ATTACHMENT 3
Project Justification

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3 Attachment 3 - Project Justification

3.1 Project Summary Table

Table 3.1-1: 2014 IRWM Drought Solicitation Project Summary Table (PSP Table 4)

Drought Project Element		Project 1 Brackish GW Recovery Project	Project 2 CVC Pool No. 7 Lining Project	Project 3 In-lieu Program	Project 4 Water Main Replacement & Meter Install Project
D.1	Provide immediate regional drought preparedness	X	X	X	X
D.2	Increase local water supply reliability and the delivery of safe drinking water	X	X	X	X
D.3	Assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective				X
D.4	Reduce water quality conflicts or ecosystem conflicts created by the drought	X			
IRWM Project Element					
IR.1	Water supply reliability, water conservation, and water use efficiency	X	X	X	X
IR.2	Stormwater capture, storage, clean-up, treatment, and management				
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands	X			
IR.4	Non-point source pollution reduction, management, and monitoring	X	X	X	
IR.5	Groundwater recharge and mgmt. projects	X	X	X	
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users	X			
IR.7	Water banking, exchange, reclamation, and improvement of water quality	X	X	X	
IR.8	Planning and implementation of multipurpose flood management programs				
IR.9	Watershed protection and management	X	X		
IR.10	Drinking water treatment and distribution				X
IR.11	Ecosystem and fisheries restoration and protection	X	X		

3.2 Project Descriptions

BVWSD Brackish Groundwater Recovery Project

Project Description: The BVWSD Project allows an average annual recovery of up to 1,740 acre-feet of perched brackish groundwater for blending and beneficial reuse on crops and wetlands.

Alleviate Drought Impacts: The BVWSD Project will alleviate the following drought impacts:

- *At risk of not meeting existing drinking water demands:* With this new water supply the groundwater basin will be less impacted by reducing deep well groundwater pumping, maintaining a sustainable water supply for BCWD.
- *At risk of not meeting existing agricultural water demands:* This additional water supply is expected to be utilized every year generating a long-term, sustainable water supply. In drought years, the blended water will be used by local farmers in-lieu of additional groundwater pumping. Additionally, the District will be able to expand its water exchanges with other water agencies in the Kern Region.
- *At risk of not meeting ecosystem water demands:* The additional water supply can be utilized in a drought year to meet water demands at the Kern National Wildlife Refuge (KNWR). This can be accomplished by blending the water to meet wetland water quality requirements. In drought years, 300 acres of wetlands are protected.
- *Drinking Water MCL Violations*: Reduced groundwater extraction helps prevent increasing arsenic levels that impact BCWD.
- *Groundwater basin overdraft:* Utilization of this new water supply will result in positive benefits to BVWSD and other water districts by maintaining existing groundwater in the basin, thereby helping reduce overdraft. The District has historically been able to achieve a groundwater balance within the BVWSD, which results in a groundwater outflow that contributes positively to the overall Kern Sub-Basin.
- *Other drought related adverse impacts:* The project will reduce lands that are currently fallowed, increase crop production in the Region, and add farming-related jobs, thereby stimulating economic growth. Additionally, existing impacts to crops in the District will be reduced by lowering the perched groundwater table below the root zone. This will also help alleviate the economic impacts of the drought as these District lands will support higher value crops.

Drought Project Eligibility: The Project is eligible as it assists with the following Drought Project Elements (refer to Section 3.1):

- *Element D.1.* - By utilizing this additional water source for crops in the District, in-lieu recharge is accomplished (i.e. brackish water blended with surface water supplies are used to meet crop demands rather than other deep-aquifer groundwater sources with good water quality). Through this in-lieu operation, groundwater overdraft is reduced. Additionally, existing water supplies can be further utilized in exchange programs. By increasing conjunctive use through the reuse of non-beneficial groundwater the Sub-Basin is more efficiently managed.
- *Element D.*2. - The supplemental water supply can be used to meet irrigation demands of local growers even in drought years. By increasing conjunctive use the aquifer is less impacted during drought years, benefitting farmers and BCWD customers that rely upon this supply.
- *Element D.4* – Additional drought year water supplies will be beneficial to the KNWR by protecting wetland habitat acreage.

Expedited funding for this project is needed in order to implement the project in Summer 2015. For the 2014 Drought, the District has utilized its banked water supplies to meet grower demands and to provide water for exchanges with other Kern Region water agencies. This new water supply will be utilized to help supplement the banked water and can be utilized for exchanges that may be needed if the drought or dry conditions continue into 2015.

ID4 CVC Extension Lining Project (Phase 1 – Pool No. 7)

Project Description: The Project consists of the lining of the CVC Extension Pool No. 7, substantially reducing seepage to an area underlain by groundwater with contaminants.

Alleviate Drought Impacts: The ID4 Project will alleviate the following drought impacts:

- *At risk of not meeting existing drinking water demands:* By constructing a liner along approximately 2 miles of the CVC Extension, non-beneficial seepage is reduced, which is especially critical in a drought year. By reducing seepage (and the associated groundwater extraction to make up for these losses), the project will help alleviate groundwater pumping in the urban and industrialized areas along the Kern Fan, which benefits other drinking water wells. Additionally, a lined channel eliminates the risk of a breech in the canal that would cut off deliveries to the Henry C. Garnett Water Purification Plant on which much of the Metropolitan Bakersfield area relies for drinking water.
- *At risk of not meeting existing agricultural water demands:* By alleviating groundwater extraction along the Kern Fan, extraction for agricultural water demands is benefited by reducing the potential outages of wells due to a dropping water table.
- *At risk of not meeting ecosystem water demands:* By reducing losses in the canal, more surface water is available for recharge in the Kern River channel in normal to wet years, which is a vital ecosystem corridor through the urban Bakersfield area. However, recharge will not occur in a drought year, as the scare water supply will be delivered to the Henry C. Garnett Water Purification Plant.
- *Drinking Water MCL Violations*: Seepage from the unlined canal provides a potential mechanism that might make cleanup efforts from a localized plume contaminated by an upgradient oil refinery more difficult. Groundwater monitoring near the refinery has found plumes of volatile aromatics (benzene) in the upper aquifer. Reducing water lost through seepage is expected to aid in water management and cleanup activities of this plume and protect drinking water from potential MCL violations.
- *Groundwater basin overdraft:* Construction of the project will provide drought relief by reducing water losses along the canal, thereby reducing needed groundwater extraction from drought relief wells for delivery to the Henry C. Garnett Water Purification Plant. The drought conditions experienced recently have dropped groundwater levels in the Kern Sub-basin and this project will aid in the effort to not further exacerbate overdraft in the basin.

Drought Project Eligibility: The Project is eligible as it assists with the following Drought Project Elements (refer to Section 3.1):

- *Element D.1.* – The project promotes water conservation; approximately 2,500 AF per year of seepage losses will no longer occur along Pool No. 7. However, ID4 will increase recharge along the Kern River channel in normal and wet years to account for losses attributed to SWP water supply and maintain the average recharge volume in the Sub-basin. In drought years, though, less groundwater extractions occur since the seepage losses do not have to be pumped to deliver the same amount of water to the Henry C. Garnett Water Purification Plant, thereby promoting efficient management of the groundwater basin.
- *Element D*.2. – By lining the canal, potential canal breeches are eliminated, thereby protecting deliveries to the Henry C. Garnett Water Purification Plant. Additionally, drinking water quality for surrounding wells is protected by reducing the potential expansion of the localized contaminated plume.

Expedited funding for this project is needed in order to have the project completed by the end of 2015. The completion of this project will be beneficial if the drought or dry years continue into 2015, which will require the continued use of the CVC Extension to deliver groundwater to the Henry C. Garnett Water Purification Plant.

AEWSD In-Lieu Program

Project Description: In-lieu groundwater recharge/banking projects (two areas) and new reverse flow pumps are proposed for conservation of otherwise lost water and drought protection.

Alleviate Drought Impacts: The AEWSD In-Lieu Program will alleviate the following drought impacts:

- *At risk of not meeting existing drinking water demands:* No immediate assistance is expected, but City of Arvin wells, a disadvantaged community, may receive long-term water quality benefits from increased importation of high quality waters originating in the Sierra Nevada Mountains.
- *At risk of not meeting existing agricultural water demands:* Additional drought year water will help meet existing agricultural water demands from in-lieu project wells, and use of efficient reverse-flow pumps in the District's canal system allows delivery flexibility to convey water to other service areas.
- *Drinking Water MCL Violations*: No immediate assistance expected; possible long-term reduction in MCL Violations in the City of Arvin.
- *Groundwater basin overdraft:* Water conserved by the project will help mitigate basin overdraft.
- *Other drought related adverse impacts:* Groundwater levels will be improved, resulting in lower energy use, pumping cost, and fewer wells requiring deepening of wells and/or pumps. Fewer farms will lose income as a result of annual crop fallowing and permanent crop removal. Local farm-related businesses will have smaller losses of income. Fewer farm workers and employees of farm-related businesses will lose their jobs and/or income.

Drought Project Eligibility: The Project is eligible as it assists with the following Drought Project Elements (refer to Section 3.1):

- *Element D.1.* – Immediate regional drought preparedness will be improved through increased drought year water supplies to AEWSD and improved groundwater basin conditions.
- *Element D.*2. – Local water supply reliability for agriculture will be improved through use of in-lieu project wells and reverse flow pumps.

Expedited funding for this project is needed for AEWSD to raise enough capital to implement the project beginning this Fall; otherwise, the District will not pursue the In-lieu Program in time to provide drought protection in 2015, and possibly not at all.

Additional Program Description Discussion: AEWSD's In-lieu Program proposes to administer, design and construct the Sycamore and North In-lieu Projects to increase delivery of surface water thereby achieving in-lieu groundwater recharge (banking), that would otherwise be irrecoverably lost to evaporation or spilled (ultimately into the ocean) and later recovered typically during dry periods, including supplementing AEWSD's existing extraction facilities. Landowners' existing irrigation facilities and extraction wells in the project service areas will be integrated into the District's irrigation distribution system, including provision of power service to wells using the District's Power and Water Resources Pooling Authority (PWRPA) power.

The North Canal Pump Back Project is an additional drought relief component of the In-lieu Program, which features new reverse-flow pumps that would be retrofitted into the existing North Canal Check Structure. The Structure was designed and built for the future expansion of the proposed Pump Back. The Pump Back would allow for reverse flow of canal operations and convey groundwater from a southern reach of the canal to a northern reach/service area to water users during dry years or low flow periods. The Pump Back operation would increase operational flexibility and limit AEWSD's need to import surface water into the northern area, where crop demands can exceed available AEWSD groundwater supplies. The Pump Back would also be needed to deliver in-lieu recovered groundwater to water users on the north end of the District.

BCWD Water Main Replacement and Meter Installation Project

Project Description: BCWD will implement water conservation measures in connection with water main replacement and new meter installation, thereby reducing annual groundwater pumping.

Alleviate Drought Impacts: The BCWD Project will alleviate the following drought impacts:

- *At risk of not meeting existing drinking water demands:* Installation of new water mains, valves and meters would assist the BCWD in achieving long-term water conservation by (1) substantially reducing losses from existing water mains and (2) allowing for the implementation of graduated water rates based on actual customer water use that is measured by new meters, thereby incentivizing water conservation. Through conservation the maximum day demand (MDD) will be reduced by an estimated 168 gpm allowing the District to meet existing water demands. Without these reductions in water demands, the system would be at risk of shortages during the summer as the drought has reduced the well pumping capacity to a threshold close to the District's MDD; and if a well were to go out of service, then emergency measures would need to be implemented by BCWD. If this condition were to occur after the addition of water meters, the District will be able to track customer water use and charge higher rates or fines for excessive water use above the mandatory conservation levels required. This is currently not possible as the District is unmetered.
- *Drinking Water MCL Violations*: With dropping groundwater levels due to the drought, arsenic is known to be released from the aquifer formation causing potential MCL violations (which have occurred in the past at Well No. 4). Total Dissolved Solids (TDS), with Secondary MCL of 500 mg/L, has increased due to the drought; Well No. 4 was tested at 1,200 mg/L, placing it in the short term allowance category by CDPH. Through this project (and BVWSD's project) groundwater pumping in the area is decreased, alleviating these conditions. Additionally, the replacement of water mains and the mitigation of water shortages will help decrease the potential for bacteriological and other MCL violations as contaminants can siphon into the system under a low pressure condition (e.g. water main break or insufficient water supply).
- *Groundwater basin overdraft:* The project will reduce groundwater pumping by an estimated 64 AF/year (for the first 20 years), which helps reduce the demands on the drought-impacted Kern Sub-basin.
- *Other drought related adverse impacts:* As a small community with approximately 1,500 residents that make on average 62% of the Statewide Median Household Income (MHI) and many working in the local farming industry, the drought will have a severe impact on their quality of life. By moving to a rate structure based on use, customers that are most affected by the drought can utilize less water than the average to obtain a lower water bill. Additionally, the increase in maintenance required for the District will have an effect on the operating budget of the District requiring rate increases. This is especially the case if major portions of pipelines have to be replaced.

Drought Project Eligibility: The Project is eligible as it assists with the following Drought Project Elements (refer to Section 3.1):

- *Element D.1.* – The project will result in a long-term reduction in groundwater use estimated at 16% of total water use (first 20 years), improving the management of the groundwater basin. As customers will be billed based on water use, they will seek to conserve water; as an example, customers will improve landscape irrigation efficiency by reducing over-irrigation.
- *Element D*.2. – With the reduction in water demands, the local water supply will be more reliable as redundancy in groundwater pumping is increased. The replacement of these 1950s-era pipelines will reduce the potential for contamination as discussed above.
- *Element D.3* – As detailed in Attachment 1, this water conservation project is not locally cost-effective as the project costs exceed the costs associated with the benefits.

Expedited funding for this project is needed in order to implement the project a quickly as possible. The District has minimal extra water supply capacity and is at risk of water shortages during the summer with the higher water demands and the dropping water table.

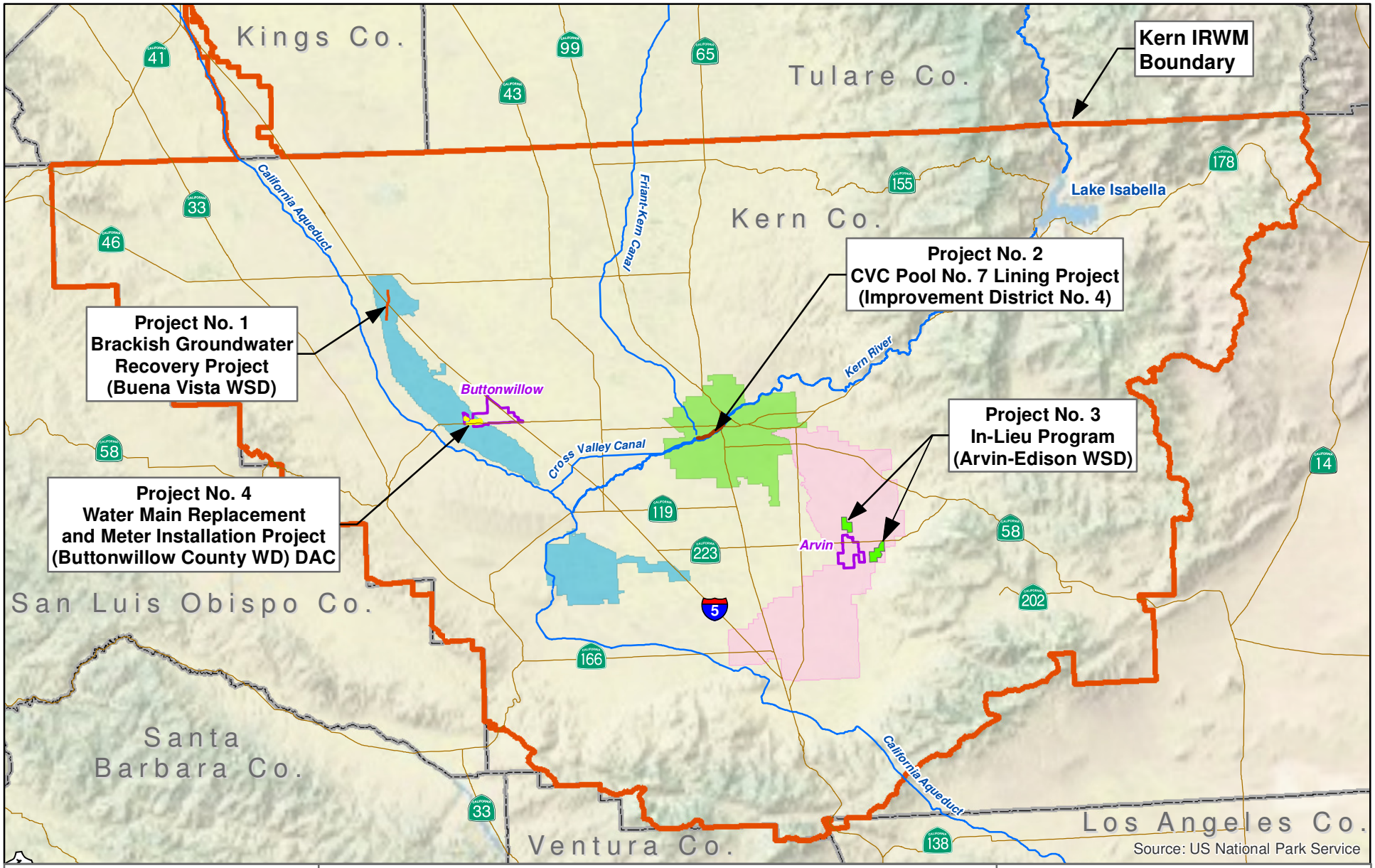
3.3 Regional and Project Maps

A Regional Map identifying the IRWM boundary in relation to the Project Proponent district boundaries and project locations is included as **Figure 3.3-1**.

Project maps are included as follows:

- BVWSD Brackish Groundwater Recovery Project - **Figure 3.3-2**
- ID4 CVC Extension Lining Project (Phase 1-Pool No. 7) – **Figure 3.3-3**
- AEWSD In-Lieu Program – **Figure 3.3-4**
- BCWD Water Main Replacement and Meter Installation Project – **Figure 3.3-5**

Each project map shows the projects geographical location, work limits, existing and proposed facilities, groundwater and surface water resources affected, and proposed monitoring locations.



0 6 12 Miles

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- Buttonwillow County W.D.
- Arvin-Edison W.S.D.
- Buena Vista W.S.D.
- K.C.W.A. Improvement District No. 4
- DWR DAC or SDAC Community
- Kern IRWM Boundary

Kern IRWM Regional Map with Project Locations

Figure 3.3-1

Kern IRWM Group

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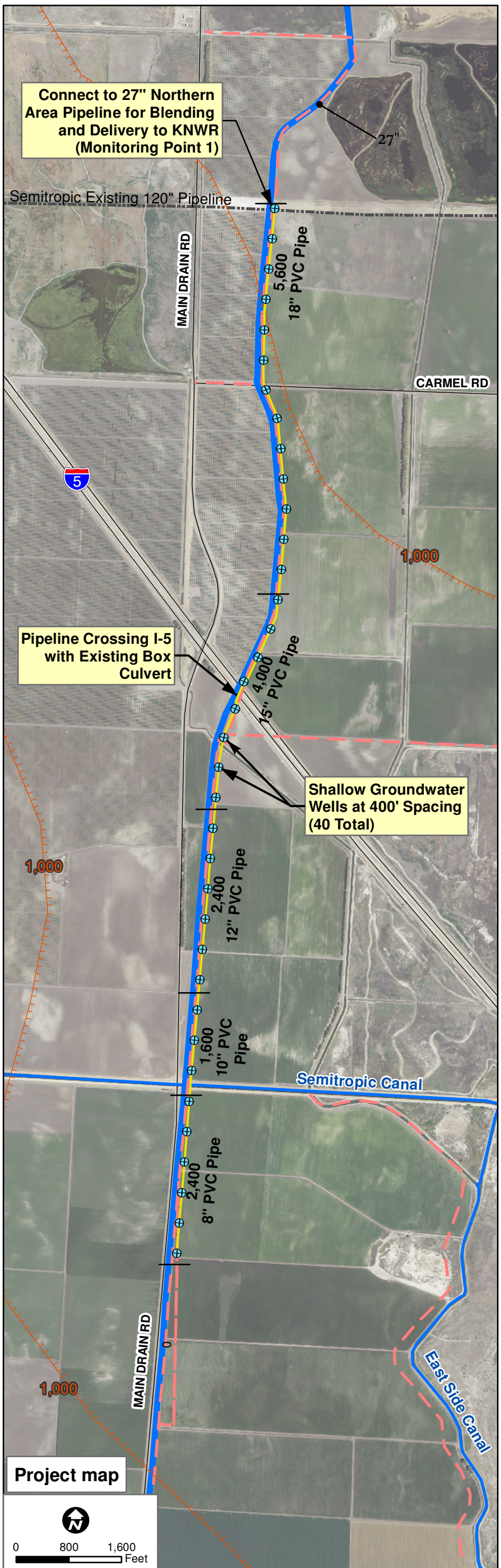

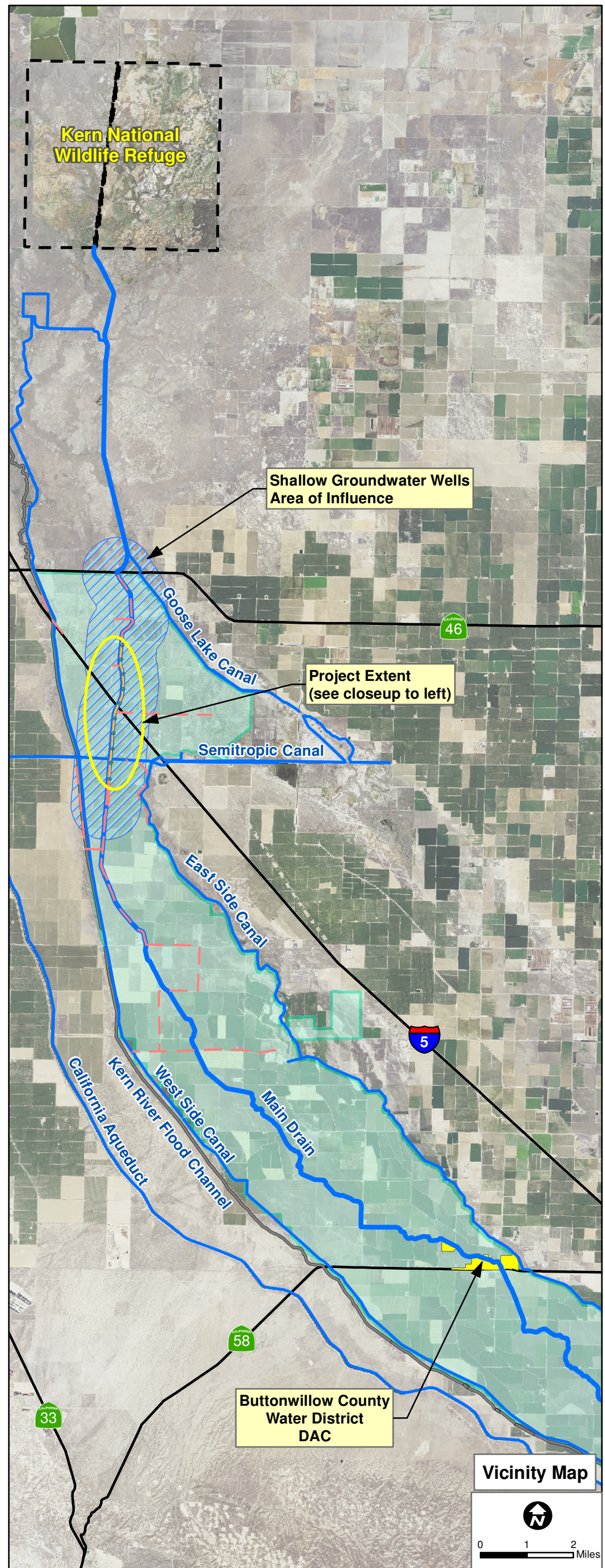

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Shallow GW TDS (mg/L)
Canals
Proposed Northern Area Pipeline (complete Spring 2015)
Proposed Shallow GW Wells with Collector Pipeline (monitoring points at turnouts to be located in field)
Area of Influence
Buttonwillow Service Area

Buena Vista Water Storage District

Brackish Groundwater Recovery Project

Figure 3.3-2

Kern IRWM Group

0 500 1,000 Feet

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Legend

CVC Pool No. 7 Lining Extent (lengths are approx.)

Existing CVC Underground Siphon

Improvement District No. 4

Cross Valley Canal Extension
Lining Project (Phase 1-Pool No. 7)

Figure 3.3-3

Kern IRWM Group

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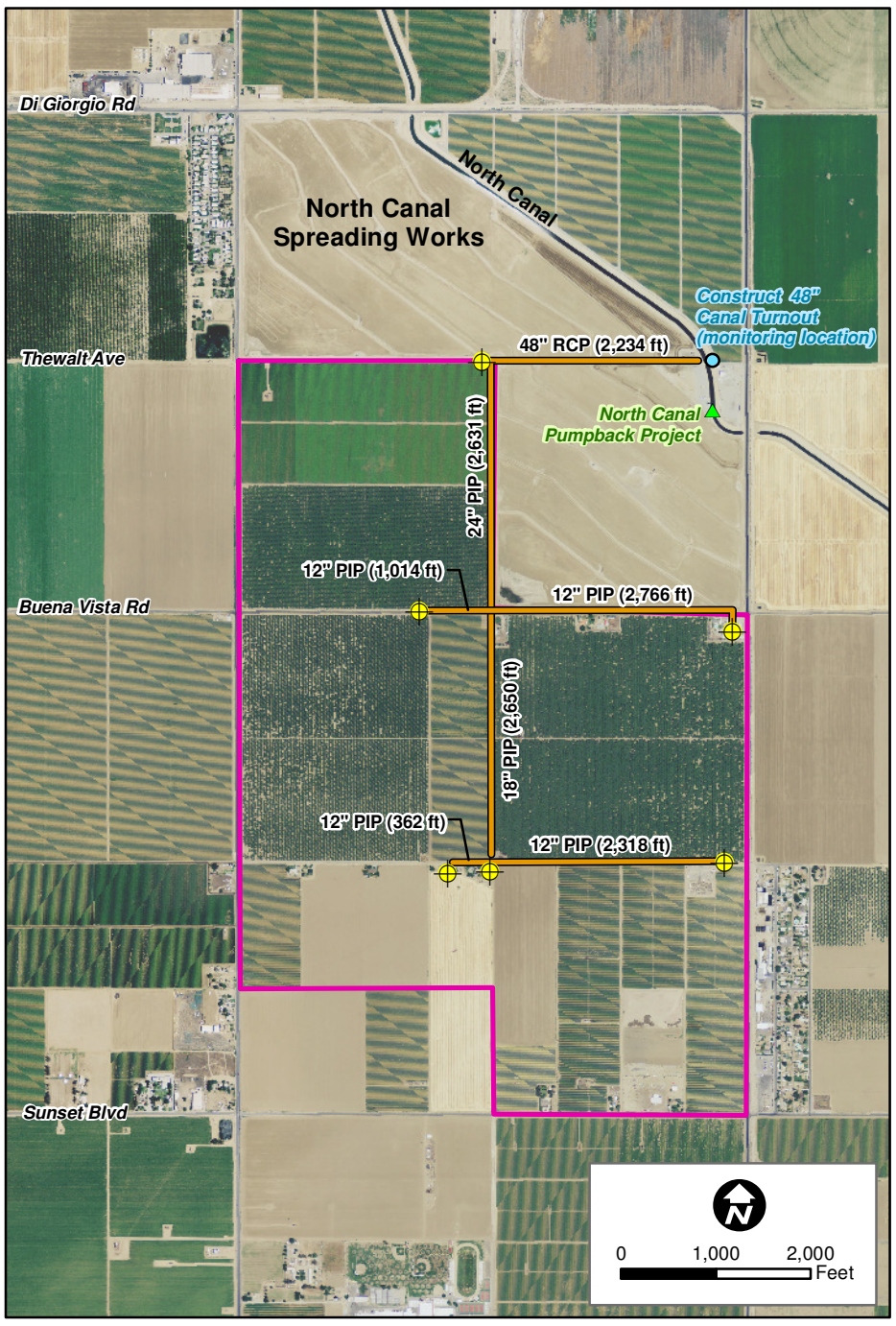
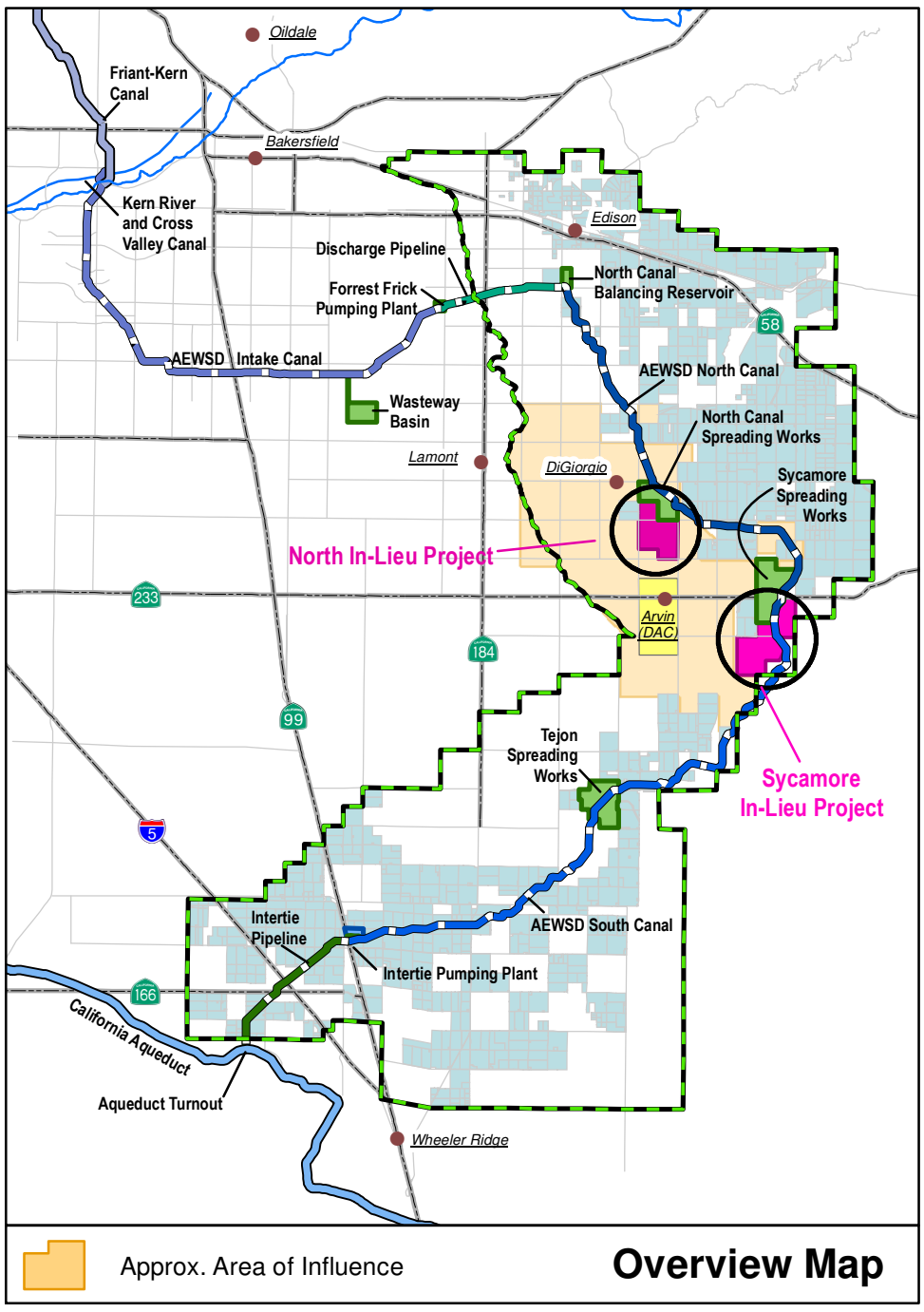
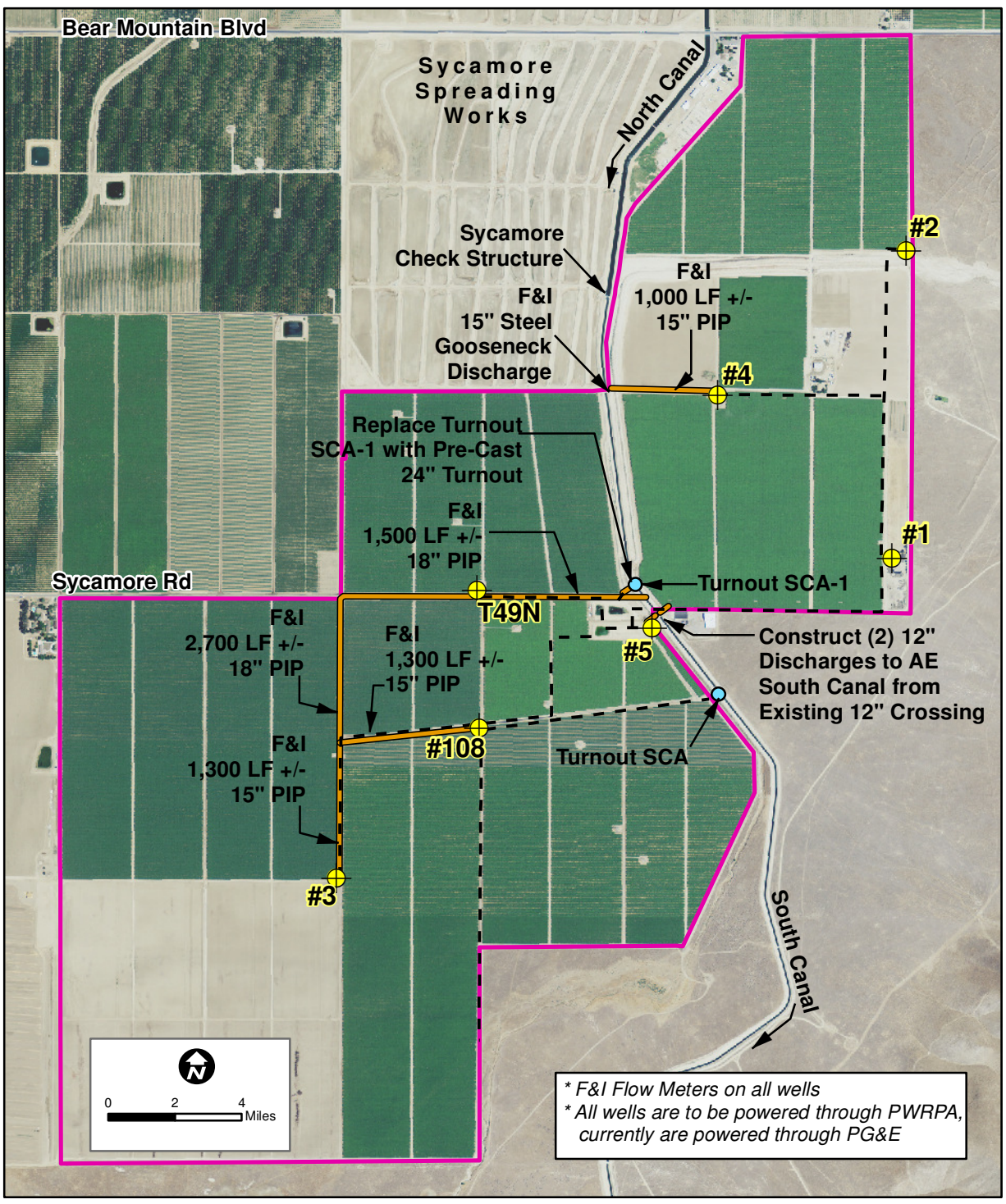


North In-Lieu Project





Sycamore In-Lieu Project

Arvin-Edison Water Storage District - In-Lieu Program

Figure 3.3-4

Legend

- Well (Monitoring Locations)
- Turnout
- Existing Facility
- Proposed Facility
- In-Lieu Project Boundary

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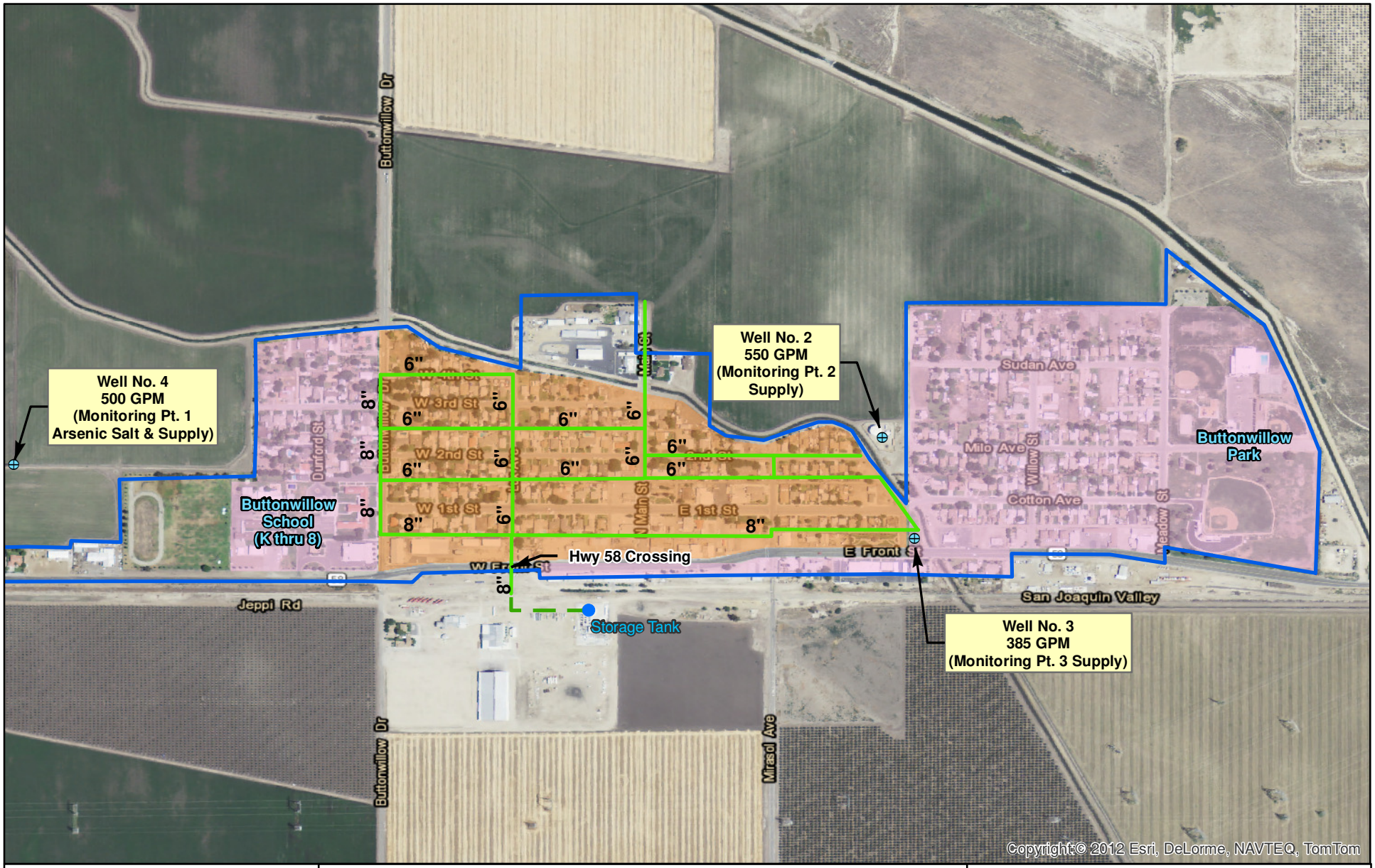

0 400 800 Feet

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- Wells
- Proposed New Water Main
- New Water Meters Area (Monitoring Pt. 4 Customer Demands)
- Replacement Water Meters Area (Monitoring Pt. 5 Customer Demands)
- Buttonwillow County Water District Boundary (DAC)

Buttonwillow County Water District

Water Main Replacement and
Meter Installation Project

Figure 3.3-5

Kern IRWM Group

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3.4 BVWSD Brackish Groundwater Recovery Project

3.4.1 Project Physical Benefits

The BVWSD project will result in the following physical benefits:

- **Physical Benefit 1 (Primary) – Water Supply Produced**: By blending the brackish water with existing SWP surface water supplies, a new long-term average annual water supply of 1,661 AF/year will be generated for use on crops within the District. By utilizing this water on local crops, the District will have an equal amount of water to be utilized for in-lieu banking and water exchanges (as the District has a generally positive groundwater balance). The Project will ultimately produce 41,526 AF of brackish groundwater to be blended with surface water supplies for crop use.
- **Physical Benefit 2 (Primary) – KNWR Wetland Habitat Protected**: From August to February crop irrigation demands are minimal and water deliveries can be provided to the KNWR for winter habitat for water fowl. The supplemental water supply can be transitioned from crop use to supply water to the KNWR wetlands. This brackish groundwater will be diluted significantly with existing surface water supplies to meet water quality objectives of the KNWR. Typically, the KNWR has sufficient water supplies to meet the Refuge's needs. However, the 2014 drought has significantly reduced the water available to the Refuge. This supplemental water supply will provide approximately 991 AF to meet needs of the KNWR wetlands in a drought year, thereby increasing habitat acreage. Through the Project's life span 1,982 AF of brackish groundwater will be supplied to KNWR, protecting a total of 300 acres of wetland habitat (in two drought years).
- **Physical Benefit 3 (Secondary) – Energy Saved**: By comparing the crop water supply provided by these shallow groundwater wells to other deeper groundwater wells in the District, an estimated 4,981 megawatt-hours (MWh) of energy use is conserved.
- **Physical Benefit 4 (Secondary) – Greenhouse Gases (GHG) Avoided**: The associated GHG that are avoided by offsetting the electrical energy use is estimated to be 2,108 metric tons (MT) of carbon dioxide (CO2).
- **Physical Benefit 5 (Secondary) – Crop Benefit (non-quantified)**: The existing impacts to crops in the District will be reduced by lowering the perched groundwater table below the root zone. The perched water table also limits the choice of crops to be planted as it interferes with the root zone of both annual and perennial crops. The number of acres benefited from this groundwater table reduction are uncertain but are estimated to be in the range of 2,000 acres.

Table 3.4-1: BVWSD Annual Project Physical Benefit 1 - Water Supply Produced

Table 5a - Annual Project Physical Benefits

Project Name: Buena Vista Water Storage District Brackish Groundwater Recovery Project

Type of Benefit Claimed: Water supply produced by blending brackish recovered groundwater with existing SWP surface water supplies.

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Allows for an equal amount of water for in-lieu banking and/or water exchanges.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	409	409
2016	0	1,292	1,292
2017	0	1,397	1,397
2018	0	1,502	1,502
2019	0	1,607	1,607
2020	0	1,650	1,650
2021	0	1,693	1,693
2022	0	1,736	1,736
2023	0	1,779	1,779
2024	0	1,779	1,779
2025	0	1,779	1,779
2026	0	1,779	1,779
2027	0	1,779	1,779
2028	0	1,779	1,779
2029	0	1,779	1,779
2030	0	1,779	1,779
2031	0	1,779	1,779
2032	0	1,779	1,779
2033	0	1,779	1,779
2034	0	1,779	1,779
2035	0	1,779	1,779
2036	0	1,779	1,779
2037	0	1,779	1,779
2038	0	1,779	1,779
2039	0	1,779	1,779
Totals	0	41,526	41,526
Averages	0	1,661	1,661

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 25 year project life.

Table 3.4-2: BVWSD Annual Project Physical Benefit 2 - KNWR Wetland Habitat Protected

Table 5a - Annual Project Physical Benefits

Project Name: Buena Vista Water Storage District Brackish Groundwater Recovery Project

Type of Benefit Claimed: KNWR wetland habitat protected during critical drought years.

Units of the Benefit Claimed: Acres

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0
2024	0	0	0
2025	0	0	0
2026	0	300	300
2027	0	300	300
2028	0	0	0
2029	0	0	0
2030	0	0	0
2031	0	0	0
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	0	0
2038	0	0	0
2039	0	0	0
Totals	0		
Averages	0		

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 25 year project life.

Table 3.4-3: BVWSD Annual Project Physical Benefit 3 - Energy Saved

Table 5a - Annual Project Physical Benefits

Project Name: Buena Vista Water Storage District Brackish Groundwater Recovery Project

Type of Benefit Claimed: Energy saved by pumping shallow groundwater instead of groundwater in the pumping zone.

Units of the Benefit Claimed: Megawatt-hours (MWh)

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	49	49
2016	0	155	155
2017	0	168	168
2018	0	180	180
2019	0	193	193
2020	0	198	198
2021	0	203	203
2022	0	208	208
2023	0	213	213
2024	0	213	213
2025	0	213	213
2026	0	213	213
2027	0	213	213
2028	0	213	213
2029	0	213	213
2030	0	213	213
2031	0	213	213
2032	0	213	213
2033	0	213	213
2034	0	213	213
2035	0	213	213
2036	0	213	213
2037	0	213	213
2038	0	213	213
2039	0	213	213
Totals	0	4,981	4,981
Averages	0	199	199

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 25 year project life.

Table 3.4-4: BVWSD Annual Project Physical Benefit 4 - GHG Avoided

Table 5a - Annual Project Physical Benefits

Project Name: Buena Vista Water Storage District Brackish Groundwater Recovery Project

Type of Benefit Claimed: Greenhouse gasses avoided resulting from the Project energy savings.

Units of the Benefit Claimed: Metric tons (MT) of carbon dioxide (CO2)

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	21	21
2016	0	66	66
2017	0	71	71
2018	0	76	76
2019	0	82	82
2020	0	84	84
2021	0	86	86
2022	0	88	88
2023	0	90	90
2024	0	90	90
2025	0	90	90
2026	0	90	90
2027	0	90	90
2028	0	90	90
2029	0	90	90
2030	0	90	90
2031	0	90	90
2032	0	90	90
2033	0	90	90
2034	0	90	90
2035	0	90	90
2036	0	90	90
2037	0	90	90
2038	0	90	90
2039	0	90	90
Totals	0	2,108	2,108
Averages	0	84	84

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 25 year project life.

3.4.2 Technical Analysis of Physical Benefits Claimed

Technical Basis of Project

The BVWSD project consists of the construction of 40 shallow groundwater wells to recover brackish groundwater from the perched aquifer located in the northern portion of the Buttonwillow Service Area (BSA) and blend with surface water supplies for use on salt tolerant crops. Based on past shallow groundwater wells constructed in the area, a constant well yield between 60 gpm to 100 gpm can be obtained from this perched groundwater aquifer, which extends from approximately 5 feet below ground surface to depths greater than 100 feet. The estimated TDS of the brackish groundwater recovered will range from 1,500 mg/L and 2,500 mg/L.

The brackish water will be pumped from 40 shallow groundwater wells (design per Figure 1, spaced 400 feet apart, along a 3 mile corridor. To be conservative, we have assumed that 60 gpm can be generated by each well. The well depth will be approximately 100 feet deep. The water will be piped into a collector pipeline that will be aligned parallel to the Northern Area Pipeline and the existing Main Drain Canal. As mentioned previously, the District will be constructing the Northern Area Pipeline in late 2014 to early 2015. The collector pipeline will have turnouts for crop fields along the pipeline with a flowmeter to determine suitable blend ratios with surface water depending upon the crop type.

A turnout will be located at the north end of the project at the existing Semitropic Water Storage District (SWSD) 120-inch pipeline. At this location, surface water from the SWSD can be blended with the shallow groundwater and delivered by a proposed 27-inch Northern Area Pipeline for use by fields to the north or the KNWR in a drought year.

The following documents provide the technical basis for the benefits claimed and are referenced in the subsequent sections:

Document Name	Author/Source, Year	Appendix
BVWSD Brackish Groundwater Recovery Project	Provost & Pritchard, 2014	**Appendix 3.4-A**
Shallow Perched Groundwater TDS	BVWSD, 2008	**Appendix 3.4-B**
May 2014 Crop Map	BVWSD, 2014	**Appendix 3.4-C**
Crop ETc, Effective Rainfall and Demands for Brackish Groundwater Service Area	Provost & Pritchard, 2014	**Appendix 3.4-D**
KNWR Water Deliveries – 1984-2013	BVWSD, 2014	**Appendix 3.4-E**
Demands and Brackish Groundwater Blending Calculations for Service Area	Provost & Pritchard, 2014	**Appendix 3.4-F**
Crop Salinity Tolerance and Yield Potential	Provost & Pritchard, 2014	**Appendix 3.4-G**
Project Benefits Summary	Provost & Pritchard, 2014	**Appendix 3.4-H**
Water Quality Data - Desalination Demonstration Report for BVWSD	AECOM, 2003	**Appendix 3.4-I**

Document Name	Author/Source, Year	Appendix
Year 2010 eGrid Subregion Emissions – GHG	USEPA, 2010	**Appendix 3.4-J**
Costs of water purchased in California water market and transported to Kern County	Dale Melville, 2013	**Referenced in Appendix 3.4-K**
State Water Project Water Supply Reliability Report, Table 6 – 2013 Draft	DWR, 2013	
Water sales price in a year with 5% SWP allocation	BVWSD, 2014	
BVWSD Project Costs	Provost & Pritchard, 2014	**Appendix 3.4-L**

Recent and Historical Conditions

Shallow Groundwater Supply

The District retained a hydro-geologist to provide a feasibility level analysis of the proposed project (**Appendix 3.4-A**). The analysis included a review of the shallow groundwater well work performed by previous contractors as well as recommendations for the shallow groundwater well design and construction. The memorandum also provided information regarding the groundwater basin characteristics, aquifer system, groundwater depth and elevation, water supply availability and general water quality.

A preliminary estimate of the available perched groundwater that would be under the influence of these proposed wells was analyzed and determined to be in the order of 35,000 to 48,000 AF (refer to **Figure 3.3-2** for the approximate area of influence). As discussed in the memo (page 3-4), this is a conservative estimate as this is considered the existing groundwater in the perched aquifer and does not account for groundwater inflow, deep percolation from irrigation water, and recharge from BVWSD canal systems (especially in flood years).

Shallow Groundwater Quality

As discussed in memorandum, the sampled TDS of the shallow groundwater ranges from 850 and 4,000 mg/L. The location of the wells (and their area of influence) was selected to obtain lower TDS concentrations and is estimated to be between 1,500 and 2,500 mg/L (see Figure 11 of **Appendix 3.4-A**). A comprehensive water quality analysis was performed for two wells drilled for a reverse osmosis water treatment pilot study (page 2 of memo). It should be noted that these wells were drilled to the south of the proposed project…a location where TDS ranges from 3,000 to 4,000 mg/L based on the TDS contour map (**Appendix 3.4-B**). The second shallow groundwater well project located to the north of the proposed project resulted in a TDS of 2,800 mg/L (in line with the TDS contour map).

Crop Data

A current crop map for the District is included as **Appendix 3.4-C**. The area that can be served by the collector pipeline is outlined in this map. Currently 1,000 acres of pomegranates and 300 acres of cotton are farmed in this area. An additional 1,300 acres of pistachios are going into production. The

current total estimated water demand by these crops is 4,800 AF/year, and once the pistachios are mature, the total demand will be 9,200 AF/year based on analysis in **Appendix 3.4-D**.

KNWR

The KNWR was established in 1960, under the authority of Migratory Bird Conservation Act "for the use as an inviolate sanctuary, or for any other management purposes, for migratory birds" (16 U.S.C 715d). Prior to the Central Valley Project Improvement Act (CVPIA), insufficient water was provided for the refuge, only allowing up to 2,000 acres of wetland habitat. Most of these water deliveries occurred after October 1, after the migrating waterfowl arrive in the area. The lack of flooded habitat also precluded nesting of most waterfowl and shorebirds. Through the CVPIA, the KNWR now has contracts for 25,000 AF/year of water that is made up of Federal Level 2 water (9,950 AF/year) and Level 4 water (15,050 AF/year). An average of 21,000 AF/year has been delivered since 2001 (see **Appendix 3.4-E**), which typically meets the wetland water needs. For the current drought year, the KNWR has only been allocated 8,000 AF, reducing the wetlands to only 2,000 acres out of the 6,500 acres are used as wetlands. Since the Refuge's old wells are out of service, no additional water supplies are available to make up the difference. This reduction will impact the migratory birds during the winter months, reduce habitat in the spring for tri-colored blackbirds, and impact the visitors' service programs.

Estimates of Without-project Conditions

If the project is not implemented the existing and proposed crops that are to be served by this blended water will fully utilize SWP water or Kern River water, which will not allow for increased in-lieu recharge in the District or increased water available for water exchanges.

Additionally, without the supplemental water supply, the KNWR will not be able to achieve the optimum quantity of water for wetland management in a drought year (such as this year), the KNWR is especially impacted as described above.

Description of Methods used to Estimate Physical Benefits

As a conservative estimate, a 25 year project life has been assumed. This is based on the existing water supply available in the perched aquifer. However, additional recharge and other inflows have not been factored into the hydrogeologic analysis and would further extend the life of the project.

Physical Benefit 1 (Primary) – Water Supply Produced

To determine the new water supply benefit, Provost & Pritchard Consulting Group analyzed the expected use of the shallow groundwater. To determine the volume of this brackish groundwater that will be utilized, the crop type, acreage, crop consumptive use, and water quality objectives were analyzed. This analysis is summarized in tables contained in **Appendix 3.4-F**. The crop types and acreages, as discussed in the "Crop Data" section above, were used in the analysis and assumed to

not change[1]. Crop water demands were determined using ETc values from the Irrigation Training and Research Center's (ITRC) *California Crop and Soil Evapotranspiration* reference (http://goo.gl/pfOFok). For new pistachios, the water demand will increase gradually over 9 years; this has been accounted for in the analysis using data contained in the appendix. To be conservative, Provost & Pritchard utilized a TDS of 2,000 mg/L for the brackish groundwater. The historical average TDS of the SWP water is approximately 450 mg/L. An assumed blending ratio of one part groundwater to three parts SWP water results in a blended TDS of 832 mg/L (equivalent to an electrical conductivity (EC) of 1.3). Comparing this EC with the EC limits of crops in this area (**Appendix 3.4-G**), no reduction of crop yield is expected. This benefit analysis, as well as the following benefits, are summarized in **Appendix 3.4-H**.

Physical Benefit 2 (Primary) –KNWR Wetland Habitat Protected

Based on discussions with USBR, the water supply impacts for this drought year appear to be a rare situation. Based on information from CVP contractors, we have assumed that a reduction to the Level 2 allocation (and no Level 4 allocation) only occurs twice during the life of the project (once every 12 years). For these two years, the total supplemental water to be delivered is 1,982 AF. The assumed blend ratio is one part groundwater to five parts SWP, which results in a conservative TDS of 708 mg/L that would be allowable by the KNWR. At this blend ratio, Selenium and other water constituents are not of concern based on available water quality information (**Appendix 3.4-I**), but the new wells will be sampled regularly to confirm that it meets KNWR requirements.

Physical Benefit 3 (Secondary) – Energy Saved

By utilizing the shallow groundwater instead of extracting groundwater from the deeper aquifer in the District, a net annual average energy savings of 199 MWh/year will be achieved. The assumptions regarding the hydraulics of the pumping lifts and the calculated energy use is included in **Appendix 3.4-H**.

Physical Benefit 4 (Secondary) – GHG Avoided

Using the estimated energy saved the project results in a proportional reduction in GHG based upon a factor of 0.423 MT CO2 per MWh. This factor is from a 2010 Environmental Protection Agency study of GHG associated with energy generation in California (eGRID GHG Annual Output Emission Rates table is included as **Appendix 3.4-J**). Using this factor, the energy reduction results in an average annual GHG avoidance of 84 MT CO2 (see **Appendix 3.4-H** for analysis).

Physical Benefit 5 (Secondary) – Crop Benefit

The areas adjacent to the well field will benefit from the lowering of the perched groundwater table. Based on the area of influence, it is estimated that approximately 2,000 acres (of the 4,400 acres in the

[1] Note that changing from one crop type to another will not result in a significant change in brackish groundwater use as conservative factors are built into this analysis. For example, blending ratios are very conservative and less surface water could be utilized without affecting crop viability or yield.

area of the influence) will see a reduction in the shallow groundwater table between 2 to 5 feet. This lowering of the water table below the root zone of planted crops will benefit the yield and vitality.

Facilities, Policies, and Action Required to Obtain the Physical Benefits

To obtain the physical benefits, the farmers will need to utilize this additional water supply. Based on the conservative analysis, no impacts are anticipated for any crop types farmed in BVWSD. Additionally, farmers in the area are fully utilizing reclaimed drain water that is of a lesser water quality than the brackish groundwater. It is expected that the proposed project will be fully utilized by the growers. As is the typical practice, the district and farmers will monitor water quality of the new water supply to ensure that water quality targets are met for the crop types.

The supplemental water supply for the KNWR will be required to meet water quality parameters for the wetlands. Water quality sampling will be conducted after the wells have been completed. Blending ratios will be determined for the water supply to ensure that water quality targets are met for the refuge. On-going sampling will occur as required in the KNWR Water Management Plan.

Potential Adverse Physical Effects

By ensuring that the blend ratios are in accordance with the recommended crop water management practices, no adverse physical effects are expected for the crops.

Deliveries of project water to the KNWR are not expected to result in adverse physical effects to the wetlands management.

3.4.1 Cost Effective Analysis

Table 6 - Cost Effective Analysis **Project Name: BVWSD Brackish Groundwater Recovery Project**	
Question 1	Types of benefits provided:
	Water Supply Produced - The estimated amount of crop water supply produced by the project averages 1,661 acre-feet per year.
	KNWR Wetland Habitat Protected – The estimated amount of habitat protected in a drought year is 300 acres.
	Energy Saved – By comparing the crop water supply provided by these shallow groundwater wells to other deeper groundwater wells in the District, an average annual 199 MWh of energy use is conserved.
	Reduce emission of greenhouse gases – The associated GHG that are avoided by offsetting the electrical energy use is estimated to be 84 MT CO2 per year.
	Crop Benefit – The existing impacts to crops in the District will be reduced by lowering the perched groundwater table below the root zone.

Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? **Yes**
	If no why? **N/A**
	If yes, list the methods (including the proposed project) and estimated costs: **A comparison was made between the costs of purchasing an equivalent amount of water produced by the Brackish Water Recovery Project in California's water market and paying Aqueduct conveyance costs to deliver it to BVWSD(see Appendix 3.4-K). Capital costs of the Brackish Water Recovery Project are based upon Appendix 3.4-L, Engineer's Projection of Probable Project Costs .** **The cost of water in California's water market varies greatly from year to year, and is strongly related to the State Water Project (SWP) Table A allocation. Water market costs versus SWP Table A allocation were obtained from Dale Melville, manager of Dudley Ridge Water District, who purchases market water on behalf of west-side State Water Project contractors, and from BVWSD's sale of water in 2014 (a 5% SWP Table A allocation year).** **A 25 year analysis of water purchase costs versus Brackish Water Recovery costs was performed in Appendix 3.4-K using %SWP Table A Allocation data taken from the 2013 Draft SWP Water Supply Reliability Report with 25 model years whose average of %SWP Table Allocation match the average %SWP Table Allocation of the 80 year analysis period. It was concluded that the Brackish Water Recovery Project would be more cost effective.**
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
	The proposed project is the most cost effective, as can be seen in Appendix 3.4-K.
Comments:	

3.5 ID4 CVC Extension Lining Project

3.5.1 Project Physical Benefits

The ID4 CVC Extension Lining Project for Pool No. 7 will result in the following physical benefits:

- **Physical Benefit 1 (Primary) – Dry Year Groundwater Extraction Reduction**: In dry years, groundwater is pumped from the Kern Fan and is delivered through the CVC Pool No. 7 to the Henry C. Garnett Water Purification Plant. By constructing a liner in the CVC Pool No. 7, seepage losses are reduced by 80% in the canal reach. By reducing water losses, the volume of water obtained from groundwater wells is reduced by approximately 51,000 AF over the 50 year life of the project.
- **Physical Benefit 2 (Primary) – Beneficial Recharge of SWP Water**: The CVC Pool No. 7 water losses are not considered beneficial recharge as they are near an existing upper aquifer contaminant plume. By reducing these losses by 80%, ID4 will repurpose the SWP portion of these water losses to beneficial recharge in the Kern River channel during wet and normal water year types. This will result in a total estimated recharge of approximately 78,000 AF over the life of the project.
- **Physical Benefit 3 (Secondary) – Increased Intermittent Wetland Habitat**: By increasing the volume of water in the Kern River channel wetland habitat along the Kern River will be improved. This habitat is especially beneficial as it provides wetlands for migratory birds along the Pacific Flyway in addition to benefiting other wildlife. The total estimated flow into the Kern River is approximately 78,000 AF over the life of the project.
- **Physical Benefit 4 (Secondary) – Energy Saved**: In relation to Benefit 1, the amount of water that needs to be pumped from the Kern Sub-Basin and delivered through the CVC is reduced, which reduces energy use from the wells and CVC pump stations by an estimated 16,400 MWh over the life of the project.
- **Physical Benefit 5 (Secondary) – Greenhouse Gases (GHG) Avoided**: The reduction in energy required to pump the water in Benefit 3 results in avoided GHG emissions and is estimated to be approximately 6,900 MT CO2 over the life of the project.
- **Physical Benefit 6 (Secondary) – Prevention of Interrupted Service (non-quantifiable)**: By lining the CVC Pool No. 7, the risk of potential canal breeches are eliminated, thereby protecting deliveries to the Henry C. Garnett Water Purification Plant.

Table 3.5-1: ID4 Annual Project Physical Benefit 1 - Dry Year Groundwater Extraction Reduction

Table 5a - Annual Project Physical Benefits

Project Name: ID4 CVC Pool No. 7 Canal Lining Project

Type of Benefit Claimed: Dry Year Groundwater Extraction Reduction

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Portion of CVC Seepage Loss in Pool No. 7 that Reduces Groundwater Pumping from Kern Fan.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	2,647	2,647	0
2015	0	0	0
2016	0	0	0
2017	2,349	470	1,879
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	7,633	1,527	6,106
2024	2,647	529	2,118
2025	0	0	0
2026	0	0	0
2027	2,349	470	1,879
2028	0	0	0
2029	0	0	0
2030	0	0	0
2031	0	0	0
2032	0	0	0
2033	7,633	1,527	6,106
2034	2,647	529	2,118
2035	0	0	0
2036	0	0	0
2037	2,349	470	1,879
2038	0	0	0
2039	0	0	0
2040	0	0	0
2041	0	0	0
2042	0	0	0
2043	7,633	1,527	6,106
2044	2,647	529	2,118
2045	0	0	0
2046	0	0	0
2047	2,349	470	1,879
2048	0	0	0
2049	0	0	0
2050	0	0	0
2051	0	0	0
2052	0	0	0
2053	7,633	1,527	6,106
2054	2,647	529	2,118
2055	0	0	0
2056	0	0	0
2057	2,349	470	1,879
2058	0	0	0
2059	0	0	0
2060	0	0	0
2061	0	0	0
2062	0	0	0
2063	7,633	1,527	6,106
2064	2,647	529	2,118
2065	0	0	0
Totals	63,146	12,629	50,516
Average	1,263	253	1,010

Comments: Actual data from 2004-2013 (10 years) is assummed to repeat over the 50 year project life as this is representative of the CVC Extension operations. Construction is complete by 2016; therefore no water savings shown in 2014-2015. Reduction is assumed to be 80% of losses as a seepage still occurs with a concrete liner.

Table 3.5-2: ID4 Annual Project Physical Benefit 2 - Beneficial Recharge of SWP Water

Table 5a - Annual Project Physical Benefits

Project Name: ID4 CVC Pool No. 7 Canal Lining Project

Type of Benefit Claimed: Beneficial Recharge of SWP Water

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Re-purpose CVC Pool No. 7 losses attributed to SWP deliveries to beneficial recharge of Kern River channel.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	2,088	2,088	0
2016	2,741	548	2,193
2017	0	0	0
2018	138	28	110
2019	0	0	0
2020	4,551	910	3,641
2021	2,824	565	2,259
2022	5,621	1,124	4,497
2023	0	0	0
2024	2,088	418	1,671
2025	2,741	548	2,193
2026	0	0	0
2027	138	28	110
2028	0	0	0
2029	4,551	910	3,641
2030	2,824	565	2,259
2031	5,621	1,124	4,497
2032	0	0	0
2033	2,088	418	1,671
2034	2,741	548	2,193
2035	0	0	0
2036	138	28	110
2037	0	0	0
2038	4,551	910	3,641
2039	2,824	565	2,259
2040	5,621	1,124	4,497
2041	0	0	0
2042	2,088	418	1,671
2043	2,741	548	2,193
2044	0	0	0
2045	138	28	110
2046	0	0	0
2047	4,551	910	3,641
2048	2,824	565	2,259
2049	5,621	1,124	4,497
2050	0	0	0
2051	2,088	418	1,671
2052	2,741	548	2,193
2053	0	0	0
2054	138	28	110
2055	0	0	0
2056	4,551	910	3,641
2057	2,824	565	2,259
2058	5,621	1,124	4,497
2059	0	0	0
2060	2,088	418	1,671
2061	2,741	548	2,193
2062	0	0	0
2063	138	28	110
2064	0	0	0
2065	4,551	910	3,641
Totals	97,244	19,449	77,795
Average	1,945	389	1,556

Comments: Actual data from 2004-2013 (10 years) is assummed to repeat over the 50 year project life as this is representative of the CVC Extension operations. Construction is complete by 2016; therefore no water savings shown in 2014-2015. Reduction is assumed to be 80% of losses as a seepage still occurs with a concrete liner. Actual timing of SWP water recharge shall be determined based on hydrologic conditions and water system operations; however, the overall recharge volume attributed to the estimated losses will be met over the time period.

Table 3.5-3: ID4 Annual Project Physical Benefit 3 - Increased Intermittent Wetland Habitat

Table 5a - Annual Project Physical Benefits

Project Name: ID4 CVC Pool No. 7 Canal Lining Project

Type of Benefit Claimed: Increased Intermittent Wetland Habitat

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Actual data from 2004-2013 (10 years) is assummed to repeat over the 50 year life as this is representative of the CVC Extension operations.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	2,193	2,193
2017	0	0	0
2018	0	110	110
2019	0	0	0
2020	0	3,641	3,641
2021	0	2,259	2,259
2022	0	4,497	4,497
2023	0	0	0
2024	0	1,671	1,671
2025	0	2,193	2,193
2026	0	0	0
2027	0	110	110
2028	0	0	0
2029	0	3,641	3,641
2030	0	2,259	2,259
2031	0	4,497	4,497
2032	0	0	0
2033	0	1,671	1,671
2034	0	2,193	2,193
2035	0	0	0
2036	0	110	110
2037	0	0	0
2038	0	3,641	3,641
2039	0	2,259	2,259
2040	0	4,497	4,497
2041	0	0	0
2042	0	1,671	1,671
2043	0	2,193	2,193
2044	0	0	0
2045	0	110	110
2046	0	0	0
2047	0	3,641	3,641
2048	0	2,259	2,259
2049	0	4,497	4,497
2050	0	0	0
2051	0	1,671	1,671
2052	0	2,193	2,193
2053	0	0	0
2054	0	110	110
2055	0	0	0
2056	0	3,641	3,641
2057	0	2,259	2,259
2058	0	4,497	4,497
2059	0	0	0
2060	0	1,671	1,671
2061	0	2,193	2,193
2062	0	0	0
2063	0	110	110
2064	0	0	0
2065	0	3,641	3,641
Totals	0	77,795	77,795
Average	0	1,556	1,556

Comments: Actual timing of SWP water recharge shall be determined based on hydrologic conditions and water system operations; however, the overall recharge volume attributed to the estimated losses will be met over the time period.

Table 3.5-4: ID4 Annual Project Physical Benefit 4 - Energy Saved

Table 5a - Annual Project Physical Benefits

Project Name: ID4 CVC Pool No. 7 Canal Lining Project

Type of Benefit Claimed: Energy Saved

Units of the Benefit Claimed: Megawatt-hours (MWh)

Additional Information About this Benefit: Actual data from 2004-2013 (10 years) is assummed to repeat over the 50 year life as this is representative of the CVC Extension operations.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	-29	-29
2017	0	646	646
2018	0	-1	-1
2019	0	0	0
2020	0	-47	-47
2021	0	-29	-29
2022	0	-58	-58
2023	0	2,101	2,101
2024	0	707	707
2025	0	-29	-29
2026	0	0	0
2027	0	645	645
2028	0	0	0
2029	0	-47	-47
2030	0	-29	-29
2031	0	-58	-58
2032	0	0	0
2033	0	2,079	2,079
2034	0	700	700
2035	0	0	0
2036	0	-1	-1
2037	0	646	646
2038	0	-47	-47
2039	0	-29	-29
2040	0	-58	-58
2041	0	0	0
2042	0	-22	-22
2043	0	2,072	2,072
2044	0	728	728
2045	0	-1	-1
2046	0	0	0
2047	0	599	599
2048	0	-29	-29
2049	0	-58	-58
2050	0	0	0
2051	0	-22	-22
2052	0	-29	-29
2053	0	2,101	2,101
2054	0	727	727
2055	0	0	0
2056	0	-47	-47
2057	0	617	617
2058	0	-58	-58
2059	0	0	0
2060	0	-22	-22
2061	0	-29	-29
2062	0	0	0
2063	0	2,099	2,099
2064	0	728	728
2065	0	-47	-47
Totals	0	16,366	16,366
Average	0	327	327

Comments: Actual timing of energy savings will be dependant on water availability. However, long term energy savings are anticipated to be met over the time period.

Table 3.5-5: ID4 Annual Project Physical Benefit 4 - GHG Avoided

Table 5a - Annual Project Physical Benefits

Project Name: ID4 CVC Pool No. 7 Canal Lining Project

Type of Benefit Claimed: Greenhouse gas emissions avoided by reduction of power use

Units of the Benefit Claimed: Metric tons (MT) of carbon dioxide (CO2)

Additional Information About this Benefit: Actual data from 2004-2013 (10 years) is assummed to repeat over the 50 year life as this is representative of the CVC Extension operations.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	-12	-12
2017	0	274	274
2018	0	-1	-1
2019	0	0	0
2020	0	-20	-20
2021	0	-12	-12
2022	0	-25	-25
2023	0	889	889
2024	0	299	299
2025	0	-12	-12
2026	0	0	0
2027	0	273	273
2028	0	0	0
2029	0	-20	-20
2030	0	-12	-12
2031	0	-25	-25
2032	0	0	0
2033	0	880	880
2034	0	296	296
2035	0	0	0
2036	0	-1	-1
2037	0	274	274
2038	0	-20	-20
2039	0	-12	-12
2040	0	-25	-25
2041	0	0	0
2042	0	-9	-9
2043	0	877	877
2044	0	308	308
2045	0	-1	-1
2046	0	0	0
2047	0	254	254
2048	0	-12	-12
2049	0	-25	-25
2050	0	0	0
2051	0	-9	-9
2052	0	-12	-12
2053	0	889	889
2054	0	308	308
2055	0	0	0
2056	0	-20	-20
2057	0	261	261
2058	0	-25	-25
2059	0	0	0
2060	0	-9	-9
2061	0	-12	-12
2062	0	0	0
2063	0	888	888
2064	0	308	308
2065	0	-20	-20
Totals	0	6,925	6,925
Average	0	138	138

Comments: Actual timing of CO2 emission reductions will be dependant on water availability. However, long term CO2 reductions are anticipated to be met over the time period.

3.5.2 Technical Analysis of Physical Benefits Claimed

Technical Basis of Project

The proposed project consists of constructing approximately 9,400 linear feet of liner in the canal prism of the unlined of the CVC Extension Pool No. 7. Preliminary construction plans (approximate design level of 15%) have been prepared for the project that shows the limits of construction, the proposed cross sections, and construction details (see **Appendix 3.5-A**). A technical memorandum has been included as **Appendix 3.5-B** with design details of the proposed project. The canal is located in an area with sandy soils with high percolation rates resulting in high losses. Lining the canal will reduce water losses due to seepage from the canal that may contribute to the adjacent contaminated plume in upper aquifer. Localized contamination of the upper aquifer has been caused by an oil refinery north of the CVC. Reduction of water seepage is expected to aid in water management and cleanup activities limiting the spread of the contaminant plume to areas of the aquifer used for drinking water.

Additionally, the condition of the canal has raised concerns of potential breeches. Although these occurrences have been avoided thus far, there have been instances where the canal has come close to breeching the canal bank due to rodent burrowing. A canal breech would result in flooding of the surrounding area resulting in property damage and would disrupt water service to the Henry C. Garnett Water Purification Plant. Lining the canal banks would reduce the risk of a canal breech.

The following documents provide the technical basis for the benefits claimed and are referenced in the subsequent sections:

Document Name	Author/Source, Year	Appendix
15% Construction Plans	Provost & Pritchard, 2014	**Appendix 3.5-A**
ID4 CVC Pool 7 Channel Analysis	Provost & Pritchard, 2014	**Appendix 3.5-B**
Improvement District No. 4 Report on Water Conditions	ID4, 2013	**Appendix 3.5-C**
Groundwater Conditions & Potential Impacts of Pumping for the ID-4 Kern Parkway and Rosedale Rio Bravo WSD Project	Schmidt, 2003	**Appendix 3.5-D**
ID4 CVC Pool No. 7 Operations – 2004-2013	Provost & Pritchard, 2014	**Appendix 3.5-E**
Benefits Summary	Provost & Pritchard, 2014	**Appendix 3.5-F**
Canal Lining Demonstration Project	USBR, 2002	**Appendix 3.5-G**
Well Power Calculation Sheet	ID4, 2004	**Appendix 3.5-H**
US EPA eGrid Data	California Energy Commission	**Appendix 3.4-J**
ID4 Project Cost	Provost & Pritchard, 2014	**Appendix 3.5-I**
ID4 Alternative Project Cost	Provost & Pritchard, 2014	**Appendix 3.5-J**

Recent and Historical Conditions

Water Supply

ID4 delivers surface water from its SWP allocation (either directly or by exchange with Kern River or Friant-Kern Canal water) to the Henry C. Garnett Purification Plant for distribution to Metropolitan Bakersfield water purveyors. ID4 also participates in groundwater banking projects along the Kern Fan that provide a water supply in dry years. ID4 maintains records of water availability, water usage, water deliveries and water losses. A summary of operations is prepared annually in the Improvement District No. 4 Report on Water Conditions. Two tables from this report are included as **Appendix 3.5-C**. The first table (page 39) is a summary of 2013 operations and also provides the current recharge and recovery capacities of its portion of the banking facilities. The second table (page 40) is a summary of the historical deliveries to the Purification Plant by water source. The SWP and Recovered columns are the water supplies that ID4 delivers through the CVC Extension to the Purification Plant. Cawelo Water District (CWD) also delivers water through the Extension to their turnout at the end of CVC Pool No. 8 but is not included in this table.

Groundwater Quality

Seepage from the unlined canal currently contributes to an aquifer that has been contaminated by an adjacent oil refinery to the north. Groundwater near the CVC generally flows south to south-east, which places much of the unlined canal directly downgradient of the refinery. Groundwater monitoring near the refinery has found plumes of volatile aromatics (benzene) and MTBE in the upper aquifer (refer to page 30 of **Appendix 3.5-D**). The locations of these plumes, groundwater gradients and potential for impacts to groundwater were documented in a report by Ken Schmidt and Associates prepared in 2003 (**Appendix 3.5-D**).

Groundwater contamination in the area is further documented in a Clean Up & Abatement Order (CAO) No. R5-2007-0716 issued by the Central Valley Regional Water Quality Control Board to Big West of California, LLC. This CAO states the following:

> *Past releases of liquid petroleum hydrocarbons (LPH) throughout the facility, including Mohawk Tank Farms, impact soil and polluted groundwater. Past impacts have been investigated and are undergoing remediation by Big West and another responsible party.*

Groundwater remediation for the area is an ongoing effort. However, the operation of the remediation efforts has been inconsistent.

Estimates of Without-project Conditions

The “Without-project” conditions are assumed to be similar to historical conditions for the last 10 years of operations (2004 to 2013). Although the CVC Extension operations are not directly tied to hydrological conditions, this period has an average Kern River runoff of 92% of the long term mean of the April to June snow melt runoff. Additionally, the SWP allocation for this period is an average of 62% which compares relatively well to the 2013 SWP Delivery Reliability Report’s long term future conditions estimate of 58% (DWR, 2013). **Appendix 3.5-E** is a summary table of the CVC Pool No. 7 operations for this period and includes the measured conveyance deliveries through the pool (ID4 and CWD deliveries) and measured losses (evaporation and seepage along the pool). It should be noted that ID4 incurs all of the seepage losses in the CVC Extension. These losses have been separated into losses attributed to groundwater pumping and SWP import. No other CVC Extension capacity increases or

changes to the delivery pattern are planned that would affect the without-project or with-project conditions.

Description of Methods used to Estimate Physical Benefits

Physical Benefit 1 (Primary) – Dry Year Groundwater Extraction Reduction

The Dry Year Groundwater Extraction Reduction benefit was determined by estimating the reduced CVC Pool No. 7 losses that are attributed to groundwater extraction as a result of installing a concrete liner. From **Appendix 3.5-F,** the estimated losses attributed to groundwater pumping result in an average annual volume of 1,263 AF. With a new concrete liner, the loss reduction is estimated to be 80%. This factor is based on a 10 year study by the USBR on canal linings which included seepage reduction estimates. An excerpt of this study is included as **Appendix 3.5-G**. The data collected by USBR showed an effectiveness ranging from 60 to 90% with a long-term effectiveness of about 70%. With a new concrete liner and the utilization of fiberglass reinforcement embedded in the concrete, cracking of the concrete would be reduced, improving water tightness. A factor of 80% has been used in this analysis and has been applied in the summary table. Additionally based on data in this study, the project life is estimated to be 50 years for a concrete liner. Based on this seepage reduction, the total annual average reduction to groundwater extraction is 1,010 AF.

Physical Benefit 2 (Primary) – Beneficial Recharge of SWP Water

Similar to Benefit 1, the same seepage reduction factors were estimated for the SWP water losses that occur in CVC Pool No. 7. This results in an average annual volume of 1,556 AF that will be beneficially recharged in the Kern River channel from River Turnout No. 4 (in CVC Pool No. 8). The actual timing of SWP water recharge will be determined by ID4 based on hydrologic conditions and water system operations; however, the overall recharge volume attributed to the estimated losses will be met over the time period. It should be noted that in dry/drought years SWP water will not be recharged in the channel as groundwater extraction would be occurring.

Physical Benefit 3 (Secondary) – Increased Intermittent Wetland Habitat

By increasing recharge in the Kern River channel, wetland habitat is benefitted. Typically, in most years, there is no water in the Kern River channel at the River Turnout No. 4 (and further downstream). The project is expected to increase the number of years where water is recharging in the river channel, and in years when water is in the channel, the recharge will increase the time period when water is in the channel. The average annual water that will be delivered to the Kern River channel for wetland habitat matches Benefit 2.

Physical Benefit 4 (Secondary) – Energy Saved

The energy saved for the project is associated with the reduced groundwater extractions that were determined in Benefit 1. These extractions incur energy use from the well pump and four of the CVC pumping plants. As documented in **Appendix 3.5-H**, for well pumps utilized by ID4, the average energy use per acre-feet is approximately 260 kWh/AF for a pump operating with 200 feet of total dynamic head (which is the long term approximate average in the Kern Fan). Energy use per acre-feet pumped at the CVC pumping plants is approximately 21 kWh/AF per plant. Each pumping plant has a similar hydraulic operating condition. The resultant annual average energy reduction is estimated as:

(260 kWh + 4 x 21 kWh)/AF x 1,010 AF = 348,000 kWh

However, for Benefit 2, additional energy will be used at Pumping Plant No. 7 to pump the recharge water to CVC Pool No. 8 for delivery into the Kern River channel. This average annual energy use associated with Benefit 2 is estimated to be 20,000 kWh (13 kWh/AF x 1,556 AF) and must be subtracted from the Benefit 1 energy saved.

Therefore, the average annual net energy saved is 327,000 kWh (327 MWh).

Physical Benefit 5 (Secondary) – GHG Avoided

Using the estimated energy saved the project results in a proportional reduction in greenhouse gasses based upon a factor of 0.423 MT of CO2 per mWh. This factor is from a 2010 Environmental Protection Agency study of greenhouse gasses associated with energy generation in California (eGRID GHG Annual Output Emission Rates table is included as **Appendix 3.4-J**). Using this factor, the energy reduction results in an average annual GHG avoidance of 138 MT CO2.

Physical Benefit 6 (Secondary) – Prevention of Interrupted Service (non-quantifiable)

Although this benefit is not quantifiable, the concrete lining protects the CVC Extension from outages that could occur due to breeches in the canal bank. Additionally, the concrete liner will reduce the associated maintenance time and costs that are required for an earthen canal.

Facilities, Policies, and Action Required to Obtain the Physical Benefits

To achieve the benefits as described above, the concrete lining would need to be constructed, operated, and maintained in accordance with the design. For construction, temporary construction easements are needed to stockpile materials. Potential sites have been identified and discussions with the property owners are proceeding; no delays are anticipated as multiple sites are available and landowners would not be opposed to the project.

ID4 will establish a policy to ensure that the estimated seepage losses associated with the SWP water will meet the long term recharge requirement identified in Benefit 2. This volume of water will be tracked by ID4 and factored into recharge operations.

Potential Adverse Physical Effects

Potential adverse physical effects of the project will be reviewed as part of California Environmental Quality Act compliance, and are expected to be limited to localized construction-related effects. Mitigation measures, if needed, will be implemented as part of the project.

3.5.3 Cost Effective Analysis

Table 6 - Cost Effective Analysis **Project Name: ID4 CVC Extension Lining Project**	
Question 1	Types of benefits provided:
	Dry Year Groundwater Extraction Reduction - The estimated reduction of CVC Pool No. 7 losses attributed to groundwater recovery results in an

	average annual volume of 1,010 AF/year of reduced groundwater pumping in the Kern Fan.
	Beneficial Recharge of SWP Water – The estimated reduction of Pool No. 7 losses attributed to SWP water will be repurposed for the Kern River channel resulting in the average annual beneficial recharge of 1,556 AF/year.
	Increased Intermittent Wetland Habitat – An average annual flow of 1,556 AF/year will be delivered to the Kern River channel resulting in improved wetland habitat.
	Energy Saved – ID4 will reduce energy use by approximately 327 MWh/year on an average annual basis.
	GHG Avoided – The reduced energy use will result in an average annual 138 MT of avoided CO2.
	Prevention of Interrupted Service – The lined canal will help prevent an outage of the CVC Extension that could cut off a portion of the Metropolitan Bakersfield area from their drinking water demands.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? **Yes**
	If no why? **N/A**
	If yes, list the methods (including the proposed project) and estimated costs: **1. Proposed Project – Concrete-lined channel. Estimated Construction Cost: $5.4M (see Appendix 3.5-I) with a life expectancy of 50 years.** **2. Alternative Project – Geomembrane-lined channel. Estimated Construction Cost: $3.3M (see Appendix 3.5-J) with a life expectancy of 25 years.**
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
	When comparing the preferred concrete-lined channel alternative to the geomembrane-lined channel the unequal project lives must be accounted for in the economic analysis. Therefore, an Annualized Cost Method must be performed (see bottom table in Appendix 3.5-J); the concrete lining alternative has an annualized cost of $299,000, while the geomembrane alternative has an annual cost of $241,000. Even though the geomembrane lining alternative is cheaper (and has a slight improvement in seepage reduction), concrete lining is the preferred alternative, because of less maintenance time and costs, a replacement project is not needed after approximately 25 years (along with outages), and safety concerns are reduced (geomembrane liner is slippery).
Comments:	

3.6 AEWSD In-Lieu Program

3.6.1 Project Physical Benefits

The AEWSD project will result in the following physical benefits:

- **Physical Benefit 1 (Primary) – Water Conserved**: Water banked underground during wet periods in In-lieu Program facilities is water that would otherwise be lost to beneficial use because it either would have flooded land in the Central Valley and been lost to evaporation or it would have been lost to the Pacific Ocean. This conserved water is projected to amount to 50,308 AF over the 50 year life of the In-lieu Program.
- **Physical Benefit 2 (Primary) – Drought Relief Water Supply Produced**: Water banked underground during wet periods and recovered in critical drought periods through use of In-lieu Program facilities will allow the District to avoid prorating water supplies to growers in critical drought periods and provide 29,374 AF for use on crops within the District over the 50 year project life. This drought relief water supply comes from the Water Conserved, and a remainder of the Water Conserved would remain in underground storage at the end of the 50 year project life.
- **Physical Benefit 3 (Secondary) – Energy Saved**: Water delivered to growers for use in-lieu of their pumping of groundwater reduces energy use by approximately 0.495 MWh/AF, because delivery of surface water requires less energy use than pumping groundwater. This totals a projected 61,902 MWh over the 50 year project life. In addition to this, higher groundwater levels resulting from groundwater stored in the aquifer in the area of influence of the in-lieu projects provides an additional projected savings of 19,450 MWh over the Program life, for a total of 66,523 MWh conserved.
- **Physical Benefit 4 (Secondary) – Greenhouse Gases (GHG) Avoided**: Energy saved by the project results in reduced greenhouse gasses (the gasses associated with energy generation, transmission, and delivery to pumps in which energy is conserved. The associated GHG that are avoided as a result of energy savings is estimated to be 28,147 metric tons (MT) of carbon dioxide (CO2).
- **Physical Benefit 5 (Secondary) – Crop Benefit (non-quantifiable)**: The existing impacts to crops in the District resulting from drought year shortage and water supply prorates in critical drought years will be eliminated resulting in increased crop yield and crop quality improvements in both annual and perennial crops. Approximately 50,000 acres (the size of the Surface Water Service Area) would receive these benefits. The yield and crop quality improvements cannot be quantified due to the number of different crops involved and the complexity of analysis that would be required.
- **Physical Benefit 6 (Secondary) – Water Quality Improvement (non-quantifiable)**: Increased use of high quality conserved floodwaters, which originate in the Sierra Nevada Mountains, versus continued use of groundwater (which diminishes water quality over time) will improve local groundwater quality in the area of influence of the In-lieu Program facilities. This is approximately 40,200 acres, and includes City of Arvin wells (disadvantaged community).

Table 3.6-1: AEWSD Annual Project Physical Benefit 1 - Water Conserved

Table 5a - Annual Project Physical Benefits

Project Name: Arvin-Edison WSD In-Lieu Program

Type of Benefit Claimed: Water conserved by supplying available Fraint-Kern flood flows to growers in the project area in-lieu of pumping groundwater to meet crop irrigation demands.

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Water banked underground during wet periods will be available for recovery in critical drought periods allowing the District to avoid prorating water supplies to growers.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	2,954	2,954
2021	0	2,743	2,743
2022	0	2,511	2,511
2023	0	0	0
2024	0	0	0
2025	0	2,954	2,954
2026	0	2,511	2,511
2027	0	0	0
2028	0	2,511	2,511
2029	0	0	0
2030	0	0	0
2031	0	0	0
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	2,511	2,511
2038	0	2,682	2,682
2039	0	2,511	2,511
2040	0	0	0
2041	0	0	0
2042	0	0	0
2043	0	2,743	2,743
2044	0	2,743	2,743
2045	0	0	0
2046	0	0	0
2047	0	2,682	2,682
2048	0	2,511	2,511
2049	0	2,743	2,743
2050	0	2,511	2,511
2051	0	0	0
2052	0	2,511	2,511
2053	0	2,511	2,511
2054	0	0	0
2055	0	2,954	2,954
2056	0	2,511	2,511
2057	0	0	0
2058	0	0	0
2059	0	0	0
2060	0	0	0
2061	0	0	0
2062	0	0	0
2063	0	0	0
2064	0	0	0
Totals	0	50,308	50,308
Average	0	1,006	1,006

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 50 year project life.

Table 3.6-2: AEWSD Annual Project Physical Benefit 2 - Drought Relief Water Supply Produced

Table 5a - Annual Project Physical Benefits

Project Name: Arvin-Edison WSD In-Lieu Program

Type of Benefit Claimed: Drought relief water supply produced by recovery of available stored water in critical drought periods through the In-lieu Program facilities.

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: Allows the District to avoid prorating water supplies to growers in ciritical drought periods. Recovery will not exceed the amount of banked In-lieu Program water.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0
2024	0	0	0
2025	0	0	0
2026	0	0	0
2027	0	0	0
2028	0	0	0
2029	0	0	0
2030	0	0	0
2031	0	10,000	10,000
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	0	0
2038	0	0	0
2039	0	0	0
2040	0	0	0
2041	0	0	0
2042	0	0	0
2043	0	0	0
2044	0	0	0
2045	0	0	0
2046	0	10,000	10,000
2047	0	9,374	9,374
2048	0	0	0
2049	0	0	0
2050	0	0	0
2051	0	0	0
2052	0	0	0
2053	0	0	0
2054	0	0	0
2055	0	0	0
2056	0	0	0
2057	0	0	0
2058	0	0	0
2059	0	0	0
2060	0	0	0
2061	0	0	0
2062	0	0	0
2063	0	0	0
2064	0	0	0
Totals	0	29,374	29,374
Average	0	587	587

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 50 year project life.

Table 3.6-3: AEWSD Annual Project Physical Benefit 3 - Energy Saved

Table 5a - Annual Project Physical Benefits

Project Name: Arvin-Edison WSD In-Lieu Program

Type of Benefit Claimed: Energy saved by delivering available surface water in-lieu of pumping groundwater, and reduced groundwater well pumping lifts from banked water.

Units of the Benefit Claimed: Megawatt-hours (MWh)

Additional Information About this Benefit: Allows the District to avoid prorating water supplies to growers in ciritical drought periods. Recovery will not exceed the amount of banked In-lieu Program water.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	3,580	3,580
2021	0	3,465	3,465
2022	0	3,487	3,487
2023	0	397	397
2024	0	397	397
2025	0	3,971	3,971
2026	0	3,738	3,738
2027	0	667	667
2028	0	3,855	3,855
2029	0	790	790
2030	0	544	544
2031	0	-7,022	-7,022
2032	0	299	299
2033	0	299	299
2034	0	300	300
2035	0	299	299
2036	0	300	300
2037	0	3,512	3,512
2038	0	3,817	3,817
2039	0	3,750	3,750
2040	0	670	670
2041	0	670	670
2042	0	670	670
2043	0	3,976	3,976
2044	0	4,106	4,106
2045	0	695	695
2046	0	-7,092	-7,092
2047	0	-3,453	-3,453
2048	0	3,344	3,344
2049	0	3,570	3,570
2050	0	3,592	3,592
2051	0	506	506
2052	0	3,710	3,710
2053	0	3,827	3,827
2054	0	749	749
2055	0	4,302	4,302
2056	0	4,078	4,078
2057	0	1,020	1,020
2058	0	1,020	1,020
2059	0	1,022	1,022
2060	0	1,020	1,020
2061	0	1,022	1,022
2062	0	1,020	1,020
2063	0	1,017	1,017
2064	0	1,020	1,020
Totals	0	66,523	66,523
Average	0	1,330	1,330

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 50 year project life.

Table 3.6-4: AEWSD Annual Project Physical Benefit 4 - GHG Avoided

Table 5a - Annual Project Physical Benefits

Project Name: Arvin-Edison WSD In-Lieu Program

Type of Benefit Claimed: Greenhouse gas emission reduction from reduced groundwater pumping in project area during in-lieu operations, and reduced well groundwater lifts due to groundwater level rise.

Units of the Benefit Claimed: Metric tons (MT) of carbon dioxide (CO2)

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	0	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	1,515	1,515
2021	0	1,466	1,466
2022	0	1,475	1,475
2023	0	168	168
2024	0	168	168
2025	0	1,680	1,680
2026	0	1,581	1,581
2027	0	282	282
2028	0	1,631	1,631
2029	0	334	334
2030	0	230	230
2031	0	-2,971	-2,971
2032	0	127	127
2033	0	127	127
2034	0	127	127
2035	0	127	127
2036	0	127	127
2037	0	1,486	1,486
2038	0	1,615	1,615
2039	0	1,587	1,587
2040	0	284	284
2041	0	284	284
2042	0	284	284
2043	0	1,682	1,682
2044	0	1,737	1,737
2045	0	294	294
2046	0	-3,001	-3,001
2047	0	-1,461	-1,461
2048	0	1,415	1,415
2049	0	1,510	1,510
2050	0	1,520	1,520
2051	0	214	214
2052	0	1,570	1,570
2053	0	1,619	1,619
2054	0	317	317
2055	0	1,820	1,820
2056	0	1,725	1,725
2057	0	431	431
2058	0	431	431
2059	0	432	432
2060	0	431	431
2061	0	432	432
2062	0	431	431
2063	0	430	430
2064	0	431	431
Totals	0	28,147	28,147
Average	0	563	563

Comments: Construction begins in 2015 therefore no water savings shown in 2014. Calculations based on 50 year project life.

3.6.2 Technical Analysis of Physical Benefits Claimed

Technical Basis of Project

Two project location sites for in-lieu groundwater recharge projects have been selected. The Sycamore In-lieu Project provides a connection to seven grower wells and will provide service to about 1,000 acres. The North In-lieu Project will provide connections to 6 wells and will provide service to about 650 acres, with potential for later expansion. These areas were selected for the following reasons: (1) growers have requested surface water deliveries as available, (2) these areas have previously been demonstrated to have suitable hydrogeologic conditions for groundwater storage projects (through the successful implementation of groundwater banking at the Sycamore Spreading Works and North Canal Spreading Works), and (3) bi-annual groundwater level readings taken in wells and groundwater elevation and depth maps indicate abundant remaining storage capacity in the aquifer. Furthermore, similar in-lieu recharge programs have had success in other areas of Kern County and San Joaquin Valley.

Available wet period surface water supplies available to AEWSD that exceed demands in their Surface Water Service Area would be delivered via improved and new facilities to landowners in the Groundwater Service Area that have historically relied mostly or entirely on pumping their own wells to meet their irrigation needs. That replacement of groundwater pumping with surface water recharges groundwater reserves “in-lieu”. AEWSD’s Power and Water Resources Pooling Authority (PWRPA) power, provided to landowner wells, is less expensive than PG&E power (which they currently use). The difference provides an incentive for Project participation. And, projected transfer of wells to the District provides a revenue source to the District to help repay project costs.

The in-lieu projects will include construction of pipeline networks to and from the District’s canal system. These projects will: (1) provide increased delivery of surface water to landowners who normally pump groundwater and (2) plumb landowner wells to the District for increased extraction capability during years of water supply deficit. Project components will include well flowrate and power data collection and baseline analysis, engineering, design, environmental documentation, agreements and plan updates. During wet years, supplemental surface water (that would otherwise be lost to non-beneficial use) will be provided for the growers to irrigate with, subsequently reducing the grower’s groundwater pumping, thus recharging groundwater and banking some of that for recovery with the landowner wells in dry periods. The landowners’ existing wells and any associated booster pumps will be integrated into the District’s irrigation distribution system by serving them with District power and constructing water metering and pipeline return systems.

North Canal Pump Back Project reverse flow pumps will be needed to distribute increased drought year flows from in-lieu projects to growers. These pumps are needed to move well water in the District’s canal system towards the northern end of the District when surface water entering the canal system and well water from wells in the north end of the District are insufficient to meet grower demands.

The following documents provided the technical basis for the benefits claimed and are referenced in the subsequent sections:

Author/Source, Year	Document Name	Appendix
AEWSD Staff, 2014	WELLFIELD PUMPING WATER LEVELS – 2007, 2008, 2009, 2013, 2014	**Appendix 3.6-A**
AEWSD Staff, 2014	Landowner Well Hydrographs	**Appendix 3.6-B**
Provost & Pritchard, 2014	In-Lieu Program Project Benefits Calculations	**Appendix 3.6-C**
University of California Division of Agriculture and Natural Resources, 1989	Irrigation Scheduling: A Guide for Efficient On-Farm Water Management	**Appendix 3.6-D**
Provost & Pritchard, 2014	North In-Lieu Project ETc & Effective Rainfall	**Appendix 3.6-E**
Provost & Pritchard, 2014	Sycamore In-Lieu Project ETc & Effective Rainfall	**Appendix 3.6-F**
AEWSD Staff, 2014	Actual Energy Rate KWh/AF by WY	**Appendix 3.6-G**
USEPA, 2010	Year 2010 eGrid Subregion Emissions – GHG	**Appendix 3.4-J**
Provost & Pritchard, 2014	In-Lieu Program 20% Design Sheet Set	**Appendix 3.6-H**
South Valley Water Banking Authority, 2013	Pixley Groundwater Bank Info	**Appendix 3.6-I**
Semitropic WSD, 2013	Semitropic WSD Rate Structure for Customers	**Appendix 3.6-J**
Provost & Pritchard, 2014	In-Lieu Program Alternative Cost Analysis	**Appendix 3.6-K**
Provost & Pritchard, 2014	In-Lieu Program Engineer's Opinion of Probable Program Cost	**Appendix 3.6-L**

Recent and Historical Conditions

The prolonged drought has had profound effects on the growers in the AEWSD. Surface water deliveries have been severely cut and growers, who are able to, have had to rely on groundwater to meet their demands. As a result, groundwater levels in the area have dropped. Pumping water levels in the District's well fields has declined dramatically in recent years, as can be seen in **Appendix 3.6-A**. Surface water supply shortages and reduced flows in District wells (resulting from deeper groundwater levels) have combined to cause the current 6 month water supply prorate to growers in the Surface Water Service Area.

Dropping groundwater levels also create problems for growers within the District that are not currently able to receive surface water supplies due to the District's distribution system configuration. Hydrographs of water levels in landowner wells can be seen in **Appendix 3.6-B**.

Dropping groundwater levels at a minimum increase the cost of pumping irrigation water, but can also require expensive modifications to wells and potentially developing new, deeper wells to meet demands.

Historically, AEWSD arrested dropping groundwater levels and stabilized them on a long-term basis through constructing and operating the District's original project, beginning in the late 1960's with importation of Friant-Kern Canal water. The District's history of successful conjunctive use, groundwater banking, and water management programs has included participating in Cross Valley Canal exchange agreements since the mid 1970's to aid in regulating the District's erratic Friant-Kern supply, and expanded water banking and water management programs since 1997 to increase water regulation capabilities as well as manage water costs. In particular AEWSD has operated a successful water management program with Metropolitan Water District of Southern California (MWD) for over 17 years. The loss of supplies to restore the San Joaquin River, reductions in State Water Project supplies to Kern County, basin-wide overdraft, increasing statewide competition for water, and climate change combine to threaten the long-term stability of AEWSD's groundwater levels.

Estimates of Without-project Conditions

Without the project, wet period water will continue to be lost to beneficial use when it floods lands in the Central Valley or flows to the ocean. Furthermore, AEWSD's water supplies will need to be prorated in critically dry years, landowner wells will continue to suffer drought period declines and supply shortages, and basin-wide overdraft and localized water quality problems will continue to get worse. Furthermore, energy use and greenhouse gas emissions associated with their generation will continue. Drought year negative impacts to farms from crop yield and crop quality losses and to farm-related businesses and their employees will continue.

Description of Methods used to Estimate Physical Benefits

The District retained Provost & Pritchard Consulting Group (Provost &Pritchard) to estimate the In-lieu Program's physical benefits. Calculations are included in **Appendix 3.6-C.**

Physical Benefit 1 (Primary) – Water Conserved: The amount of water conserved by the proposed In-lieu Program is estimated to total 1,006 AF/yr.

Calculations for the In-lieu Program factor previous capacity for in-lieu deliveries to the grower farming lands in the Sycamore In-lieu Project area. Temporary Contract (In-lieu) water deliveries to the landowner in the In-lieu Project area during the 2011 water year (see table below) can be viewed as "baseline" for pre-project potential in-lieu recharge capacity, as Temporary water was available in the 2011 water year.

MONTHLY SUMMARY OF 2011 IN-LIEU SPREADING - AF													
TURNOUT	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	TOTAL
SC-A1	8	62	85	127	82	95	88	13	10	0	0	16	586

The "baseline" pre-project maximum capacity of Turnout SC-A1 can be computed to be 8.4 cubic-feet per second (cfs) from its June 2011 deliveries (127 acre-feet/ 30 days * 86,400 sec/day/ 43,560 cubic feet/acre-foot), as the landowner reported that District water deliveries were limited by its capacity during that month.

Water pumped by in-lieu project landowners from the Program's thirteen existing wells to irrigate their lands are not currently measured. Therefore, Provost & Pritchard estimated their pumping amounts for four Friant water year types using climatic data and methods consistent with those employed by J.M. Lord, Inc., the District's consulting agronomist (who annually estimate reasonable crop water requirements for AEWSD). The water year types are based on San Joaquin River Restoration Program designations for recent water years (2004 as example "Normal Dry" and "Critical", 2006 as example "Wet", 2007 as example "Dry", and 2010 as example "Normal Wet"). Crop demands (**ETc**) were estimated using methods published by University of California Division of Agriculture and Natural Resources, provided as **Appendix 3.6-D**. Estimated ETc and required applied irrigation for the North In-lieu Project and Sycamore In-lieu Project areas are presented in **Appendices 3.6-E** and **3.6-F**, respectively.

Provost & Pritchard then reviewed an April 2014 analysis of Friant flood water availability to AEWSD performed by the San Joaquin River Restoration Program (SJRRP), (built with 80 years of hydrologic records and expert knowledge of the system's operations and use of the CalSim operations model). For its benefits analysis, Provost & Pritchard extracted floodwater availability data from a fifty year period of records from that analysis where average floodwater availability was equal to the average from eighty years from the SJRRP study.

It should be noted that AEWSD sometimes has its own Class 2 water to regulate, and many other types of floodwater available besides Friant (including Westside CVP Section 215, water pumped into the Friant-Kern Canal from other rivers, Kern River, and State Water Project Article 21 water). So, the water availability described above is considered to be conservative.

Provost & Pritchard deducted the volume represented by 8.4 cfs of pre-project capacity from In-lieu Program water demands to be met by the in-lieu project facilities during the analysis period to estimate the incremental volume recharged each year. Thus the incremental volume of increased recharge during each year was estimated as conserved water.

As it currently does, when floodwater supplies exceed then-current demands in the in-lieu service areas, AEWSD would regulate this water through its Water Management Program with Metropolitan Water District of Southern California and its storage facilities within the calendar year.

Physical Benefit 2 (Primary) – Drought Relief Water Supply Produced: Projects Benefits calculations made by Provost & Pritchard assume recovery of a volume of water equal to 0.2 acre-feet per acre in the Surface Water Service Area would be withdrawn in Critical Friant water year types for drought protection to eliminate the six-month prorate. That water would be withdrawn from the much larger volume of water banked underground during wet periods. Again, this drought relief water supply comes from the Water Conserved, and a remainder of the Water Conserved would remain in underground storage at the end of the 50 year project life.

Physical Benefit 3 (Secondary) – Energy Saved: Energy saved in kWh each year for the fifty year analysis period were calculated with a first step using annual Program volumes delivered to in-lieu project growers for recharge in AF/yr multiplied by average differences in KWh/AF for pumping groundwater in the in-lieu project areas and AEWSD's average energy use for pumping surface water through the Forrest Frick Pumping Plant. In addition to this, energy savings from higher groundwater levels resulting from groundwater stored in the aquifer in the area of influence of the in-lieu projects was estimated. Based upon operations and groundwater models of AEWSD's existing water banking facilities (including the North Canal Spreading Works and Sycamore Spreading Works), the area of influence for each of the in-lieu service areas was estimated to be approximately 3 miles wider than the areas served with in-lieu water. Furthermore, specific capacity of the aquifer was assumed to be 0.12, based upon Provost & Pritchard's prior analysis of well drillers logs. And, annual increased

groundwater levels in the area of influence were estimated based upon the average volume of Program water remaining in storage during the year divided by the area of influence and multiplied by 0.12. Furthermore, volumes of groundwater pumped from the area of influence were assumed to equal the sum of post Program well pumping in the in-lieu service areas, plus average District well pumping from District well fields in the area (which would continue), plus 2.8 acre-feet per acre per year from remaining areas served by groundwater only. The 2.8 acre-feet per acre per year number assumes that average groundwater use in areas of AEWSD that rely only on groundwater is equal to average water deliveries in the area served by surface water.

Physical Benefit 4 (Secondary) – Greenhouse Gases (GHG) Avoided: Provost & Pritchard's calculations assume that all of the Energy saved by the project results in a proportional reduction in greenhouse gasses based upon a factor of 0.423 Metric Tons of CO2 per kWh from EPA, 2010 (**Appendix 3.4-J**).

Facilities, Policies, and Action Required to Obtain the Physical Benefits

In-lieu Program facilities, including the Sycamore In-lieu Project, North In-lieu Project, and North Canal Pump Back Project would need to be constructed, operated, and maintained to achieve the above-described benefits. The 20% design In-Lieu Program plan set is included as **Appendix 3.6-H**. Agreements with landowners for joint use of wells and PWRPA power supply will be needed, as well as provision of right of way for in-lieu project facilities. PWRPA power supply agreements will be needed under the existing PG&E Wholesale Distribution Tariff to supply power to landowner wells and their associated booster pumps. Agreements done by other water agencies that have done similar in-lieu programs and groundwater integration programs are being studied by AEWSD staff and their engineering and legal consultants for possible adaption to AEWSD.

Potential Adverse Physical Effects

Potential adverse physical effects of the In-lieu Program will be reviewed as part of California Environmental Quality Act compliance, and are expected to be limited to localized construction-related effects in farmed areas. Mitigation measures, if needed, are expected to be implemented as part of the Program.

3.6.3 Cost Effective Analysis

Table 6 - Cost Effective Analysis Project Name: AEWSD In-lieu Program	
Question 1	Types of benefits provided:
	Water Conserved - The estimated amount of water conserved by the project averages 1,006 acre-feet per year. Most of this (less drought relief water discussed below) would remain in groundwater storage at the end of the analysis and represents an asset for groundwater overdraft correction.
	Drought Relief Water – The estimated amount of drought relief water is approximately 10,000 acre-feet per year in critical drought years.

	Energy Saved – the estimated energy savings 1,330 MWh per year will save the District and its landowners energy costs for pumping water.
	Crop Benefit – The reduction in impacts to crops in the District resulting from drought-related water shortage and water supply prorates will increase farm income and reduce job losses in farm-related businesses. The yield and crop quality improvements cannot be quantified or monetized due to the number of different crops involved and the complexity of analysis that would be required.
	Water Quality Benefit – Non-quantified or monetized water quality improvements in the area of influence of the In-lieu Program facilities are expected (includes City of Arvin wells).
	Reduce emission of greenhouse gases – The estimated reduction of CO2 emissions by 563 Metric Ton (MT) annually from reduced groundwater pumping is a non-monetized benefit.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? **Yes**
	If no why? **N/A**
	If yes, list the methods (including the proposed project) and estimated costs: **A comparison was made between the costs of participation in other groundwater banking projects (Pixley Groundwater Bank and Semitropic Water Storage District Stored Water Recovery Project, Appendices 3.6-I and 3.6-J, respectively) based on their published rate structures and the costs of banking water in AEWSD's In-lieu Program (see Appendix 3.6-K). Capital costs of AEWSD's In-lieu Program are based upon Appendix 3.6-L, Engineer's Opinion of Probable Program Costs for the three projects that comprise the In-lieu Program. It was concluded that AEWSD's In-lieu Program would be more cost effective.**
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods.
	The proposed project is the most cost effective, as can be seen in Appendix 3.6-K. Furthermore, local monetized and non-monetized benefits in AEWSD would result that would not result from the alternatives considered.
Comments:	

3.7 BCWD Water Main Replacement and Meter Installation Project

3.7.1 Project Physical Benefits

The BCWD project will result in the following physical benefits:

- **Physical Benefit 1 (Primary) – Water Conserved**: Installing new water mains will save approximately 0.7 percent of current water usage or approximately 923 thousand gallons (2.8 AF) per year. This project will minimize the possibility of contamination of the existing water supply when water main breaks occur, and with new valves, smaller isolation areas can be utilized when needed for repairs. Installing water meters will save approximately 15 percent of current water usage or approximately 20 million gallons (61.7 AF) per year. This is accomplished by incentivizing water conservation through the implementation of graduated water rates based on actual customer water use. By notifying customers of their water use, meter installation becomes a way to educate residents about conservation, thereby reducing non-essential water use. The proposed project, if fully implemented, is estimated to save 15.7 percent of current water usage or approximately 21 million gallons (64 AF) per year (first 20 years).
- **Physical Benefit 2 (Primary) – Energy Saved**: The primary energy benefit will be through the reduced electricity use for pumping approximately 64 acre-feet of water annually from the underlying aquifer for the first 20 years. This secondary energy benefit is estimated to save 37.5 MWh annually for the first 20 years. The 50 year annual average energy savings for the project is 16 MWh per year. A second energy benefit is associated with a reduced volume of wastewater that would be treated at Buttonwillow's wastewater treatment plant; however this quantity has not been quantified.
- **Physical Benefit 3 (Secondary) – Greenhouse Gases (GHG) Avoided**: Reduced electricity use associated with groundwater pumping will result in avoided GHG (CO2) emissions that are generated by energy production. The GHG that are avoided as a result of energy savings is estimated to be 15.8 MT CO2 per year (first 20 years). The 50 year annual average GHG emission avoidance for the project is 7 MT CO2 per year.
- **Physical Benefit 4 (Secondary) – Water Quality Improvement (non-quantifiable)**: The installation of the new water mains and the conservation resulting from a metered system will reduce the risk of low-pressure situations where bacteriological or other contaminates enter the water system. Also, as the groundwater pumping from the aquifer is reduced, the potential for increased arsenic concentrations and a lowering of salinity concentrations should be reduced.
- **Physical Benefit 5 (Secondary) – Increased Fire Flow Protection (non-quantifiable)**: An additional benefit for the water system is the added fire flowrates that will result in larger, newer pipelines in some locations of the District. In particular, the commercial buildings along Highway 58 will have fire flows in excess of the 1,500 gpm flow rate required by the County of Kern. Currently the flowrates in this area are between 860 gpm (near Buttonwillow School) to 1,100 gpm. Additionally, fire hydrants are not spaced in accordance with the Fire Department standards resulting in reduced fire protection.

Table 3.7-1: BCWD Annual Project Physical Benefit 1 - Water Conserved

Table 5a - Annual Project Physical Benefits

Project Name: BCWD Water Main Replacement and Meter Installation Project

Type of Benefit Claimed: Water Conserved

Units of the Benefit Claimed: Acre-Feet

Additional Information About this Benefit: 0.7% (2.8 AF/year) estimated water conservation from installing new water mains and 15% (61.7 AF/year) estimated savings from meters.

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	411.0	411.0	0.0
2015	411.0	411.0	0.0
2016	411.0	346.5	64.5
2017	411.0	346.5	64.5
2018	411.0	346.5	64.5
2019	411.0	346.5	64.5
2020	411.0	346.5	64.5
2021	411.0	346.5	64.5
2022	411.0	346.5	64.5
2023	411.0	346.5	64.5
2024	411.0	346.5	64.5
2025	411.0	346.5	64.5
2026	411.0	346.5	64.5
2027	411.0	346.5	64.5
2028	411.0	346.5	64.5
2029	411.0	346.5	64.5
2030	411.0	346.5	64.5
2031	411.0	346.5	64.5
2032	411.0	346.5	64.5
2033	411.0	346.5	64.5
2034	411.0	346.5	64.5
2035	411.0	346.5	64.5
2036	411.0	408.2	2.8
2037	411.0	408.2	2.8
2038	411.0	408.2	2.8
2039	411.0	408.2	2.8
2040	411.0	408.2	2.8
2041	411.0	408.2	2.8
2042	411.0	408.2	2.8
2043	411.0	408.2	2.8
2044	411.0	408.2	2.8
2045	411.0	408.2	2.8
2046	411.0	408.2	2.8
2047	411.0	408.2	2.8
2048	411.0	408.2	2.8
2049	411.0	408.2	2.8
2050	411.0	408.2	2.8
2051	411.0	408.2	2.8
2052	411.0	408.2	2.8
2053	411.0	408.2	2.8
2054	411.0	408.2	2.8
2055	411.0	408.2	2.8
2056	411.0	408.2	2.8
2057	411.0	408.2	2.8
2058	411.0	408.2	2.8
2059	411.0	408.2	2.8
2060	411.0	408.2	2.8
2061	411.0	408.2	2.8
2062	411.0	408.2	2.8
2063	411.0	408.2	2.8
2064	411.0	408.2	2.8
2065	411.0	408.2	2.8
Totals	20,550	19,176	1,374
Average	411	384	27

Comments: Construction is complete by 2016 therefore no water savings shown in 2014-15. Calculations based on 50 year project life. New water pipes have an estimated 50 years service life. Meters have an estimated 20 years service life.

Table 3.7-2: BCWD Annual Project Physical Benefit 2 - Energy Saved

Table 5b - Annual Project Physical Benefits

Project Name: BCWD Water Main Replacement and Meter Installation Project

Type of Benefit Claimed: Energy Saved

Units of the Benefit Claimed: Megawatt-hours (MWh)

Additional Information About this Benefit: 15.5% estimated savings (15%-meters and 0.5% from new water mains)

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	238.6	238.6	0.0
2015	238.6	238.6	0.0
2016	238.6	201.1	37.5
2017	238.6	201.1	37.5
2018	238.6	201.1	37.5
2019	238.6	201.1	37.5
2020	238.6	201.1	37.5
2021	238.6	201.1	37.5
2022	238.6	201.1	37.5
2023	238.6	201.1	37.5
2024	238.6	201.1	37.5
2025	238.6	201.1	37.5
2026	238.6	201.1	37.5
2027	238.6	201.1	37.5
2028	238.6	201.1	37.5
2029	238.6	201.1	37.5
2030	238.6	201.1	37.5
2031	238.6	201.1	37.5
2032	238.6	201.1	37.5
2033	238.6	201.1	37.5
2034	238.6	201.1	37.5
2035	238.6	201.1	37.5
2036	238.6	236.9	1.6
2037	238.6	236.9	1.6
2038	238.6	236.9	1.6
2039	238.6	236.9	1.6
2040	238.6	236.9	1.6
2041	238.6	236.9	1.6
2042	238.6	236.9	1.6
2043	238.6	236.9	1.6
2044	238.6	236.9	1.6
2045	238.6	236.9	1.6
2046	238.6	236.9	1.6
2047	238.6	236.9	1.6
2048	238.6	236.9	1.6
2049	238.6	236.9	1.6
2050	238.6	236.9	1.6
2051	238.6	236.9	1.6
2052	238.6	236.9	1.6
2053	238.6	236.9	1.6
2054	238.6	236.9	1.6
2055	238.6	236.9	1.6
2056	238.6	236.9	1.6
2057	238.6	236.9	1.6
2058	238.6	236.9	1.6
2059	238.6	236.9	1.6
2060	238.6	236.9	1.6
2061	238.6	236.9	1.6
2062	238.6	236.9	1.6
2063	238.6	236.9	1.6
2064	238.6	236.9	1.6
2065	238.6	236.9	1.6
Totals	11,928	11,130	798
Average	239	223	16

Comments: Construction is complete by 2016 therefore no energy reduction shown in 2014-15. Calculations based on 20 year project life for meters and 50 year project life for pipes. After 2035 only pipe savings are showing.

Table 3.7-3: BCWD Annual Project Physical Benefit 3 - GHG Avoided

Table 5c - Annual Project Physical Benefits			
Project Name: BCWD Water Main Replacement and Meter Installation Project			
Type of Benefit Claimed: GHG Avoided			
Units of the Benefit Claimed: Metric Ton (MT) CO2			
Additional Information About this Benefit: 0.4231 MT/MWh			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) - (c)
2014	100.9	100.9	0.0
2015	100.9	100.9	0.0
2016	100.9	85.1	15.8
2017	100.9	85.1	15.8
2018	100.9	85.1	15.8
2019	100.9	85.1	15.8
2020	100.9	85.1	15.8
2021	100.9	85.1	15.8
2022	100.9	85.1	15.8
2023	100.9	85.1	15.8
2024	100.9	85.1	15.8
2025	100.9	85.1	15.8
2026	100.9	85.1	15.8
2027	100.9	85.1	15.8
2028	100.9	85.1	15.8
2029	100.9	85.1	15.8
2030	100.9	85.1	15.8
2031	100.9	85.1	15.8
2032	100.9	85.1	15.8
2033	100.9	85.1	15.8
2034	100.9	85.1	15.8
2035	100.9	85.1	15.8
2036	100.9	100.3	0.7
2037	100.9	100.3	0.7
2038	100.9	100.3	0.7
2039	100.9	100.3	0.7
2040	100.9	100.3	0.7
2041	100.9	100.3	0.7
2042	100.9	100.3	0.7
2043	100.9	100.3	0.7
2044	100.9	100.3	0.7
2045	100.9	100.3	0.7
2046	100.9	100.3	0.7
2047	100.9	100.3	0.7
2048	100.9	100.3	0.7
2049	100.9	100.3	0.7
2050	100.9	100.3	0.7
2051	100.9	100.3	0.7
2052	100.9	100.3	0.7
2053	100.9	100.3	0.7
2054	100.9	100.3	0.7
2055	100.9	100.3	0.7
2056	100.9	100.3	0.7
2057	100.9	100.3	0.7
2058	100.9	100.3	0.7
2059	100.9	100.3	0.7
2060	100.9	100.3	0.7
2061	100.9	100.3	0.7
2062	100.9	100.3	0.7
2063	100.9	100.3	0.7
2064	100.9	100.3	0.7
2065	100.9	100.3	0.7
Totals	5,047	4,709	338
Average	101	94	7

Comments: Construction is complete by 2016 therefore no GHG avoidance shown in 2014-2015. Calculations based on 50 year project life. After 2035 only pipe savings are showing.

3.7.2 Technical Analysis of Physical Benefits Claimed

Technical Basis of Project

BCWD provides water to a low-income, predominately farmworker, disadvantaged community of about 1,500 people through its current distribution lines that are over 60 years old. The District is continually experiencing mainline breaks (3+ per year for 2.5 miles of pipe) and service leaks throughout the community due to the age of the lines. System isolation valves typically do not function, making system isolation difficult when repairing pipeline breaks. The District has experienced several breaks in the last two years that have resulted in the loss of tens of thousands of gallons of water (approximate estimate from District staff). The installation of new isolation valves will allow smaller areas to be shut off when a repair is necessary, limiting the number of customers affected by the disruption of service. Operating valves and new water mains will minimize losses and improve local water supply reliability and also delivery of safe drinking water.

The proposed project would include the installation of approximately 450 water meters for the entire District. The District would shift from its current flat rate charge to a volumetric charge based on water usage. In times of shortage, a metered system also provides the opportunity to issue fines for excessive use by individual users (if necessary). It is proposed that an automatic meter reading (AMR) system be installed to decrease staff time for reading meters. AMR units offer the following benefits:

- AMR units result in additional water conservation by obtaining notifications when the meter registers a potential leak during low flow time periods. These notifications can be included in the customer's bill, informing them of a potential leak that they need to repair.
- Improve District's water management and not significantly impact the labor expenses of the District.
- Increase and improve customer service by allowing the District to more easily move to a monthly billing cycle. Bill disputes can be quickly resolved by showing a customer hourly data, thereby providing an understanding of when excessive water is used.
- Improve security and tamper detection for illegal use of water.
- In cases of water shortages, District will be able to manage and conserve water supply through enforceable restrictions.
- The District will be able to use this additional data and information for a variety of purposes such as planning, customer service, conservation, and rate development.
- Customer meters accurately identify water loss within the distribution system by making total usage data available on an hourly basis, which can be compared to flow meters at the wells in a water audit.

The following documents provide the technical basis for the benefits claimed and are referenced in the subsequent sections:

Author/Source, Year	Document Name	Appendix
Dee Jaspar & Associates, 1998	1998 Water System Improvement Study	**Appendix 3.7-A**
Provost & Pritchard, 2014	Unavoidable Background Leakage Calculation	**Appendix 3.7-B**
California Department of Water Resources	California Single Family Water Use Efficiency Study	**Appendix 3.7-C**
California Energy Commission	US EPA eGrid Data	**Appendix 3.4-J**
Provost & Pritchard, 2014	BCWD Water Main Replacement and Meter Installation Opinion of Probable Cost	**Appendix 3.7-D**

Recent and Historical Conditions

Since the District has no ability to accurately track actual water consumption by customers, there is no volumetric pricing and therefore no incentive for customers to conserve water. This leads to excessive water use and increased water well pumping. Over the past two years, approximately 410 AF of water is used by the District. With the current 444 services, each water service uses 0.92 AF/year (250 gallons per capita per day, gpcd).

Table 3.7-4 provides the status of the BCWD wells including energy use from 2013. Without Well #3 (a standby well), the well production of the two main wells dropped from 1450 gpm to 1050 gpm. This drop is mostly attributed to the declining groundwater levels and, to a lesser extent, pump wear. The District has not kept track of groundwater levels on an ongoing basis but based on a reading from 2007 the groundwater table has declined 75 feet. By way of comparison, a hydrograph of a nearby BVWSD well is shown in **Figure 3.7-1**. Based on a 1998 study of the BCWD water system, the Maximum Day Demand (MDD) of the system is 1,065 gpm (see **Appendix 3.7-A**). No houses have been built in the District in the last 15 years, so this demand has held constant. The capacity of the two main wells is slightly under this MDD; this will necessitate the use of the standby well this summer (which could fail at anytime). Furthermore, CDPH requires that water systems have the ability to meet MDD with the highest capacity well out of service for systems that rely solely upon groundwater (Section 64554(c) of the California Waterworks Standards). If Well 2 were to go out of service (a potential concern as the well is over 40 years old), significant water shortages would ensue.

An additional concern is water quality. Based on available data, Well #4 exceeded the arsenic MCL from 2001 to 2004. Since that time Arsenic levels have reduced, but with the current drought, the affect of lower water tables could mean a rise in arsenic levels as discussed in Attachment 2. More recently, Well #4 had an increase in TDS with a sample of 1,200 mg/L in December 2013. The secondary MCL for TDS is set at 500 mg/L.

Table 3.7-4: BCWD Water Supply Status

Well	Year Constructed	Flowrate Prior to Drought (gpm)	Current Flowrate (gpm)*	Groundwater Level Decline from 2007 to 2014 (feet)	FY2013-14 Energy Use (kWh)	Status
2	1972	800	550	75	71,000	Produces sand that has to be removed from the tank, added expense to operate
3	1964	800	385	75	1,200	Standby Well - potential casing failure, expensive to operate, beyond service life
4	1991	650	500	Could not measure	166,000	Past readings of high arsenic, currently high TDS of 1,200 mg/L (SMCL = 500 mg/L)

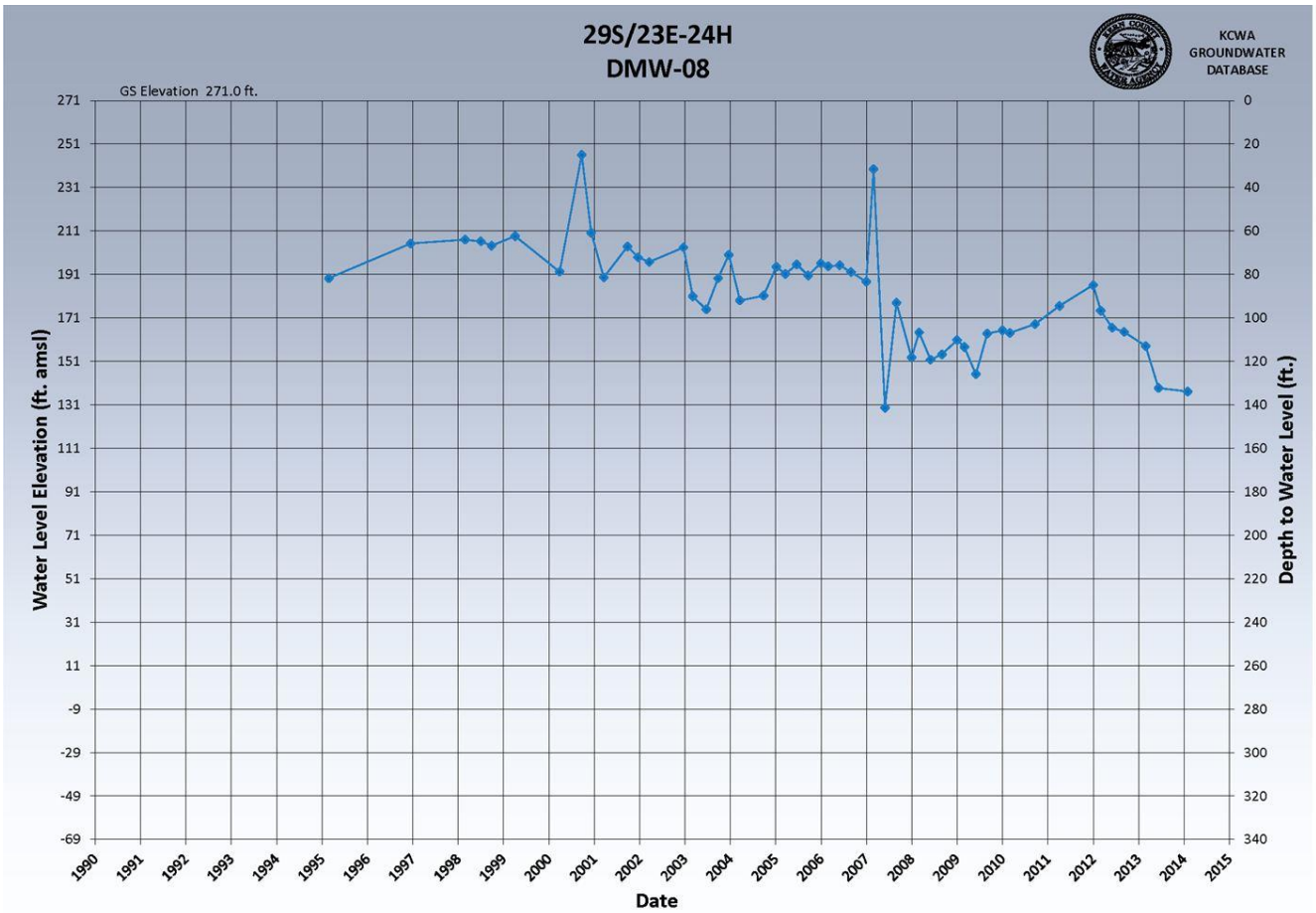

Figure 3.7-1: BVWSD Well ½ Mile East of BCWD Service Area

Estimates of Without-project Conditions

Without project conditions are assumed to be similar to historical conditions but with decreasing water supply and system reliability. Although factors such as groundwater table decline, additional dry/drought years, arsenic and TDS concentrations, and deficiencies in the distribution system affect future water supply and delivery, accurate prediction of these factors is not feasible. However, it is expected that the contract operator will have to perform more repairs on the water system as the facilities continue to age. If groundwater levels continue to decline affecting well capacity or if one of the District's wells were to become inoperable, water shortages would require mandatory restrictions (mostly unenforceable without meters and contract staff). Contamination of the water system is of continuing concern as well.

According to the 1998 Water System Improvement Study by Dee Jaspar & Associates, the current commercial fire flow capability is substandard, and the current system cannot deliver a Kern County mandated fire flow of 1,500 gpm to certain commercial properties and schools (**Appendix 3.5-A**).

No significant increase to District's population is expected over the project life. No new housing developments (or even individual homes) are planned for the community. Based on information from the District, the last houses built in the community were from 15 years ago.

Description of Methods used to Estimate Physical Benefits

Provost & Pritchard Consulting Group prepared the analyses regarding the physical benefits of the Project in the subsequent sections.

In regards to the life of the project, the replacement of the water main infrastructure is expected to have a 50 year life in accordance with industry standards. The life of the water meters is estimated to be 20 years based on water meter manufacturer information. The expectation is that water meters will be replaced as needed, continuing beyond the 20 years; however the benefits of this portion of the project are stopped after this time period for purposes of this analysis.

<u>Physical Benefit 1 (Primary) – Water Conserved:</u>
Currently there are no customer-side meters installed to monitor water distribution and water leakage in the distribution system. The estimated water loss due to leakage was calculated using standards in the 2009 American Water Works Association (AWWA) Manual of Practice M36. It is estimated the District is losing approximately 923 thousand gallons or 2.8 AF/year from leaks throughout the distribution system (see **Appendix 3.7-B** for calculation). This estimated loss is conservative as DWR's website (http://goo.gl/XlKmbG) reports that an average loss of 10% of the total water supply is typical for a water distribution system based on a water audit and leak detection program of 47 California water utilities. The estimated water usage for the water main replacement area is 248 AF/year (268 area connections / 444 total connections x 411 AF = 248 AF/year). Based on this estimated water usage for the water main replacement area in BCWD, water losses could be in the order of 25 AF/year. However, AWWA M36 is the industry standard for estimating losses, and without actual consumer-side metered data, estimated water losses due to the water distribution system cannot be accurately determined.

In regards to water conserved by implementing a metered water system, a conservative 15% reduction in water usage was utilized. According to the *California Single Family Water Use Efficiency Study*, sponsored by the DWR, municipalities have experienced upwards of a 15% reduction in water usage with the installation of water meters, the initiation of volumetric meter pricing and the ability to detect

leakage in real time (**Appendix 3.7-C**). The water conservation from implementing a metered system is 61.7 AF/year.

The project is expected to result in 15.7% water savings. Therefore, the amount of water conserved by the proposed Water Main Replacement and Water Meter Installation Project is estimated to total 64 AF/yr for the first 20 years. For the 50 year project life, the total water conserved is 1,374 AF.

With increased water conservation, the MDD of the district is reduced, resulting in less well pumping. This reduction benefits the District by allowing them to better manage well pumping (reducing energy costs with off-peak pumping). If a main well were to go offline, the District could maintain service without extreme restrictions on water use.

Physical Benefit 2 (Primary) – Energy Saved:

Based on a simplified analysis, the estimated electrical usage savings assumed to be proportional to the estimated water savings. The current annual electrical usage to pump groundwater from the District's wells is 239 MWh/year for Wells 2, 3, and 4. Using a 15.7% reduction on energy use, the estimated annual energy savings is 37.5 MWh/year for the first 20 years of the project. The total energy saved over the 50 year project life is 798 MWh.

Physical Benefit 3 (Secondary) – Greenhouse Gases (GHG) Avoided:

Using the estimated energy saved the project results in a proportional reduction in GHG based upon a factor of 0.423 MT CO2/MWh. This factor is from a 2010 Environmental Protection Agency study of greenhouse gasses associated with energy generation in California (eGRID GHG Annual Output Emission Rates table is included as **Appendix 3.4-J**). Using this factor, the energy reduction results in a GHG avoidance of 338 MT CO2 over the life of the project.

Facilities, Policies, and Action Required to Obtain the Physical Benefits

After meters are installed, estimates of water usage can be established, which will be utilized in developing a rate structure based on volumetric use (this step is important as a baseline must be developed for a rate study). The rate study would be prepared in order to determine a base rate and volumetric rates that are equitable and fair for customers. Outreach to the community will be conducted to notify them of the proposed rate structure and the potential monetary effects on their bills at their current measured usage. After these steps are completed a majority protest hearing will be conducted in accordance with Proposition 218 to implement the new rate structure.

Potential Adverse Physical Effects

Customers that have an excessive water use will be charged a higher amount than their existing flat rate (conversely customers that use less than average may have a reduced rate). If the higher water use customer cannot financially afford the additional bill amount, they will have to find ways to conserve water…most likely reduced irrigation of outdoor landscaping (a non-essential water use).

3.7.3 Cost Effective Analysis

Table 3.7.4 - Cost Effective Analysis Project Name: Buttonwillow County Water District Water Main Replacement and Meter Installation Project	
Question 1	Types of benefits provided:
	Water Conservation – The estimated water savings by reducing water leakage (2.8 AF/year) and conservation through metered water rates (61.7 AF/year) for a total estimated groundwater pumping reduction of 1,374 AF over the life of the project.
	Energy Saved – The savings from water conservation will reduce the amount of electricity used to pump water from the underlying aquifer by an estimated 798 MWh over the life of the project (approximately $10,000/year over the first 20 years).
	GHG Avoided – By reducing energy use, an estimated 338 MT CO2 will be avoided over the life of the project.
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? **Yes**
	If no why? **N/A**
	If yes, list the methods (including the proposed project) and estimated costs: **As the Project has two components, two alternatives were investigated:** **Water Main Replacement:** **1. Proposed Project – The recommendation is to install AWWA C900 Poly Vinyl Chloride (PVC) pipe for the water mains. The cost associated with the pipelines is $620,000.** **2. Alternative Project – Ductile Iron Pipe (DIP) is an alternative pipeline material for water mains. By utilizing DIP there is an additional 30-50% cost increase (an increase of approximately $200,000). DIP is a more robust material, but potential corrosion and difficulty to work with in the field make it an unsuitable alternative. PVC has a proven history of reliable service at lower cost for smaller water main sizes.** **Water Meter Installation:** **1. Proposed Project - AMR Meters – The total cost is $820,000 for purchasing and installing water meters throughout the District service area. This also includes the purchase of remote read equipment for the operator to drive through the District collecting meter readings.** **2. Alternative Project - Direct Read Meters – The cost for a direct read meter system is approximately $740,000. The incremental cost difference between the AMR meters and the manual read units is approximately $80,000 ($150/meter + $14,000 for equipment).**
Question 3	If the proposed project is not the least cost alternative, why is it the preferred alternative? Provide an explanation of any accomplishments of the proposed project that are different from the alternative project or methods. **For the Water Main Replacement component, the Proposed Project is the least**

	cost alternative. **For the Water Meter Installation component, the Proposed Project is slightly higher in initial procurement cost than the Direct Read Meter system. However, the annual cost for the operator to read the meters on a monthly schedule (walking to each meter), enter the data into the billing software, and additional administration time is a significant cost; the additional annual cost for a manual read system is estimated to be $3,000/year.** **With the AMR system additional water conservation is accomplished as described in the Technical Basis of Project section above.**