasco's North System (Lateral 134.4)

The South Interconnection between SWID and North Kern is ready for construction and is estimated to cost $600,000 to construct.

SWID/Semitropic Existing Interconnection

As mentioned earlier, the existing interconnection between SWID and Semitropic was previously evaluated in 2008 to identify any modifications that could be made to allow the Interconnection to operate at a higher capacity. Operation of the Interconnection in the west-to-east direction has proven to be challenging. The existing facilities consist of a pumping plant with a capacity of 625 horsepower and 25 cfs located at Semitropic's Pond-Poso Canal, and approximately 3.5 miles of 36-inch diameter pipeline that runs east connecting the pumping plant to the end of SWID's North System (See Figure 7 & 8).

As stated in the 1993 General Design Memorandum, operating parameters of and for the Interconnection in the west-to-east mode should be developed from exploratory operating experience after initiation of operations; for the operational conditions which result from introducing pumped Interconnection water (from the pumping plant located at the Pond Poso Canal) into SWID's system with isolation valves No. 2 and No. 3 open and CVP water flowing from the Friant-Kern Canal could not be completely predictable.

Along with several minor design changes and additions to the facilities, it was concluded from the 2008 study that in order for the system to operate more smoothly, changes to the operation of the Interconnection would need to meet mutually acceptable criteria from both the SWID and Semitropic operators. Communication protocols for operation of the Interconnection should be put in place and followed by both districts.

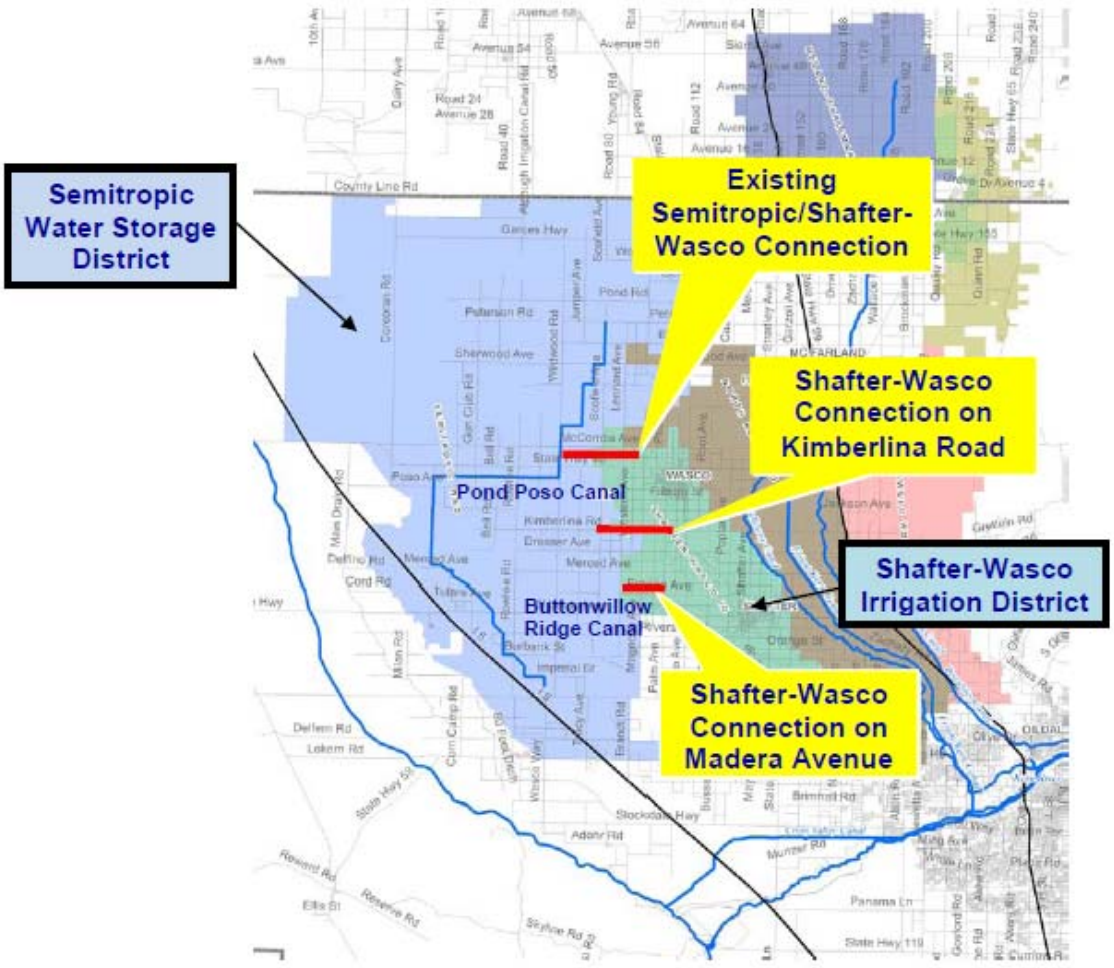

Figure 7. Semitropic Water Storage District and Shafter-Wasco Irrigation District with Locations of the Existing Interconnection, Kimberlina Road Interconnection, and Madera Avenue Interconnection

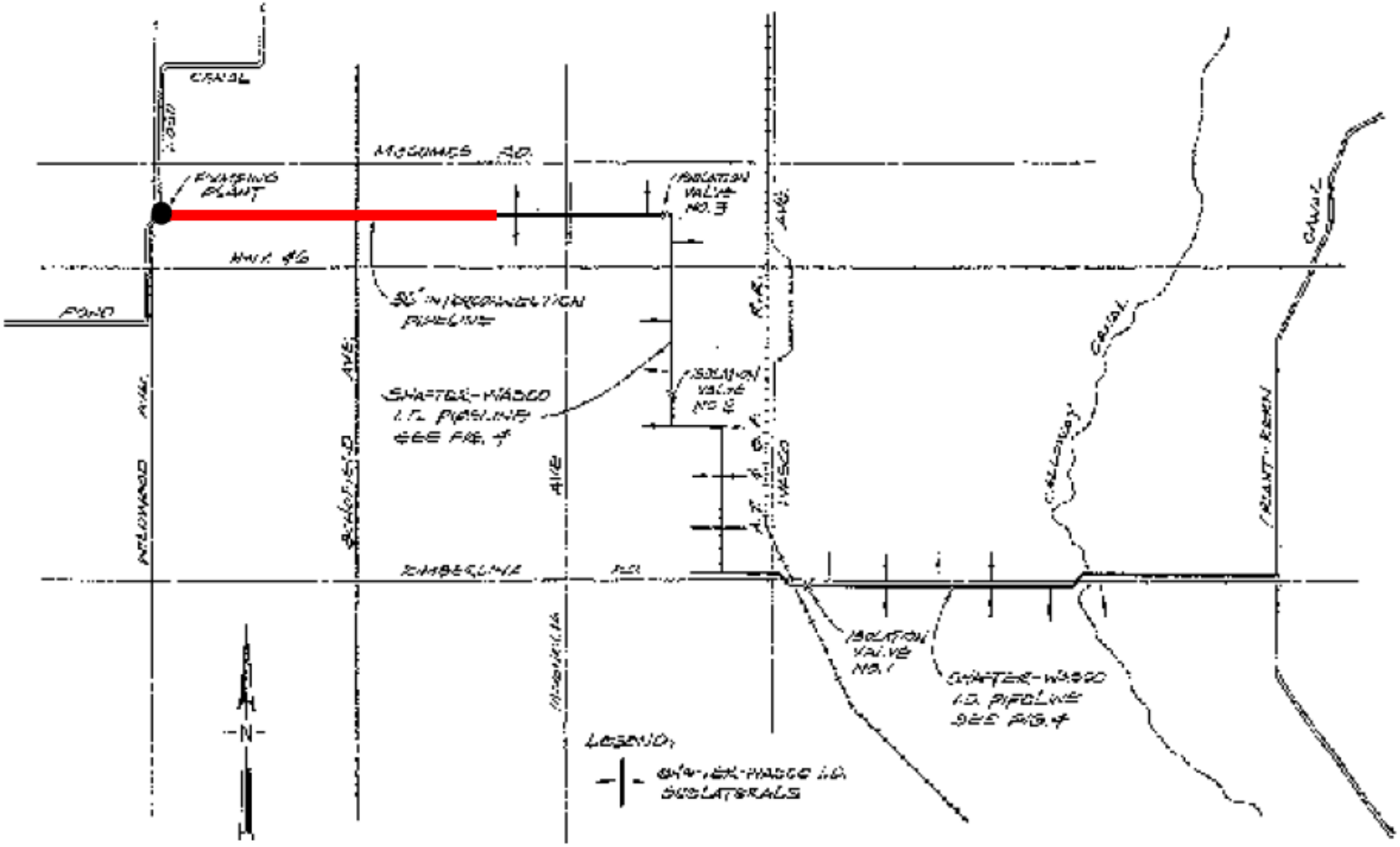

Figure 8. Existing Interconnection Between Semitropic Water Storage District and Shafter-Wasco Irrigation District

SWID/Semitropic Madera Avenue Interconnection

Another SWID/Semitropic project in consideration is the interconnection between the two districts on Madera Avenue (See Figures 7 & 9). This project is a 36-inch pipeline that would connect to the end of the 39-inch main transmission pipeline of Semitropic's Lateral B-230 to SWID's South System, a 33-inch pipeline located along Palm Avenue. This interconnection would operate in the same manner as the Kimberlina Road Interconnection. This project also has only been conceptually designed and is listed in the Poso Creek Integrated Regional Water Management Plan. Estimated at $5M with a capacity of design capacity of 50cfs, this is SWID's preferred project as there is already an existing connection to Semitropic on SWID's North System.

SWID/Semitropic Kimberlina Road Interconnection

Another interconnection project in consideration is the Kimberlina Road Interconnection between SWID and Semitropic (See Figures 7 & 9). This project would connect Semitropic's Lateral P-384 to SWID's North System main via a 60-inch intertie pipeline along Kimberlina Road. Unlike the existing intertie between Semitropic and SWID, which connects to the end of SWID's system, the intertie on Kimberlina Road would connect near the middle of SWID's North System, allowing for gravity flow to all the users downstream of the connection point.

In wet years, when there is excess non-project water available from the California Aqueduct through Semitropic's distribution system, this water can be used in-lieu of groundwater pumping by SWID growers. These facilities can also be used by Semitropic to receive water from east side sources, such as 215 Water from the Friant-Kern Canal or be used to convey Shafter-Wasco's high flow water into Semitropic's banking program. In dry years, these facilities will be used to return Shafter-Wasco's prior year banked water from Semitropic.

This project has only been conceptually designed and is one of the projects listed in the Poso Creek Integrated Regional Water Management Plan. It's estimated to cost $12M with a design capacity of 75 cfs.

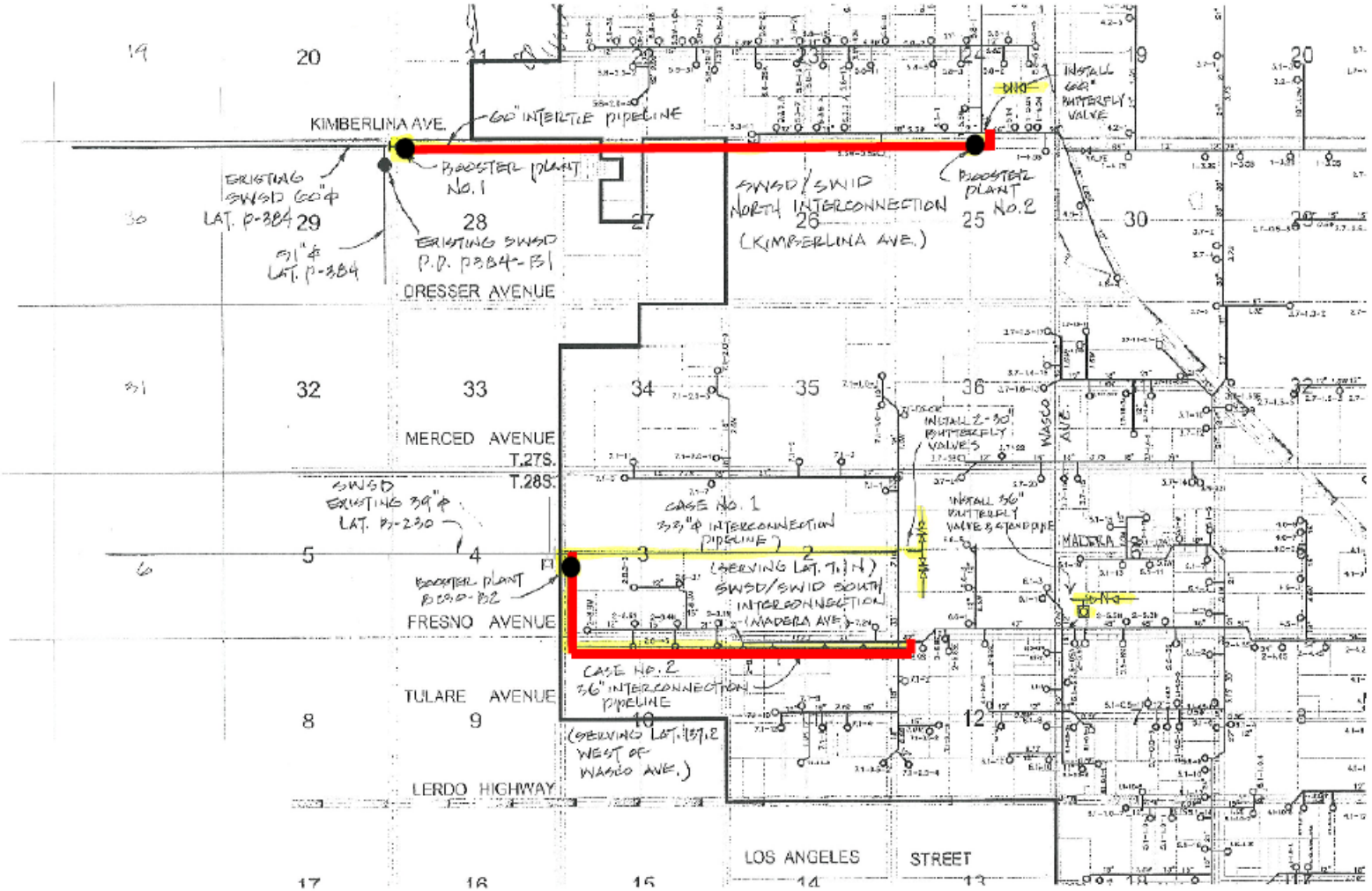

Figure 9. Proposed Kimberlina Road and Madera Avenue Interconnections between Semitropic Water Storage District and Shafter-Wasco Irrigation District

Multi-District Conveyance Facility

The Multi-District Conveyance Facility Project involves facilities that would essentially connect the California Aqueduct and the Friant-Kern Canal (See Figure 10). The goal is to provide a transmission facility to make greater use of surplus water existing in either the State Water Project or the Central Valley Project. Although several alignments and alternatives have been studied, they would all consist of a combination of canals, pipelines, and pumps that would start at Semitropic's 120-inch diameter Stored Water Recovery Unit pipeline and end near SWID's North System intake point at the Friant-Kern Canal.

Operating in the west-to-east mode, water would be conveyed directly to SWID's intake point (near the Friant-Kern Canal), allowing for the SWID system to operate as normal, by gravity, and eliminating the risk of damaging SWID's low-head pipes from pressurized reverse flow operation.

However, at an estimated cost of over $70M, the Multi-District Conveyance Facility would be very difficult to fund locally. There is also concern that the water supplies to be delivered from west to east to support the use of this facility are limited at this time due to the constraints in moving water south of the Sacramento-San Joaquin Delta.

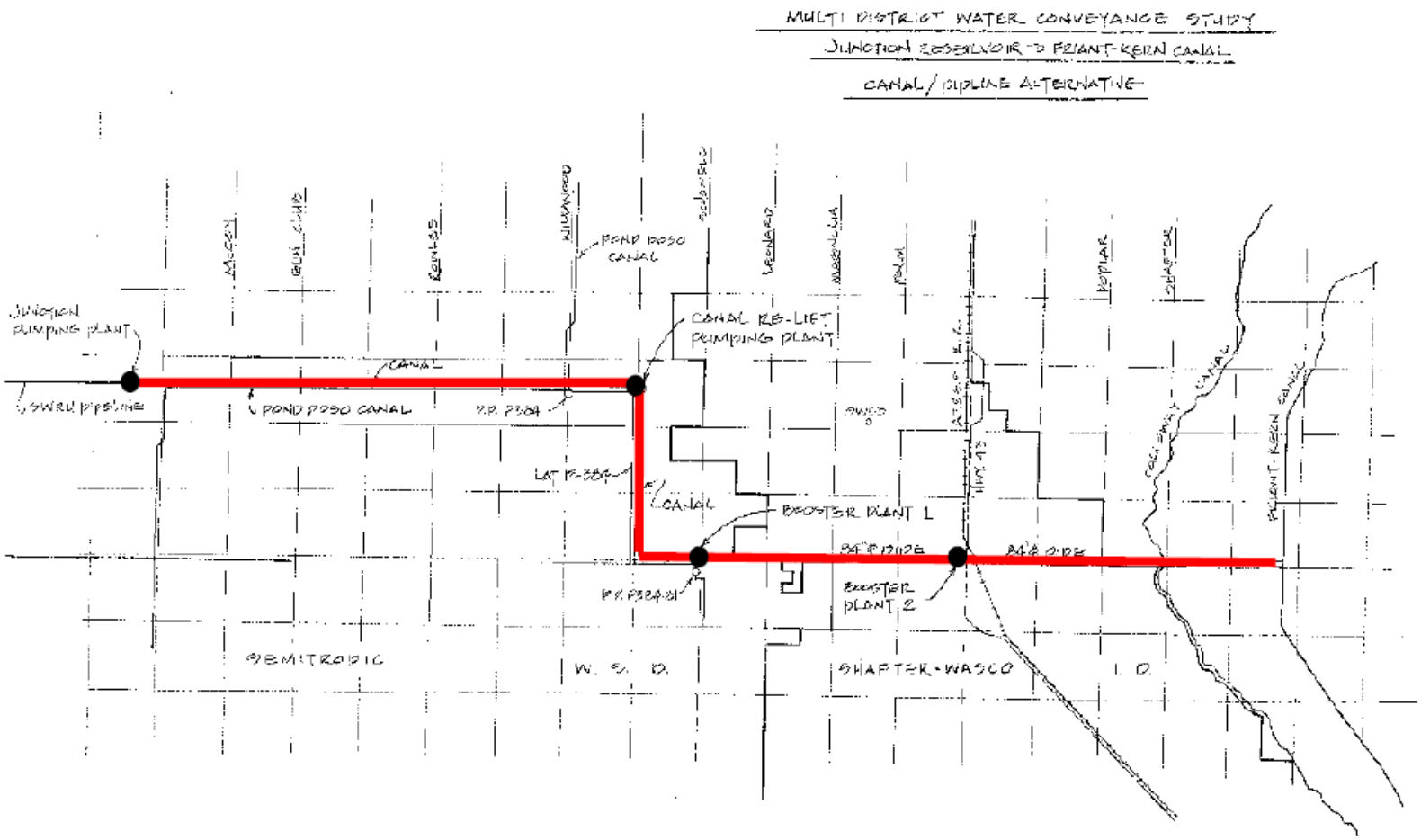

Figure 10. Proposed Multi-District Conveyance Facility from Semitropic's SWRU Pipeline to the Friant-Kern Canal

FINDINGS AND RECOMMENDATIONS

Table 2 shows the potential monthly capacity and variable operating costs of each project. Note that of the four interconnection projects with Semitropic, the Interconnection on Madera Avenue would be the least costly to operate per acre-feet of water.

Table 2. Project Capacities and Operating Costs

Project	Potential Monthly Capacity (ac-ft/mo)	Pumping Head (ft)	Capital Costs	Variable Operating Costs ($/ac-ft)
SWID/North Kern North Interconnection	4,500	-	$0.65M	-
SWID/North Kern South Interconnection	3,000	-	$0.60M	-
SWID/Semitropic Existing Interconnection	1,500	170	-	$29
SWID/Semitropic Madera Ave. Interconnection	3,000	60	$5M	$10
SWID/Semitropic Kimberlina Road Interconnection	4,500	70	$12M	$12
Multi-District Conveyance Facility	18,000	211	$70M	$36

To improve the operational capacity of the existing interconnection between SWID and Semitropic, GEI recommends that the districts meet to create operational protocols and mutually acceptable criteria for operation of the interconnection prior to any construction improvements to the interconnection are planned.

In order to implement the improvements to the existing interconnection with Semitropic and the three proposed conveyance connections (Kimberlina, Madera, Multi-District), SWID will need outside funding. A long-range goal will be to evaluate potential funding arrangements related to supporting the Semitropic Groundwater Bank, Reclamation Grant Programs, and possible funding through the Poso Creek IRWM Plan.

Regarding the three proposed new conveyance connections, SWID's preference would be to construct the Madera Avenue Interconnection between Semitropic and SWID's South System. There is no existing interconnection between SWID's South System with Semitropic, as an interconnection already exists on SWID's North System. The interconnection on Madera Avenue is also the least expensive of the proposed

interconnections with Semitropic. However, SWID's first priority is to complete the North and South interconnections with North Kern. The North Interconnection is near completion, while the South Interconnection is ready for construction.

Therefore, SWID's overall preference and priority is to add conveyance flexibility by making the following improvements:

1. Finish the North Interconnection with North Kern
2. Construct the South Interconnection with North Kern
3. Improve the existing Interconnection with Semitropic
4. Construct the Madera Interconnection with Semitropic
5. Evaluate Kimberlina Interconnection as a regional project
6. Evaluate the Multi-District Conveyance Facility as a Regional Project

SUMMARY

As part of a larger system optimization review (SOR) that GEI Consultants, Bookman-Edmonston Division (GEI) conducted for the Poso Creek Integrated Regional Water Management Plan Region (Region), a portion of the budget was used to conduct a focused SOR to evaluate the Shafter-Wasco Irrigation District (SWID). In 2009, GEI met with SWID's General Manager and System Operator with the goal to document their ideas on ways to improve the SWID system, prior to the retirement of the System Operator. The SOR documented internal and internal and external opportunities for SWID to advance their current and future water management practices. SWID intends to continue replacing old farm turnouts and isolation valves as their operation and maintenance funds allow. SWID will consider funding from outside of their district to advance the identified conveyance improvements that would add water supply flexibility between SWID and neighboring districts.