ATTACHMENT 2
Project Justification

ATTACHMENT 2 CONTENTS

2 Attachment 2 - Project Justification 2-3

2.1 Project Summary Table 2-3

2.2 Project Descriptions 2-4

2.3 Regional and Project Maps 2-7

2.4 BVWSD The Palms Groundwater Recharge and Recovery Project 2-12

2.4.1 Project Physical Benefits 2-12
2.4.2 Technical Analysis of Physical Benefits Claimed 2-17
2.4.1 Direct Water-Related Benefit to a DAC 2-26
2.4.2 Project Performance Monitoring Plan 2-27
2.4.3 Cost Effective Analysis 2-28

2.5 GHCSD Antelope Conjunctive Use Project (Steuber Phase) 2-30

2.5.1 Project Physical Benefits 2-30
2.5.2 Technical Analysis of Physical Benefits Claimed 2-32
2.5.3 Direct Water-Related Benefit to a DAC 2-40
2.5.4 Project Performance Monitoring Plan 2-41
2.5.5 Cost Effective Analysis 2-42

2.6 Lake of the Woods Water Main Replacement & Meter Installation Project 2-44

2.6.1 Project Physical Benefits 2-44
2.6.2 Technical Analysis of Physical Benefits Claimed 2-46
2.6.3 Direct Water-Related Benefit to a DAC 2-54
2.6.4 Project Performance Monitoring Plan 2-55
2.6.5 Cost Effective Analysis 2-56

LIST OF FIGURES

Figure 2.3-1: Kern IRWM Regional Map 2-8
Figure 2.3-2: BVWSD The Palms Groundwater Recharge and Recovery Project Map 2-9
Figure 2.3-3: GHCSD Antelope Conjunctive Use Project (Steuber Phase) Map 2-10
Figure 2.3-4: Lake of the Woods Water Main Replacement & Meter Installation Project Map 2-11
Figure 2.4-1. BVWSD The Palms Groundwater Recharge and Recovery Project Site Map 2-23

LIST OF TABLES

Table 2.1-1: 2015 IRWM Grant Proposal Project Summary Table (PSP Table 4) 2-3
Table 2.4-1: Project 2 Annual Project Physical Benefit 1 2-13
Table 2.4-2: Project 2 Annual Project Physical Benefit 2 2-15
Table 2.4-3. BVWSD The Palms GRRP Physical Benefits 2-24
Table 2.4-4. BVWSD The Palms Groundwater Recharge and Recovery Project Alternative Cost Analysis 2-29
Table 2.5-1: Project 3 Annual Project Physical Benefit 1 2-31
Table 2.5-2: Project 3 Annual Project Physical Benefit 2 2-31
Table 2.5-3: Well Capacities (2015) 2-35
Table 2.5-4: Comparison of GHCSD Supplies and Demands 2-35
Table 2.5-5: Historical Groundwater Recharge (AF/year) 2-36
Table 2.5-6: Summary of CEQA Initial Study 2-38
Table 2.6-1: Project 4 Annual Project Physical Benefit 1 2-45
Table 2.6-2: Project 4 Annual Project Physical Benefit 2 2-45
Table 2.6-3: Estimate of Water Conserved by Replacement Water Mains 2-51

2 Attachment 2 - Project Justification

2.1 Project Summary Table

Table 2.1-1: 2015 IRWM Grant Proposal Project Summary Table (PSP Table 4)

IRWM Project Element		Project 2* BVWSD - The Palms Groundwater Recharge and Recovery Project	Project 3 GHCSD - Antelope Conjunctive Use Project (Steuber Phase)	Project 3 Lake of the Woods - Water Main Replacement & Meter Install Project
IR.1	Water supply reliability, water conservation, and water use efficiency	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			
IR.4	Non-point source pollution reduction, management, and monitoring	X		
IR.5	Groundwater recharge and mgmt. projects	X	X	
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users			
IR.7	Water banking, exchange, reclamation, and improvement of water quality	X	X	
IR.8	Planning and implementation of multipurpose flood management programs	X		
IR.9	Watershed protection and management			
IR.10	Drinking water treatment and distribution		X	X
IR.11	Ecosystem and fisheries restoration and protection			

* Project 1 is reserved for Grant Administration

2.2 Project Descriptions

BVWSD The Palms Groundwater Recharge and Recovery Project

Project Description: The Project will construct recharge ponds to allow recharge of surplus surface water and intertie existing wells to the SWP to increase drought water supply.

Implementing Agency: Buena Vista Water Storage District

Expanded Project Description: Buena Vista Water Storage District's (BVWSD) The Palms Groundwater Recharge and Recovery Project (The Palms GRRP, Project) will increase BVWSD's water supply reliability by constructing a groundwater recharge basin, allowing BVWSD to conduct water recharge/banking, exchanges, and groundwater recovery during drought. The Project also increases 'dry' period water supply by constructing a well recovery pipeline that interties existing groundwater wells (to be re-equipped) to the State Water Project (SWP) California Aqueduct (CA), further facilitating water banking and exchange abilities for BVWSD. Construction of the groundwater recharge basin allows for BVWSD to recharge 'wet' period surplus surface water, which would likely otherwise be lost to beneficial use, for underground storage and eventual recovery during 'dry' or 'drought' periods when surface water supplies and existing wells in BVWSD are insufficient to meet irrigation demands. Re-equipping and use of some former irrigation wells on the property, and construction of the well recovery pipeline, increases BVWSD's water reliability by allowing the operational flexibility of conducting water banking, 'drought' period recovery, and exchanges through the CA.

BVWSD's The Palms GRRP consists of constructing a 260 acre of recharge basin to recharge/bank surplus surface water during 'wet' periods. The Project also proposes to equip 3 existing wells, formerly used for irrigation that currently have no pumps and motors, and construct 6,000 lineal feet of a 24" to 27" recovery pipeline to intertie the 3 existing wells to the SWP's CA to increase dry-year water supply. The Project results in average annual benefits of 1,053 AF/yr of dry-year water supply produced and 6,788 AF/yr of stored groundwater over the 50 year Project life.

How Project Addresses Current Need of Region: The BVWSD Project will address the following concerns:

- *Promote water conservation, conjunctive use, reuse, and recycling:* The project implements a conjunctive use program in which surplus surface water (some of which would otherwise be lost to beneficial use) is directly recharged/banked and stored (conserved) in the underlying groundwater aquifer in 'wet' periods for later recovery by pumping for use in 'dry' periods.
- *Increased water supply reliability during drought:* BVWSD's water supply is dependent upon Kern River (primary) and CA (secondary) surface water deliveries. During droughts surface water deliveries to BVWSD are significantly reduced, resulting in District demands exceeding available supply. As a result, growers that are able, pump groundwater to meet crop demands. This influx of groundwater pumping causes significant groundwater level decreases within the southern end of the District. BVWSD will recharge/bank surplus surface water during wet periods for recovery during dry periods to supplement their surface water supply and mitigate decreasing groundwater levels. This is a more reliable supply during drought than the alternative of year to year water market purchases, which are less reliable, and even more so during drought. Water market purchases are short-term solutions, usually arranged on a year to year basis, while the Project provides a long-term water supply source during drought periods.
- *Efficient groundwater basin management:* Groundwater recharged/banked by the Project will help mitigate basin overdraft, increase groundwater levels in the immediate and surrounding areas, plus contribute to reduced subsidence and water quality management.
- *Increased operational flexibility: The* recovery pipeline intertie to the CA will increase BVWSD, regional, and statewide operational flexibility by enabling recharge/banking and recovery exchanges for BVWSD via the CA. It will also increase BVWSD's and potential exchange partners' operational flexibility along the CA.
- *Improved water quality:* Recharge of high quality surface water will reduce the concentration of salts, nitrate, and arsenic in the underlying groundwater. Furthermore, BVWSD's western boundary is formed by the Coastal Range that is derived from marine and lacustrine deposits that tend to have marginal to poor quality groundwater (high salinity). The Project will increase groundwater levels in the southern portion of BVWSD, reducing the head gradient separating the good quality groundwater located on the basin floor and the poorer groundwater to the west.

GHCSD Antelope Conjunctive Use Project (Steuber Phase)

Project Description: The project includes a new well and pipeline to help GHCSD meet peak demands, recover recharged water, and provide emergency water to City of Tehachapi.

Implementing Agency: Golden Hills Community Services District

Expanded Project Description: The project includes the construction and operation of a new well and pipeline to deliver up to 500 gpm to the Golden Hills Community Services District (GHCSD) and the City of Tehachapi. The proposed project is located in an unincorporated portion of Kern County in the Tehachapi Mountains, and approximately 38 miles southeast of Bakersfield, CA. The City of Tehachapi and GHCSD are located approximately two and four miles, respectively, to the northwest of the proposed project site (see map in **Figure 2.3-3**). The map shows the area impacted by the project, which includes the groundwater basin, and more specifically the zone of influence for the well.

The proposed project involves the construction and operation of an additional groundwater well and connection pipeline to help meet peak water demands within GHCSD. GHCSD is currently able to meet existing water demands through the use of its existing water wells; however, in the event that its largest well is non-functioning, GHCSD would not be able to meet peak demands. The additional well capacity will also help meet future infill demands that will require additional recharge of SWP water. The project would allow GHCSD to recover water from recharge areas that currently have limited groundwater recovery capacity. Since the groundwater basin is adjudicated, groundwater pumping would be restricted to GHCSD's safe yield and intentionally recharged water. The well will also serve as an emergency supply for the City of Tehachapi, who can access the water through an existing interconnection with GHCSD. Both GHCSD and the City have designated Disadvantaged Community (DAC) areas, and for better clarity the DAC areas are shown on a different map in Attachment 7.

The components of the project include a production well, well pump, pipes, valves, water meter, chlorination equipment (storage and injection), electrical service, transformer, motor control cabinet, backup generator, minimal site grading, associated appurtenances, maintenance building and the connection pipeline. The well will be constructed to a maximum depth of 600 feet, and have a target production capacity of 500 gpm.

An 8-inch lateral pipeline will begin at the well, travel 400 feet south, and connect with a proposed 18-inch diameter transmission pipeline. The transmission pipeline will proceed west for approximately 4,100 linear feet and connect to an existing transmission pipeline that serves GHCSD. The transmission pipeline will have additional capacity to convey water from other future wells. The transmission pipeline will be placed in an existing pipeline easement.

The City of Tehachapi will have opportunities, according to a written agreement, to use the well water in emergency situations. The new pipeline will connect to an existing pipeline that has an interconnection with the City of Tehachapi. As part of this agreement, the City will pay for 50% of the pipeline design and construction costs and will also be able to share in 50% of the pipeline capacity for their own future wells planned within the next 5 years.

How Project Addresses Current Need of Region: The project will address the following concerns:

- Help GHCSD meet peak water demands when their highest capacity well is out of service.
- Provide an emergency water supply to the City of Tehachapi.
- Provide future infill water capacity for anticipated planned growth in the GHCSD.
- Provide groundwater recovery capacity from a recharge area that is underutilized due to a lack of recovery wells.
- In the future, also provide the Tehachapi-Cummings County Water District access to a dry-year water supply.

Lake of the Woods Water Main Replacement & Meter Installation Project

Project Description: LOWMWC will implement water conservation measures through water main replacement and meter installation, helping to alleviate the current water supply emergency.

Implementing Agency: Lake of the Woods Mutual Water Company

Expanded Project Description: Through the implementation of the Water Main Replacement and Meter Installation Project, Lake of the Woods Mutual Water Company (LOWMWC or Water Company) will achieve water *conservation* resulting in reduced annual groundwater pumping of at least 16.8 acre-feet/year (for the first 20 years after project completion). The project consists of designing, bidding, and constructing approximately 1.4 miles of new 6" diameter water mains, isolation valves, and fire hydrants located in areas where the existing water mains have significantly deteriorated or are inadequately sized. Many of the water mains to be replaced were constructed over 60 years ago and continually leak. With the installation of 406 water meters, the LOWMWC will be able to monitor and track the water use of customers, bill based on volumetric water use, and provide customers leak detection education, resulting in additional water conservation. These changes will *improve the LOWMWC water distribution system*. A rate study will be required to change from a flat to volumetric rate, and is included as a part of the Project Work Plan.

How Project Addresses a Current Need of Region: With the on-going drought, LOWMWC has not been able to meet existing drinking water demands due to decreasing water well production. In late 2012, one of the Water Company's wells went dry and production at the other three wells production has significantly decreased. Overall the current well production capacity is 72,000 gallons per day (gpd), which is significantly less than the maximum month average demand (MMD) of 137,000 gpd in 2011. Since the summer of 2013, the Water Company has forbidden landscape watering and provided water conservation kits and information, which has led to a decreased MMD of 95,000 gpd (August 2014), but additional water must be trucked in to still meet indoor water use and prevent water outages. In 2014, approximately 2.2 million gallons (MG) of water was trucked to LOWMWC's storage tanks at a cost of $122,000. Fortunately the Water Company has received grant funding to haul this water and drill a new well; however, attempts to drill a well have been dismal as 5 test holes were found to be dry and a 6th hole is expected to produce only 12 gpm. Lastly, grant funding has run out this year for hauling water.

As reported in the New York Times (http://goo.gl/0LK8eR), water restrictions have been policed through visual observation; however, with the water system being unmetered, actual individual customer water use is not known and conservation efforts are not fully effective and cannot be quantified. In September 2014, the Water Company received a violation from the SWRCB Division of Drinking Water for not meeting the source capacity requirements set by the California Waterworks Standards. As part of the Compliance Order, the Water Company must restore water supply and have water meters installed before November 2016. In order to install meters, multiple water mains must be replaced as some are less than 3 inches in diameter (e.g. some ¾ to 1-½ inch) and cannot have meters installed (due to pressure loss through the meter). These small water mains also prevent the Water Company from having adequate fire protection water as hydrants are incapable of providing the flowrates needed in accordance with the fire department's requirements (500 gpm minimum).

Additionally, these water mains have been a significant impact to the water demands of the system through leakage. Based on approximate tests, the water system has a daily loss of up to 37% of the current water supply. These 60-year old pipelines are severely deteriorated and over the past 1-1/2 years, more than 30 repairs have been required based on leaks visible at the surface. In areas with sandy alluvium that drains well, water losses typically are not visible until the leakage is significant. These leaks and breaks also put the system at risk of potential contamination from backflow of water through the broken mains during low pressure and water outages.

Preliminary studies have identified that Frazier Park (a neighboring community two miles to the east) could provide an ideal interconnection as they have a more reliable groundwater aquifer. In order to connect to their water system, though, the LOWMWC distribution system will have to be improved and have water meters installed to prevent water waste.

With the replacement of water mains and the installation of new meters, the Water Company will meet the following goals: (1) substantially reduce losses from existing water mains; (2) eliminate hauling of water; (3) reduce groundwater pumping thereby preserving water supply; (4) facilitate the potential future interconnection with Frazier Park; (5) provide better fire protection; (6) allow for the implementation of water rates based on actual customer water use measured by the new meters, thereby incentivizing water conservation; (7) track customer water use and charge for excessive water use higher than required conservation levels; (8) reduce energy use, greenhouse gases, and costs; (9) provide grant funding for a needed project that serves a disadvantaged community.

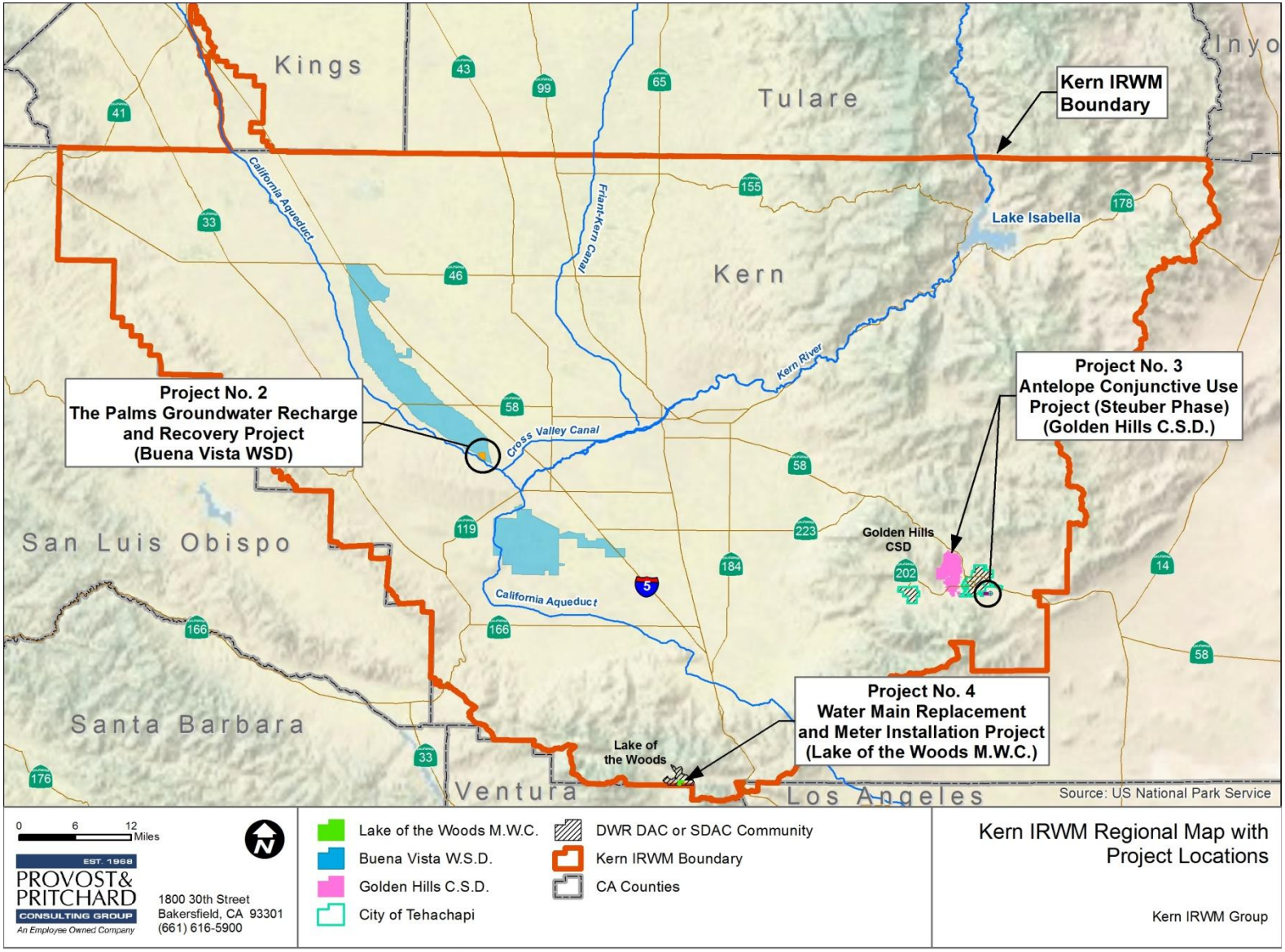
2.3 Regional and Project Maps

A Regional Map identifying the IRWM boundary in relation to the Project Proponent district boundaries and project locations is included as **Figure 2.3-1**.

Project maps are included as follows:

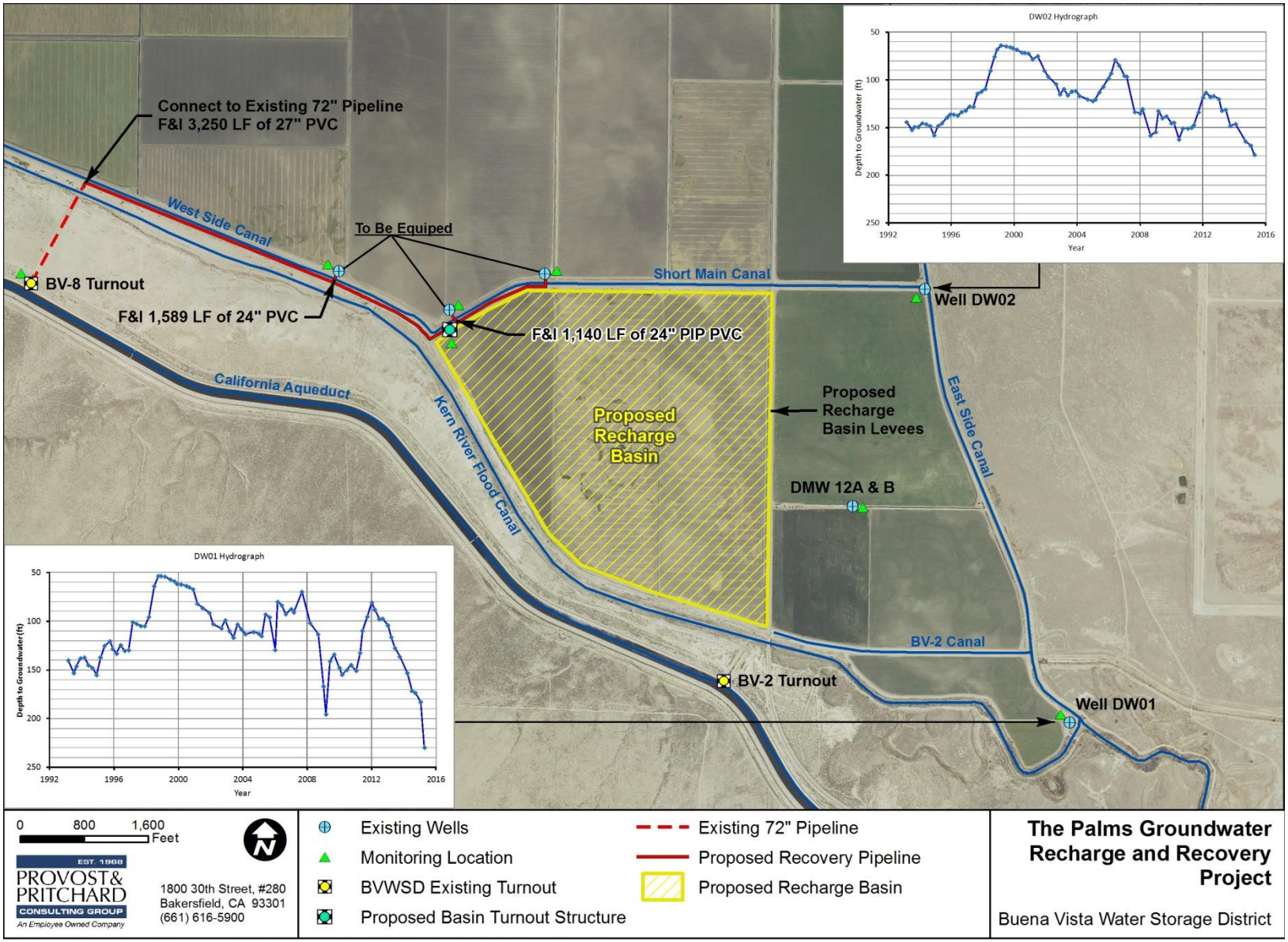
- BVWSD - The Palms Groundwater Recharge and Recovery Project - **Figure 2.3-2**
- GHCSD - Antelope Conjunctive Use Project (Steuber Phase) – **Figure 2.3-3**
- Lake of the Woods - Water Main Replacement & Meter Installation Project – **Figure 2.3-4**
  (Note: Some existing water mains to be replaced are located along the back of the properties and will be replaced with a new water main along the street right-of-way and are not shown on the map. This is the reason that some of the reported water leaks are not shown next to an existing or replacement water main on the map.)

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



8/6/2015 : G:\Buena Vista WSD-1048\104815B3-2015 IRWM Grant\GIS\BVWSD\Map\Implementing Agencies & Projects.mxd

Figure 2.3-1: Kern IRWM Regional Map



8/7/2015 : G:\Buena Vista WSD-1048\104815B3-2015 IRWM Grant\GIS\BVWSD\Map\Palms Project Area v2.mxd

Figure 2.3-2: BVWSD The Palms Groundwater Recharge and Recovery Project Map

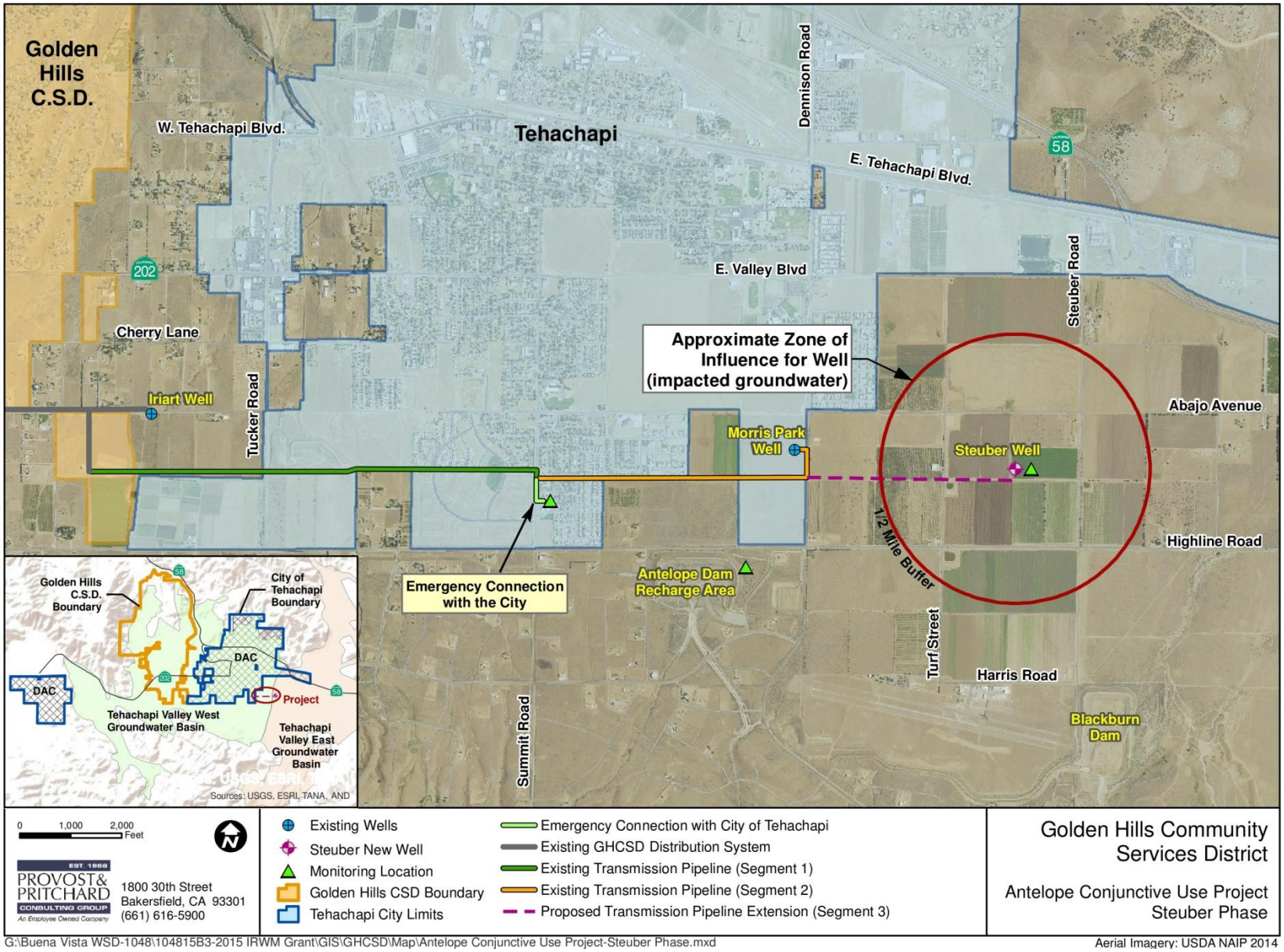
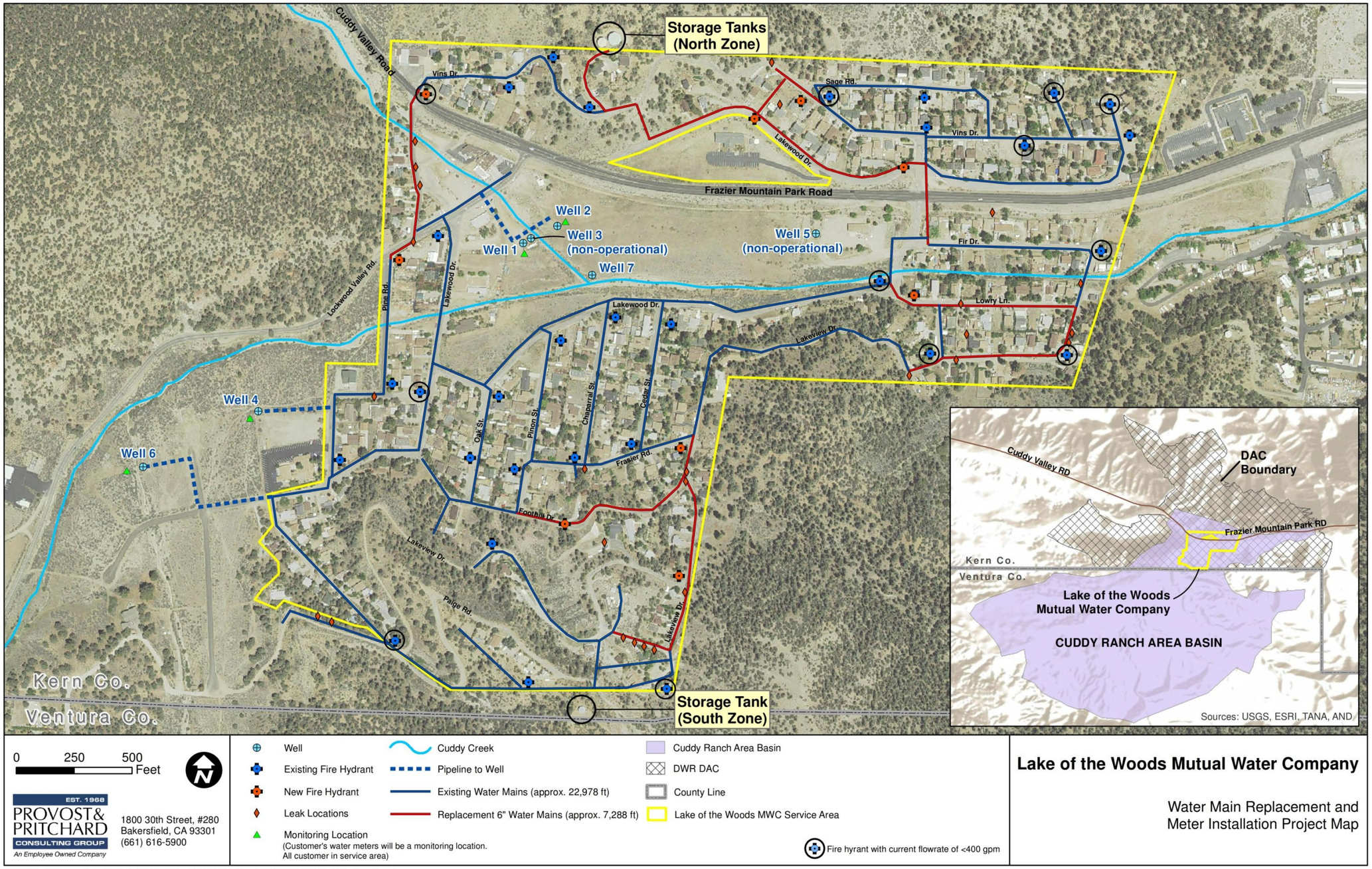


Figure 2.3-3: GHCSD Antelope Conjunctive Use Project (Steuber Phase) Map



8/5/2015 : G:\Buena Vista WSD-1048\104815B3-2015 IRWM Grant\GIS\LOWMWC\Map\Pipeline v2.mxd

Figure 2.3-4: Lake of the Woods Water Main Replacement & Meter Installation Project Map

2.4 BVWSD The Palms Groundwater Recharge and Recovery Project

2.4.1 Project Physical Benefits

The BVWSD Project will results in the following physical benefits:

- **Physical Benefit 1 (Primary) – Drought Relief Water Supply:** The project will recharge and bank surplus surface water during 'wet' periods for recovery during 'dry' periods when surface supplies and existing wells are insufficient to meet crop demands. This will help BVWSD avoid purchasing expensive supplies on the open water market. The Project will provide 52,635 AF of drought relief water supply over the 50 year life of The Palms GRRP, an average annual benefit of 1,053 AF/yr. The drought relief water supply will come from previously Banked Groundwater, and the remainder of the Banked Groundwater would remain in underground storage at the end of the 50 year Project life, as a future resource or mitigating basin overdraft.
- **Physical Benefit 2 (Secondary) – Banked Groundwater:** Surplus water that is recharged and banked underground during 'wet' periods is water that would be conserved, as it otherwise would be lost to beneficial use because it would have flowed through the Kern River Flood Canal flooding land in the Buena Vista and/or Tulare Lake Beds and evaporating, or the surplus water may be lost to non-beneficial ocean outflows. A portion of recharged and banked groundwater also mitigates basin overdraft and increases groundwater levels in the immediate and surrounding Project area. The increased groundwater levels will result in lower energy use, pumping costs, fewer wells requiring the lowering of pumps, and fewer existing wells going 'dry' requiring new wells to be drilled. The banked groundwater is projected to amount to 286,766 AF over the 50 year life of The Palms GRRP.

Table 2.4-1: Project 2 Annual Project Physical Benefit 1

Table 5 – Annual Project Physical Benefits Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project Type of Benefit Claimed: Drought Relief Water Supply Produced Units of the Benefit Claimed : Acre-feet Anticipated Useful Life of Project (years): 50			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	2,420	2,420
2019	0	0	0
2020	0	1,815	1,815
2021	0	0	0
2022	0	605	605
2023	0	0	0
2024	0	0	0
2025	0	605	605
2026	0	5,445	5,445
2027	0	0	0
2028	0	0	0
2029	0	0	0
2030	0	5,445	5,445
2031	0	5,445	5,445
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	2,420	2,420
2042	0	3,630	3,630
2043	0	1,210	1,210
2044	0	5,445	5,445

Table 5 – Annual Project Physical Benefits

Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project
Type of Benefit Claimed: Drought Relief Water Supply Produced
Units of the Benefit Claimed : Acre-feet
Anticipated Useful Life of Project (years): 50

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
2045	0	0	0
2046	0	2,420	2,420
2047	0	0	0
2048	0	2,420	2,420
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	605	605
2056	0	1,815	1,815
2057	0	0	0
2058	0	0	0
2059	0	0	0
2060	0	5,445	5,445
2061	0	0	0
2062	0	1,210	1,210
2063	0	0	0
2064	0	2,420	2,420
2065	0	1,815	1,815
AVERAGE	0	1,032	1,032

Comments: Drought relief water supply comes from previously Banked Groundwater (Physical Benefit #2), and the remainder of Banked Groundwater would remain in underground storage at the end of the 50 year Project life, as a future resource or mitigating basin overdraft.

Table 2.4-2: Project 2 Annual Project Physical Benefit 2

Table 5 – Annual Project Physical Benefits Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project Type of Benefit Claimed: Banked Groundwater Units of the Benefit Claimed : Acre-feet Anticipated Useful Life of Project (years): 50			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	6,472	6,472
2019	0	6,472	6,472
2020	0	11,771	11,771
2021	0	11,771	11,771
2022	0	32,506	32,506
2023	0	32,506	32,506
2024	0	53,847	53,847
2025	0	53,242	53,242
2026	0	47,797	47,797
2027	0	47,797	47,797
2028	0	65,581	65,581
2029	0	78,030	78,030
2030	0	72,585	72,585
2031	0	67,140	67,140
2032	0	67,140	67,140
2033	0	88,481	88,481
2034	0	93,816	93,816
2035	0	115,157	115,157
2036	0	115,157	115,157
2037	0	136,498	136,498
2038	0	157,838	157,838
2039	0	173,570	173,570
2040	0	178,906	178,906
2041	0	197,826	197,826
2042	0	194,196	194,196

Table 5 – Annual Project Physical Benefits Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project Type of Benefit Claimed: Banked Groundwater Units of the Benefit Claimed : Acre-feet Anticipated Useful Life of Project (years): 50			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
2043	0	192,986	192,986
2044	0	187,541	187,541
2045	0	187,541	187,541
2046	0	185,121	185,121
2047	0	185,121	185,121
2048	0	196,929	196,929
2049	0	196,929	196,929
2050	0	218,269	218,269
2051	0	234,275	234,275
2052	0	248,502	248,502
2053	0	269,843	269,843
2054	0	269,843	269,843
2055	0	269,238	269,238
2056	0	267,423	267,423
2057	0	267,423	267,423
2058	0	267,423	267,423
2059	0	283,429	283,429
2060	0	277,984	277,984
2061	0	277,984	277,984
2062	0	276,774	276,774
2063	0	276,774	276,774
2064	0	288,581	288,581
2065	0	286,766	286,766
AVERAGE	0	N/A	N/A
Comments: Surplus surface water that is recharged and banked underground during wet periods, accounts for recovered Drought Relief Water Supply Produced (Physical Benefit #1). Remainder of Banked Groundwater would remain in underground storage at the end of the 50 year Project life, as a future resource or mitigating basin overdraft.			

2.4.2 Technical Analysis of Physical Benefits Claimed

[10 Pages Maximum]

Technical Basis of Project

The Project is located at the southern end of the BVWSD and will include a 260 acre recharge basin connected to existing BVWSD conveyance facilities, which will allow BVWSD to receive and recharge/bank water from both the SWP and Kern River. The Project will also construct a 6,000 lineal foot 24" to 27" diameter well recovery pipeline connecting 3 existing wells and intertie to the CA, increasing BVWSD's drought water supply and exchange capacity. Included in the Project is equipping the 3 existing wells, that are currently idle, with new pumps, motors, control panels, and electrical equipment. The Project area was selected for the following reasons: (1) there is existing infrastructure to provide surplus surface water and to recover banked groundwater minimizing overall Project costs, (2) the area has previously been demonstrated to have suitable hydrogeologic conditions for groundwater recharge and banking projects (through implementation of the nearby Kern Water Bank and West Kern Water District North Well Field, on similar soils and geology), (3) the Project is scalable and can be expanded in the future, provided funding is available, and (4) groundwater level readings and a hydrogeologic review indicate sufficient remaining storage capacity in the aquifer to store the recharged/banked water.

Surplus surface water supplies available to BVWSD that exceed crop demands in the District will be delivered via existing facilities to the recharge basin. This water will be banked for eventual recovery during 'dry' periods when BVWSD's surface supplies are insufficient to meet crop demands. Recovery operations will include pumping from the 3 Project wells into the recovery pipeline, discharging to the CA or BVWSD canals. This will increase BVWSD's water supply reliability during drought, and also improve the District's operational flexibility through possible exchange opportunities.

Project components will include engineering, design, environmental documentation, and agreements, plus construction, grant administration, validation, and reporting. Remaining banked groundwater at the end of the Project's 50 year life will remain in the underlying groundwater aquifer as a future resource or to mitigate basin overdraft.

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

Document Name	Author/Source, Year	Appendix
Project Review of The Palms GRR Project	R. Crewdson, 2015	**
Buena Vista WSD Water Balance	BVWSD, 2009	**
Buena Vista WSD 2015 Hydrographs	BVWSD, 2015	**
Final Environmental Impact Report for the BVWSD Buena Vista Water Management Program	BVWSD, 2009	**
BVWSD Groundwater Management Plan	Provost & Pritchard, 2014	**
The State Water Project Draft Delivery Reliability Report 2013	California Department of Water Resources, 2013	**

** - Document not included as an Appendix due to page restrictions, can be provided upon request.

Recent and Historical Conditions

The prolonged drought has had profound effects on the growers in BVWSD. Surface water deliveries from both the Kern River and SWP have been severely cut, and growers that are able, have had to rely on groundwater to meet crop demands. However, within the northern portion of BVWSD much of the groundwater is of marginal to poor

quality, and is not suitable for irrigation due to elevated salinity. Therefore, growers in the northern BVWSD area are dependent on surface water deliveries or groundwater pumped from the southern end of the district and then conveyed to the northern area. As a result, groundwater levels in the southern end of BVWSD have significantly dropped; as much as 40 to 60 feet since 2012 (see **Figure 2.3-2** hydrographs). Growers that cannot receive groundwater from the southern end of the district have had to fallow lands due to insufficient water supply.

Dropping groundwater levels in the southern end of BVWSD create two potential problems. The first is lower groundwater levels create problems for growers by increasing the cost of pumping irrigation water – at a minimum. Lower groundwater levels can also require costly modifications to wells (e.g. lowering pumps), and potentially constructing new, deeper wells to meet crop irrigation requirements. Secondly, as discussed in the BVWSD GWMP, the District's western boundary is formed by the Coastal Range, which is derived from marine and lacustrine deposits that tend to have marginal to poor groundwater quality due to high salinity. With the dropping groundwater levels from increased pumping, the hydraulic gradient between the marginal quality groundwater to the west and better quality groundwater underlying BVWSD is increased. This can lead to the intrusion of the marginal groundwater from the west into the groundwater underlying BVWSD's southern end, potentially degrading the water to a point that it is not suitable for irrigation purposes. Dropping groundwater levels also increases the potential for subsidence to occur in areas with extensive clay layers, such as BVWSD.

Estimates of Without-project Conditions

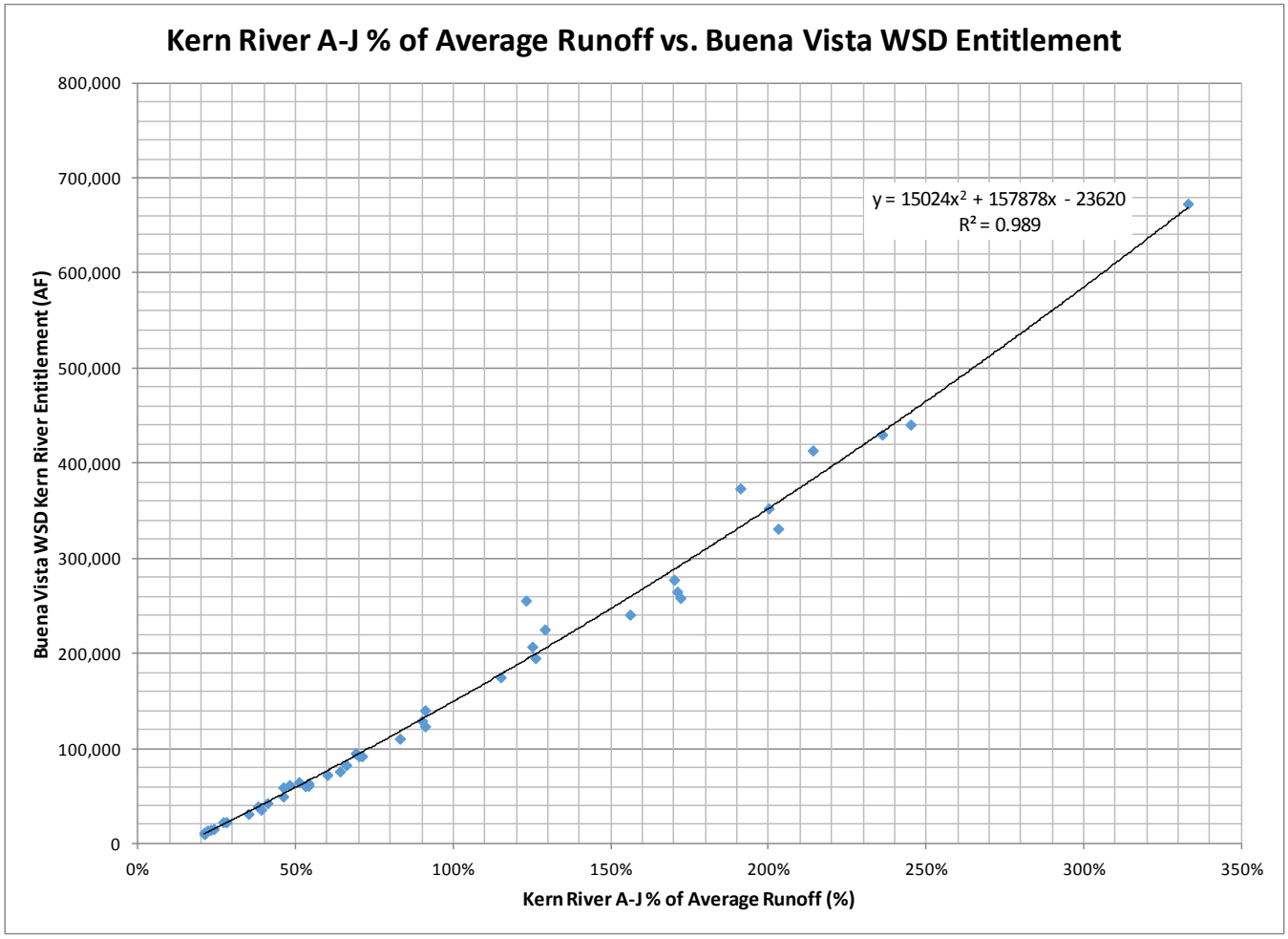
From 1970 to 2007 BVWSD has experienced drought impacts approximately 47% of the time (in-District demands exceed available water supply), as shown in the 2009 BVWSD Water Balance. In these drought years BVWSD has experienced an average supply deficit of 39,400 AF. Without the Project it is anticipated that BVWSD will still experience similar supply deficits (approximately 39,400 AF) during droughts. Furthermore, without the Project, surplus surface water will continue to be lost to beneficial uses when it floods lands in the Central Valley, most notably within the historical Buena Vista and Tulare Lake Beds, or flows to the ocean. Landowner wells will continue to suffer drought period declines and supply shortages, crop irrigation will continue to be dependent on surface water deliveries, and basin-wide overdraft and localized water quality issues will continue to worsen. Increasing dry year water purchases on the open market has been assumed as an alternative to the Project, as that has been a common solution for drought impacted areas in Kern County that have high value crops (increasing in BVWSD).

Description of Methods used to Estimate Physical Benefits

BVWSD retained Provost & Pritchard Consulting Group (Provost & Pritchard) to estimate the Project physical benefits. Project physical benefit calculations are included in **Table 2.4-3**.

Background and Assumptions

To quantify the Project benefits created by the Project, a 50 year analysis period was assumed, corresponding to the approximate project life of comparable existing groundwater recharge projects in Kern County. This includes, but is not limited to: North Kern Water Storage Project, Arvin-Edison Water Storage District, and the City of Bakersfield. A water availability and operations model was developed for the Project analysis period utilizing modeled SWP Table A and Article 21 (A21) water availability from DWR's 2013 Draft SWP Delivery Reliability Report (Table 8 and Table 11 of the Technical Addendum, respectively), which includes relatively restrictive Delta operations criteria and the effects of forecasted climate changes. Kern River water availability was identified by using historical Kern River April-July (A-J) percent of average runoff data. Kern River supply was identified by comparing historical Kern River A-J percent of average runoff to BVWSD Kern River entitlement from 1970 to 2014. A regression analysis was then performed to estimate BVWSD Kern River entitlement from the Kern River A-J percent of average runoff data for each respective year, as shown below.

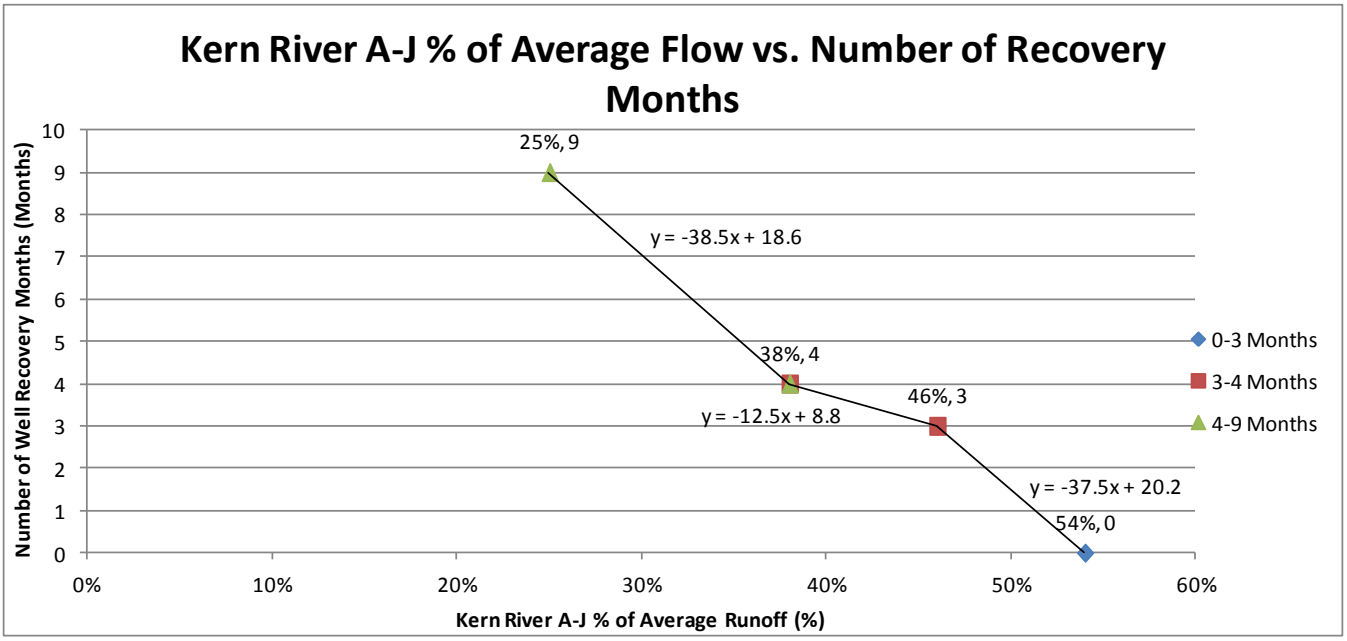


The 50 year period from 1962 to 2011 is representative of future conditions; as the average SWP Table A allocation during that period matched the SWP 2013 Delivery Reliability Report 82 year analysis average of 58% (1922 to 2003), and the historical 50 year Kern River A-J percent of average runoff is 100% of average. Kern River A-J percent of average runoff was not adjusted for climate change, as increased need for storage of Kern River water in the future (due to more rain and earlier snow melt) was assumed to balance the impact in reduced runoff. Because the DWR SWP Delivery Reliability Report modeling ends at 2003, the analysis assumed that the 82 year period cycle would continue, and therefore restarted the modeled data in 2004 (i.e. analysis year 2004 is associated with model year 1922 data). For each respective analysis year a simplified water balance was calculated. Water supply inputs were identified using SWP Table A, SWP A21, and Kern River supplies in proportion to BVWSD's rights. It is important to note that effective precipitation was not factored into the simplified water balance, making it a conservative estimation of water supply inputs. Water use (including crop use, industrial use, project use, evaporative loss, surface water outflow, and project losses) was identified as 134,911 AF/year, which is the average BVWSD water use from 1970 to 2007, as reported in the District Water Balance, and has remained relatively constant in recent years. The difference between the water supply inputs (BVWSD's portion of SWP Table A, SWP A21, and Kern River) and the BVWSD water use was assumed to be available for Project recharge/banking operations.

<u>Physical Benefit 1 (Primary) – Drought Relief Water Supply: The amount of drought relief water supply created by the proposed Project is estimated to total 52,635 AF at the end of the 50 year Project life.</u>

To identify when the proposed Project would be in recovery operations (e.g. pumping wells) a water availability and operations model was developed, incorporating information from The SWP Draft Delivery Reliability Report 2013 (DWR, 2013), historical Kern River runoff data, and input on proposed operations from BVWSD, as described above and detailed below. Recovery operations were identified to be in relation to BVWSD's Kern River

entitlement in the form of Kern River A-J percent of average runoff. In reviewing BVWSD's Water Balance, and input from the district, it was identified that when Kern River A-J percent of average runoff was below 54%, the District historically does not have enough surface water supply to meet crop irrigation demands. Historical recovery operations (recovery months per year) of similar facilities were then compared to the Kern River A-J percent of average runoff for the respective years. It was assumed that the recovery operations would not exceed 9 months in a given year, as surface supplies and need for banked water are uncertain in the first few months of the year. From the comparison, assumptions, and input on the proposed recovery operations from BVWSD, a piece-wise function was developed between Kern River A-J percent of average runoff and number of recovery months from the Project wells, as shown below.

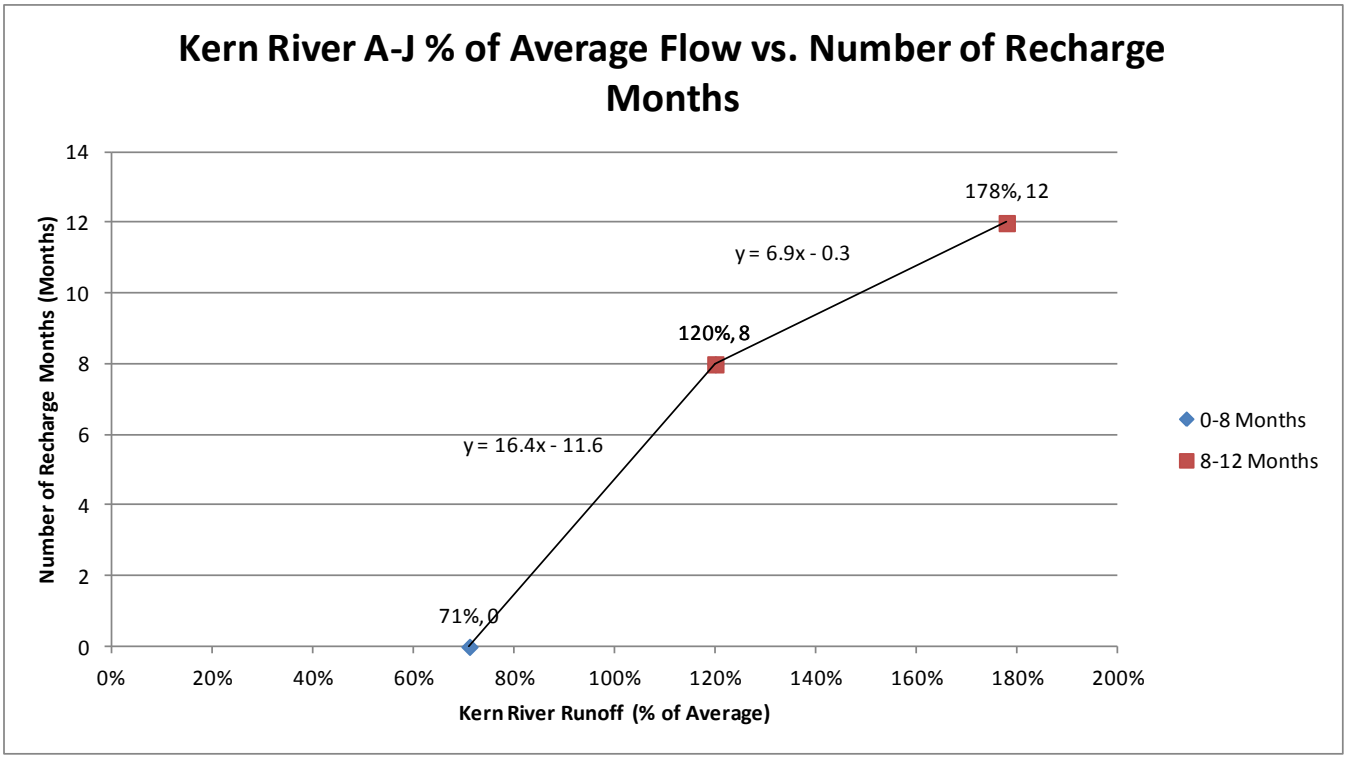


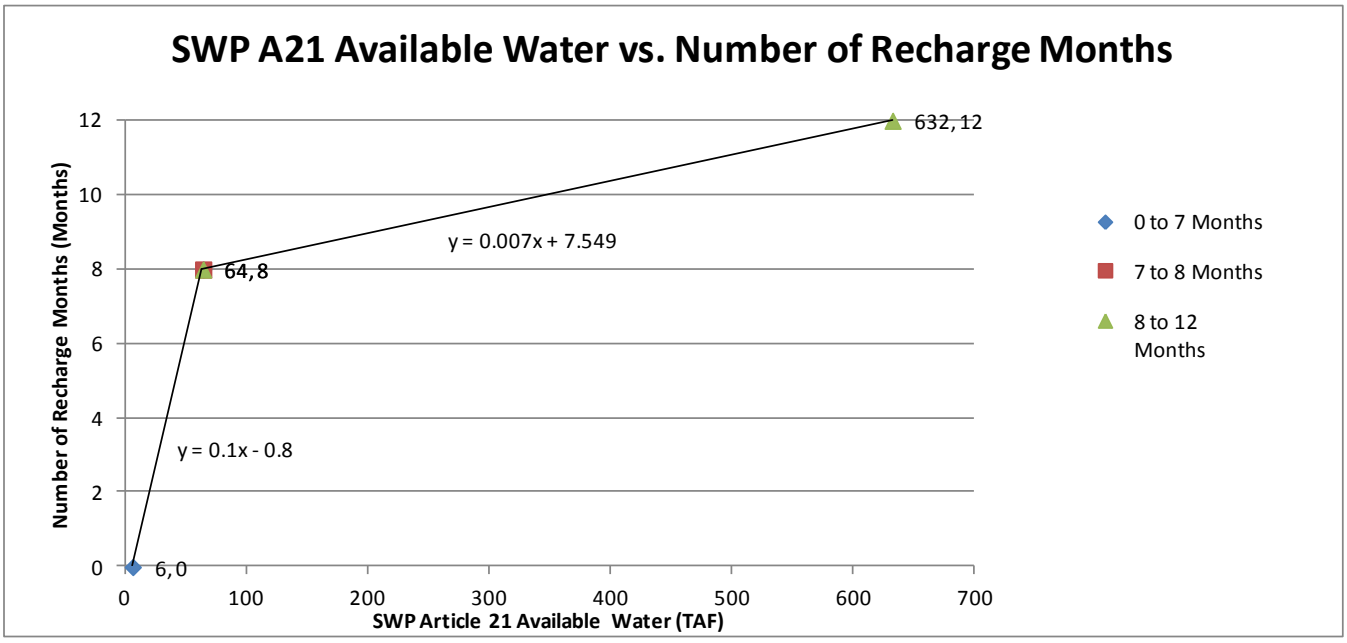
The above function was used to calculate the number of recovery months the Project would operate each analysis year for the respective Kern River A-J percent of average runoff.

Wells are assumed to operate continuously for the identified operation months, as that is common practice for Kern County banking projects. Based on the hydrogeological review it was assumed the wells would have a sustainable recovery rate of 1,500 gallons per minute (gpm), approximately 200 AF/month per well. This is a conservative value, as wells in the surrounding area have shown sustainable recovery rates as high as 2,000 gpm, as noted in the hydrogeological review. The drought relief water supply produced would be withdrawn from the larger volume of Banked Groundwater (Physical Benefit #2) stored underground during 'wet' periods. The remaining Banked Groundwater remains in underground storage at the end of the 50 year Project life.

<u>Physical Benefit 2 (Primary) – Banked Groundwater: The amount of water banked by the proposed project is estimated to total 286,766 AF at the end of the 50 year Project life.</u>

To identify when the proposed Project would be in recharge/banking operations (e.g. filling and maintaining the basin with surplus surface water) a water availability and operations model was developed incorporating information from The SWP Draft Delivery Reliability Report 2013 (DWR, 2013), historical Kern River A-J percent of average runoff data, and input on proposed operations from BVWSD, as described above and detailed below. Banking operations were identified to be in relation to both BVWSD's Kern River entitlement in the form of Kern River A-J percent of average runoff and SWP A21 availability. Historical banking operations (recharge months per year) of similar facilities were compared to both the Kern River A-J percent of average runoff and SWP A21 availability for the respective years. From the comparison and input on the proposed banking operations from BVWSD, a piece-wise function was developed for both the Kern River A-J percent of average runoff and number of recharge months, and SWP A21 availability and number of recharge months, as shown below.





The above functions were used to calculate the number of recharge months the Project would operate under each analysis year for the respective Kern River A-J percent of average runoff and SWP A21 availability scenarios, independently. Because both water supplies are available to BVWSD, and the water supplies are independent of each other, the maximum number of recharge months calculated between both functions was taken to represent the number of recharge months for the respective analysis year.

It was assumed that the long-term average sustainable recharge rate for the wetted recharge basin area is 0.25 ft/day, which corresponds to existing facilities in nearby recharge ponds in similar soils and geology on the Kern Water Bank. This is equivalent to 7.6 AF/month-ac. The gross recharge was then calculated using the number of months determined from the process described above and the sustainable recharge rate of 7.6 AF/month-ac. Gross recharge was not allowed to exceed the BVWSD available water supply for recharge, as identified by the

simplified water balance for the respective year, described above. Stored groundwater resulting from recharge operations is accounted for at the beginning of the subsequent year, and is subject to a 10% loss (per studies on the Kern Water Bank) to account for evaporation and groundwater migration losses. The Project Banked Groundwater (Physical Benefit #2) is a cumulative total of Project operations, including Drought Relief Water Supply (Project Benefit #1) recovered during drought years from the groundwater aquifer (net of recharge and recovery operations). The remaining Banked Groundwater remains in underground storage at the end of the 50 year Project life, as a future resource or to help mitigate basin overdraft.

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

The Palms GRRP facilities would need to be constructed, operated, and maintained in order to achieve the above described benefits. A 10% design Project site map is included as **Figure 2.4-1** BVWSD will need to develop and enter into a license agreement with Kern County Water Agency (KCWA) and DWR, detailing proposed pump-in operations and tracking the volume and quality of recovered water discharged into the CA during recovery operations.

Potential Adverse Physical Effects

Potential adverse physical effects of The Palms GRRP 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 Project reducing any potential adverse physical effects. It should be noted that the Project property is recently fallowed and disked farmland that has no native habitat.

No potential physical adverse effects are expected from the Project implementation. The Project proposes to re-equip existing wells that have been historically used for irrigation purposes. The re-equipped wells will not increase the recovery capacity compared to historical averages (designs will achieve a recovery rate that is typical for irrigation wells in the area). Thus, the use of the Project recovery wells will not increase or decrease the net effect of pumping groundwater compared to the wells being used for irrigation purposes. Furthermore, the Project will recharge/bank an annual average of 6,788 AF/year over the 50 year Project life. The recharged/banked groundwater will increase groundwater levels in the immediate and surrounding Project area, resulting in lower energy use, reduced pumping costs, fewer wells requiring the lowering of pumps, and fewer existing wells going 'dry' requiring new wells to be drilled. Historically this area of the District has not experienced shallow groundwater, and nearby recharge operations for banking projects (Kern Water Bank and West Kern Water District's North Well Field) have not caused shallow groundwater under similar soil and hydrogeologic conditions. Thus, the Project is not expected to induce a shallow groundwater table that would affect the root zone of surrounding crops.

How Project Effectively Addresses Long-Term Drought Preparedness

The Project effectively addresses long-term drought preparedness by contributing to sustainable water supply and reliability by achieving the following, as specified in the 2015 Guidelines:

- Promote water conservation, conjunctive use, reuse and recycling, and
- Efficient groundwater basin management.

By constructing the Project facilities (recharge basin, equipping existing wells, and well recovery pipeline), BVWSD will be able to increase their overall water supply reliability during drought. BVWSD will implement a conjunctive use program, in which surplus surface water is directly recharged/banked and stored underground during wet periods for recovery during dry periods to supplement their surface water supply. The recovery pipeline intertie to the CA also introduces exchange opportunities with BVWSD and potential partners along the SWP; increasing all participating agencies' operational flexibility. Furthermore, this is a more reliable supply during drought than the alternative of year to year water market purchases, which are less reliable, and even more so during drought. Water market purchases are short-term solutions, usually arranged on a year to year basis, while the Project can provide a long-term water supply source.

Groundwater recharged/banked by the Project will help mitigate basin overdraft and increase groundwater levels in the immediate and surrounding areas. The increased groundwater levels will result in lower energy use, pumping costs, fewer wells requiring the lowering of pumps, and existing wells going 'dry' requiring replacement wells.

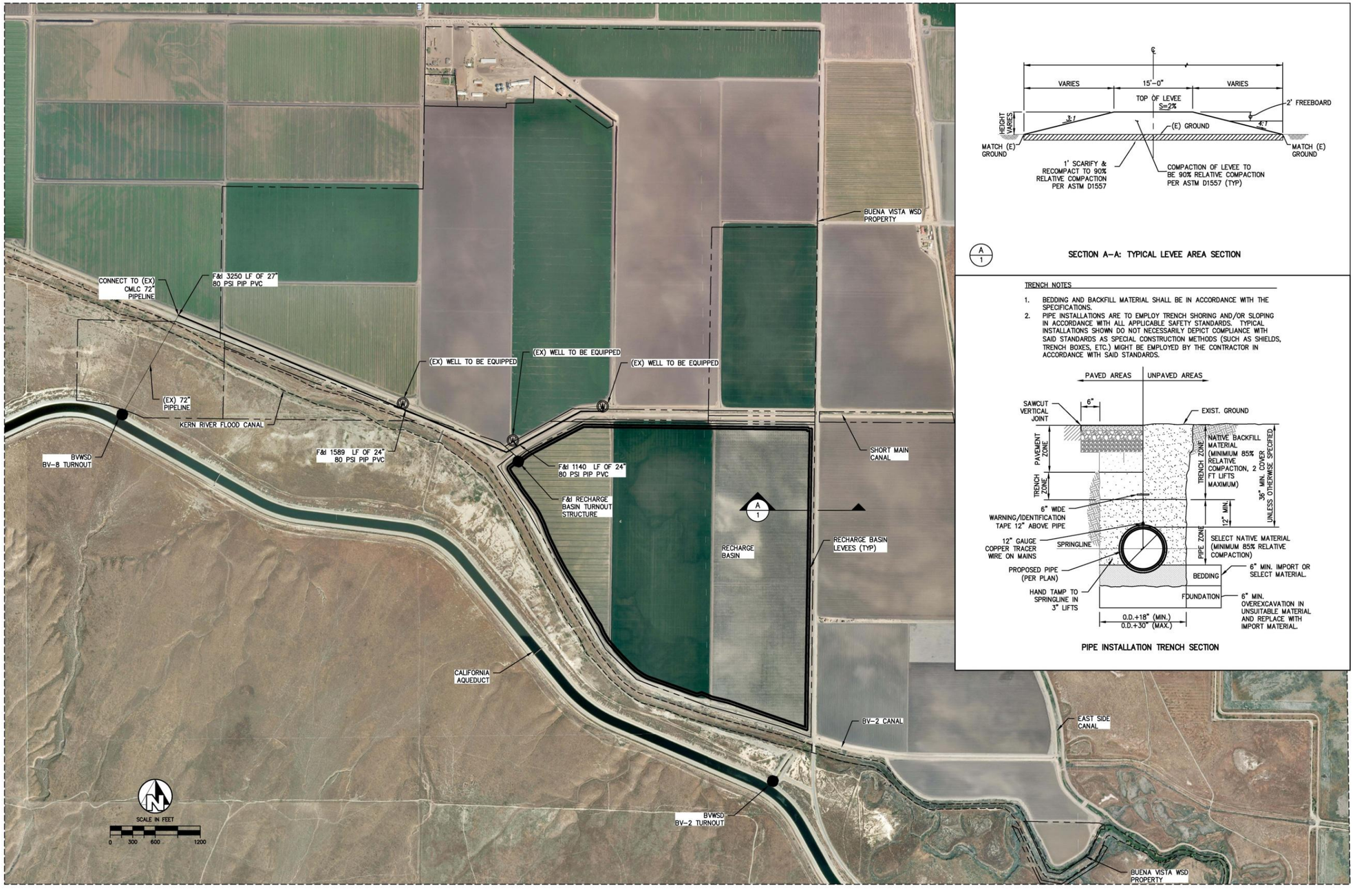


Figure 2.4-1. BVWSD The Palms Groundwater Recharge and Recovery Project Site Map

Table 2.4-3
The Palms Groundwater Recharge and Recovery Project
Project Physical Benefits

[A] Analysis Year /1	[B] Model Year /2	[C] SWP Allocation (%) /3	[D] SWP Table A Supply (AF) /4	[E] Article 21 Availability (AF) /5	[F] SWP Article 21 Supply (AF) /6	[G] Kern River A-J % of Average Runoff (%) /7	[H] Kern River Supply (AF) /8	[I] Average Water Use (AF) /9	[J] Available Water for Recharge (AF) /10	[K] Number of Recharge Months /11	[L] Number of Recovery Months /12	[M] Gross Recharge (AF) /13	[N] Stored Groundwater (AF) /14	[O] Drought Relief Water Supply Produced (AF) /15 Physical Benefit #1	[P] Banked Groundwater (AF) /16 Physical Benefit #2
2015	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	1962	61%	12,993	15,000	77	111%	170,100	(134,911)	48,259	0	0	0	0	0	0
2017**	1963	65%	13,845	15,000	77	103%	154,200	(134,911)	33,211	5	0	9,880	0	0	0
2018	1964	60%	12,780	18,000	92	39%	40,900	(134,911)	(81,139)	0	4	0	8,892	2,420	6,472
2019	1965	67%	14,271	14,000	72	98%	146,100	(134,911)	25,532	4	0	7,904	0	0	6,472
2020	1966	60%	12,780	15,000	77	47%	54,500	(134,911)	(67,554)	0	3	0	7,114	1,815	11,771
2021	1967	77%	16,401	13,000	66	199%	350,000	(134,911)	231,556	12	0	23,712	0	0	11,771
2022	1968	60%	12,780	18,000	92	53%	65,100	(134,911)	(56,939)	0	1	0	21,341	605	32,506
2023	1969	92%	19,596	163,000	833	376%	783,300	(134,911)	668,818	12	0	23,712	0	0	32,506
2024	1970	75%	15,975	16,000	82	69%	92,100	(134,911)	(26,754)	0	0	0	21,341	0	53,847
2025	1971	63%	13,419	14,000	72	53%	63,600	(134,911)	(57,820)	0	1	0	0	605	53,242
2026	1972	44%	9,372	19,000	97	28%	20,900	(134,911)	(104,542)	0	9	0	0	5,445	47,797
2027	1973	74%	15,762	262,000	1,339	156%	258,900	(134,911)	141,090	10	0	19,760	0	0	47,797
2028	1974	77%	16,401	14,000	72	115%	178,300	(134,911)	59,862	7	0	13,832	17,784	0	65,581
2029	1975	71%	15,123	15,000	77	83%	118,000	(134,911)	(1,711)	0	0	0	12,449	0	78,030
2030	1976	36%	7,668	17,000	87	23%	14,200	(134,911)	(112,956)	0	9	0	0	5,445	72,585
2031	1977	11%	2,343	9,000	46	21%	9,500	(134,911)	(123,022)	0	9	0	0	5,445	67,140
2032	1978	80%	17,040	11,000	56	236%	431,800	(134,911)	313,985	12	0	23,712	0	0	67,140
2033	1979	60%	12,780	16,000	82	90%	131,400	(134,911)	9,351	3	0	5,928	21,341	0	88,481
2034	1980	89%	18,957	290,000	1,482	213%	381,700	(134,911)	267,228	12	0	23,712	5,335	0	93,816
2035	1981	43%	9,159	18,000	92	54%	66,700	(134,911)	(58,960)	0	0	0	21,341	0	115,157
2036	1982	92%	19,596	196,000	1,001	172%	291,500	(134,911)	177,186	12	0	23,712	0	0	115,157
2037	1983	98%	20,874	227,000	1,160	333%	668,300	(134,911)	555,423	12	0	23,712	21,341	0	136,498
2038	1984	77%	16,401	644,000	3,290	91%	132,700	(134,911)	17,480	12	0	17,480	21,341	0	157,838
2039	1985	67%	14,271	17,000	87	91%	133,200	(134,911)	12,647	3	0	5,928	15,732	0	173,570
2040	1986	76%	16,188	25,000	128	191%	332,600	(134,911)	214,005	12	0	23,712	5,335	0	178,906
2041	1987	18%	3,834	14,000	72	46%	51,400	(134,911)	(79,605)	0	4	0	21,341	2,420	197,826
2042	1988	26%	5,538	11,000	56	35%	33,300	(134,911)	(96,017)	0	6	0	0	3,630	194,196
2043	1989	55%	11,715	12,000	61	50%	59,900	(134,911)	(63,235)	0	2	0	0	1,210	192,986
2044	1990	15%	3,195	14,000	72	24%	15,800	(134,911)	(115,844)	0	9	0	0	5,445	187,541
2045	1991	18%	3,834	16,000	82	60%	75,700	(134,911)	(55,295)	0	0	0	0	0	187,541
2046	1992	21%	4,473	13,000	66	39%	39,500	(134,911)	(90,872)	0	4	0	0	2,420	185,121
2047	1993	65%	13,845	15,000	77	126%	199,000	(134,911)	78,011	8	0	15,808	0	0	185,121
2048	1994	40%	8,520	20,000	102	41%	43,900	(134,911)	(82,389)	0	4	0	14,227	2,420	196,929
2049	1995	76%	16,188	11,000	56	200%	352,400	(134,911)	233,733	12	0	23,712	0	0	196,929
2050	1996	72%	15,336	15,000	77	129%	205,100	(134,911)	85,602	9	0	17,784	21,341	0	218,269
2051	1997	81%	17,253	80,000	409	123%	193,400	(134,911)	76,151	8	0	15,808	16,006	0	234,275
2052	1998	86%	18,318	13,000	66	245%	453,100	(134,911)	336,573	12	0	23,712	14,227	0	248,502
2053	1999	72%	15,336	47,000	240	54%	66,700	(134,911)	(52,635)	0	0	0	21,341	0	269,843
2054	2000	66%	14,058	13,000	66	66%	87,100	(134,911)	(33,687)	0	0	0	0	0	269,843
2055	2001	26%	5,538	17,000	87	54%	65,800	(134,911)	(63,486)	0	1	0	0	605	269,238
2056	2002	55%	11,715	11,000	56	46%	52,800	(134,911)	(70,340)	0	3	0	0	1,815	267,423
2057	2003	61%	12,993	14,000	72	70%	94,200	(134,911)	(27,646)	0	0	0	0	0	267,423
2058	1922	69%	14,697	16,000	82	133%	212,900	(134,911)	92,768	9	0	17,784	0	0	267,423
2059	1923	59%	12,567	15,000	77	72%	97,100	(134,911)	(25,167)	0	0	0	16,006	0	283,429
2060	1924	14%	2,982	12,000	61	20%	8,400	(134,911)	(123,468)	0	9	0	0	5,445	277,984
2061	1925	41%	8,733	40,000	204	67%	89,600	(134,911)	(36,374)	0	0	0	0	0	277,984
2062	1926	45%	9,585	14,000	72	50%	59,300	(134,911)	(65,954)	0	2	0	0	1,210	276,774
2063	1927	70%	14,910	82,000	419	112%	172,700	(134,911)	53,118	8	0	15,808	0	0	276,774
2064	1928	69%	14,697	15,000	77	42%	44,800	(134,911)	(75,337)	0	4	0	14,227	2,420	288,581
2065	1929	27%	5,751	12,000	61	47%	54,400	(134,911)	(74,699)	0	3	0	0	1,815	286,766
Totals		**-**	**622,386**	**2,623,000**	**13,406**	**-**	**7,917,900**	**(6,745,550)**	**1,808,142**	**194**	**87**	**377,112**	**339,401**	**52,635**	**-**
Averages		**58%**	**12,448**	**52,460**	**268**	**100%**	**158,358**	**(134,911)**	**36,163**	**4**	**2**	**7,542**	**6,788**	**1,053**	**-**

***Project construction will be complete by January 2017; therefore, Project operations and benefits do not occur until 2017.*

Table 2.4-3 cont
The Palms Groundwater Recharge and Recovery Project
Project Physical Benefits

ASSUMPTIONS:

Water Supply -			*Recharge Facilities -*		
KCWA SWP Allocation :	848,130	AF	Recharge Area :	260	acres
KCWA % SWP Allocation :	20%		Recharge Rate :	0.25	ft/day
BVWSD SWP Allocation from KCWA :	21,300	AF	Recharge Rate :	1,976	AF/mon
BVWSD % SWP Allocation from KCWA :	3%				

Recovery Wells -		
Number of Recovery Wells :	3	wells
Well Recov	1,500	gpm
Well Recov	605	AF/mon

NOTES:

/1 Analysis Water Contract Year corresponding to the Historical Water Contract Year [Col (B)] used for the 50-year benefits analysis.

/2 Historical Water Contract Year used for the 50-year benefits analysis.

/3 State Water Project (SWP) Table A allocation corresponding to the Historical Water Contract Year [Col (B)]. SWP allocation was determined from the Technical Addendum to the State Water Project Delivery Reliability Report 2013 Table 8 "Estimated Delivery Interpolated to 2033".

/4 Buena Vista WSD SWP Table A supply from Kern County Water Agency [Col (C) x 21,300 AF].

/5 SWP Article 21 availability corresponding to the Historical Water Contract Year [Col (B)]. Article 21 availability was determined from the Technical Addendum to the State Water Project Delivery Reliability Report 2013 Table 11 "Article 21 Deliveries for Future Conditions Interpolated to 2033 Climate Change".

/6 Buena Vista WSD SWP Article 21 supply from Kern County Water Agency [Col (E) x 20% KCWA SWP Allocation from DWR x 3% BVWSD SWP Allocation from KCWA].

/7 Historical Kern River April thru July (A-J) runoff in percent of average runoff corresponding to the Historical Water Contract Year [Col (B)].

/8 Buena Vista WSD Kern River entitlement based on Kern River A-J runoff in percent of average runoff [Col (G)]. Buena Vista WSD Kern River entitlement was identified using a regression analysis of historical data [{15.024 x Col $(G)^2$} + {157.878 x Col (G)} - 23.620].

/9 Average Buena Vista WSD annual water use identified in 1970 - 2007 Buena Vista WSD Water Balance (BVWSD, 2009). (Negative Input)

/10 Available Buena Vista WSD water supply for recharge operations [Col (D) + Col (F) + Col (H) + Col (I)].

/11 Number of recharge months for the Project facilities based on proposed operations as a function of SWP Article 21 [Col (F)], Kern River A-J flow [Col [G]), and Available Water for Recharge (Col [J]). See "Kern River A-J % of Average Flow vs. Number of Recharge Months" and "SWP A21 Available Water vs. Number of Recharge Months" graphs in Attachment 2 .4.2 for proposed operational scenarios and piece-wise functions used to identify the number of recharge months.

/12 Number of recovery months for the Project facilities based on proposed operations as a function of Kern River A-J flow [Col (G)]. See graph in Attachment 2.4.2 for proposed operational scenario and piece-wise function used to identify the number of recovery months.

/13 Gross recharge resulting from the Project facilities [Col (K) x1,976 AF/mon]. Gross recharge cannot exceed Buena Vista WSD's available water supply for recharge [Col (J)].

/14 Stored groundwater resulting from recharge operations including a 10% loss [Col (M) x 0.9]. Stored groundwater is accounted at the beginning of the subsequent year.

/15 Drought relief water recovered during 'dry' Kern River years resulting from the Project facilities [Col (L) x 605 AF/mon]. Drought relief water cannot exceed the cumulative Project Banked Groundwater [Col (P)]. **Physical Benefit #1**.

/16 Cumulative banked groundwater resulting from Project operations [Previous Year Col (P) + Col (N) - Col (O)]. **Physical Benefit #2**.

2.4.1 Direct Water-Related Benefit to a DAC

[1 Page Maximum]

The Palms GRRP area does not encompass a DAC; therefore, there are no direct water related benefits to a DAC. However, the Project benefits Buttonwillow County Water District (BCWD) that serves the City of Buttonwillow that is classified as a DAC. The Project benefits BCWD through the increase of groundwater recharge, which benefits the local groundwater aquifer that BVWSD and BCWD are dependent upon. By stabilizing and improving groundwater levels plus quality, and increasing storage for recovery during drought, BCWD will be less subject to potential shortages in its pump capacity due to decreasing groundwater levels and/or quality problems.

2.4.2 Project Performance Monitoring Plan

Table 6 – Project Performance Monitoring Plan **Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project**		
Proposed Physical Benefits	**Targets**	**Measurement tools and methods**
Physical Benefit 1 (Primary) – Drought Relief Water Supply	○ Recovered water volume of 1,053 AF/yr as a long-term average. ○ Recovered water volumes from the Project wells during the first 10 years provides drought relief water supply at least 1/5th of 52,635 AF, considering hydrology. During the life of the Project drought relief water supply totaling a minimum of 52,635 AF.	○ Annual long-term average of readings on Project well's flow meter totalizers. ○ Readings of Project well's flow meter totalizers add up to approximately 1/5th of 52,635 AF, and projections are made with adjustment for hydrology of those 10 years. ○ Readings of Project well's flow meter totalizers add up to a minimum of 52,635 AF over the 50 year Project life.
Physical Benefit 2 (Primary) – Banked Groundwater	○ Banked groundwater volume of 6,788 AF/yr as a long-term average. ○ 286,766 AF of banked groundwater (underground storage) from Project recharge operations over the 50 year Project life, after deducting Project recovery operations (Physical Benefit #1), estimated pond evaporation, and groundwater migrations losses.	○ Annual long-term average of banked groundwater (underground storage). Calculations can be supported by flow measuring devices at basin turnouts, groundwater levels in the Project area, and corresponding hydrogeological analysis to estimate storage volume changes. ○ Calculations of cumulative banked groundwater (underground storage) during annual reports to DWR. Calculations can be supported by flow measuring devices at basin turnouts, groundwater levels in the Project area, and corresponding hydrogeological analysis to estimate storage volume changes.

2.4.3 Cost Effective Analysis

Table 7 - Cost Effective Analysis **Project Name: BVWSD The Palms Groundwater Recharge and Recovery Project**	
Question 1	Types of benefits provided:
	Drought Relief Water Supply – The estimated amount of drought relief water supply is approximately 52,635 AF during the 50 year Project life.
	Banked Groundwater – The estimated amount of cumulative banked groundwater (accounting for recovery operations and losses) is approximately 286,766 AF during the 50 year Project life.
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 drought relief water supply produced by the Project in California's water market and paying Aqueduct conveyance costs to deliver the water to BVWSD. The cost of water in California's water market varies greatly from year to year, and is strongly related to the SWP Table A allocation. Water market costs versus Table A allocation were obtained from Dale Melville, manager of Dudley Ridge Water District, who purchases market water on behalf of Westside SWP Contractors, and from BVWSD's sale of water from voluntary fallowing by District farmers in 2014 (a 5% SWP Table A allocation year).** **A 50 year analysis of water purchase costs versus The Palms GRRP costs was performed in Table 2.4-4 using the same analysis period and SWP Table A allocation data presented in the Project Benefits Calculations (Table 2.4-3). Capital costs of The Palms GRRP are based upon Table 4.2-1 in Attachment 4. From the analysis presented in Table 2.4-4, purchasing water on the California water market equivalent to the amount of drought relief water supply produced over the 50 year Project life increased the operating cost $3M. Therefore, it can be concluded that The Palms GRRP is more cost effective than purchasing water on the California water market.**
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 shown in Table 2.4-4.
Comments:	

Table 2.4-4
The Palms Groundwater Recharge and Recovery Project
Alternative Cost Analysis

[A] Analysis Year /1	[B] Model Year /1	[C] SWP Table A Allocation (%) /2	[D] Drought Relief Water Supply Produced (AF) /3	[E] Water Cost ($/AF) /4	[F] Capital Cost ($) /5	[G] Pumping & O&M Cost ($) /6	[H] Purchased Water Cost ($) /7	[I] Discount Factor /8	[J] Alternative Cost Increase ($) /9
2015	N/A	-	0	$ -	$ 1,517,100	$ -	$ -	1.0000	$ (1,517,100)
2016	1962	61%	0	$ 139	$ -	$ -	$ -	0.9434	$ -
2017	1963	65%	0	$ 131	$ -	$ -	$ -	0.8900	$ -
2018	1964	60%	2,420	$ 142	$ -	$ 69,392	$ 342,523	0.8396	$ 229,326
2019	1965	67%	0	$ 127	$ -	$ -	$ -	0.7921	$ -
2020	1966	60%	1,815	$ 142	$ -	$ 52,044	$ 256,892	0.7473	$ 153,075
2021	1967	77%	0	$ 111	$ -	$ -	$ -	0.7050	$ -
2022	1968	60%	605	$ 142	$ -	$ 17,348	$ 85,631	0.6651	$ 45,412
2023	1969	92%	0	$ 93	$ -	$ -	$ -	0.6274	$ -
2024	1970	75%	0	$ 113	$ -	$ -	$ -	0.5919	$ -
2025	1971	63%	605	$ 135	$ -	$ 17,348	$ 81,593	0.5584	$ 35,874
2026	1972	44%	5,445	$ 192	$ -	$ 156,131	$ 1,047,669	0.5268	$ 469,651
2027	1973	74%	0	$ 115	$ -	$ -	$ -	0.4970	$ -
2028	1974	77%	0	$ 111	$ -	$ -	$ -	0.4688	$ -
2029	1975	71%	0	$ 120	$ -	$ -	$ -	0.4423	$ -
2030	1976	36%	5,445	$ 235	$ -	$ 156,131	$ 1,277,917	0.4173	$ 468,082
2031	1977	11%	5,445	$ 759	$ -	$ 156,131	$ 4,132,981	0.3936	$ 1,565,472
2032	1978	80%	0	$ 106	$ -	$ -	$ -	0.3714	$ -
2033	1979	60%	0	$ 142	$ -	$ -	$ -	0.3503	$ -
2034	1980	89%	0	$ 96	$ -	$ -	$ -	0.3305	$ -
2035	1981	43%	0	$ 197	$ -	$ -	$ -	0.3118	$ -
2036	1982	92%	0	$ 93	$ -	$ -	$ -	0.2942	$ -
2037	1983	98%	0	$ 87	$ -	$ -	$ -	0.2775	$ -
2038	1984	77%	0	$ 111	$ -	$ -	$ -	0.2618	$ -
2039	1985	67%	0	$ 127	$ -	$ -	$ -	0.2470	$ -
2040	1986	76%	0	$ 112	$ -	$ -	$ -	0.2330	$ -
2041	1987	18%	2,420	$ 466	$ -	$ 69,392	$ 1,128,080	0.2198	$ 232,710
2042	1988	26%	3,630	$ 324	$ -	$ 104,088	$ 1,175,783	0.2074	$ 222,235
2043	1989	55%	1,210	$ 154	$ -	$ 34,696	$ 186,668	0.1956	$ 29,730
2044	1990	15%	5,445	$ 558	$ -	$ 156,131	$ 3,040,267	0.1846	$ 532,287
2045	1991	18%	0	$ 466	$ -	$ -	$ -	0.1741	$ -
2046	1992	21%	2,420	$ 400	$ -	$ 69,392	$ 968,417	0.1643	$ 147,669
2047	1993	65%	0	$ 131	$ -	$ -	$ -	0.1550	$ -
2048	1994	40%	2,420	$ 211	$ -	$ 69,392	$ 511,706	0.1462	$ 64,660
2049	1995	76%	0	$ 112	$ -	$ -	$ -	0.1379	$ -
2050	1996	72%	0	$ 118	$ -	$ -	$ -	0.1301	$ -
2051	1997	81%	0	$ 105	$ -	$ -	$ -	0.1227	$ -
2052	1998	86%	0	$ 99	$ -	$ -	$ -	0.1158	$ -
2053	1999	72%	0	$ 118	$ -	$ -	$ -	0.1092	$ -
2054	2000	66%	0	$ 129	$ -	$ -	$ -	0.1031	$ -
2055	2001	26%	605	$ 324	$ -	$ 17,348	$ 195,964	0.0972	$ 17,365
2056	2002	55%	1,815	$ 154	$ -	$ 52,044	$ 280,002	0.0917	$ 20,908
2057	2003	61%	0	$ 139	$ -	$ -	$ -	0.0865	$ -
2058	1922	69%	0	$ 123	$ -	$ -	$ -	0.0816	$ -
2059	1923	59%	0	$ 144	$ -	$ -	$ -	0.0770	$ -
2060	1924	14%	5,445	$ 598	$ -	$ 156,131	$ 3,255,183	0.0727	$ 225,146
2061	1925	41%	0	$ 206	$ -	$ -	$ -	0.0685	$ -
2062	1926	45%	1,210	$ 188	$ -	$ 34,696	$ 227,693	0.0647	$ 12,479
2063	1927	70%	0	$ 122	$ -	$ -	$ -	0.0610	$ -
2064	1928	69%	2,420	$ 123	$ -	$ 69,392	$ 298,263	0.0575	$ 13,171
2065	1929	27%	1,815	$ 312	$ -	$ 52,044	$ 566,332	0.0543	$ 27,920
								Total	**$ 2,996,073**

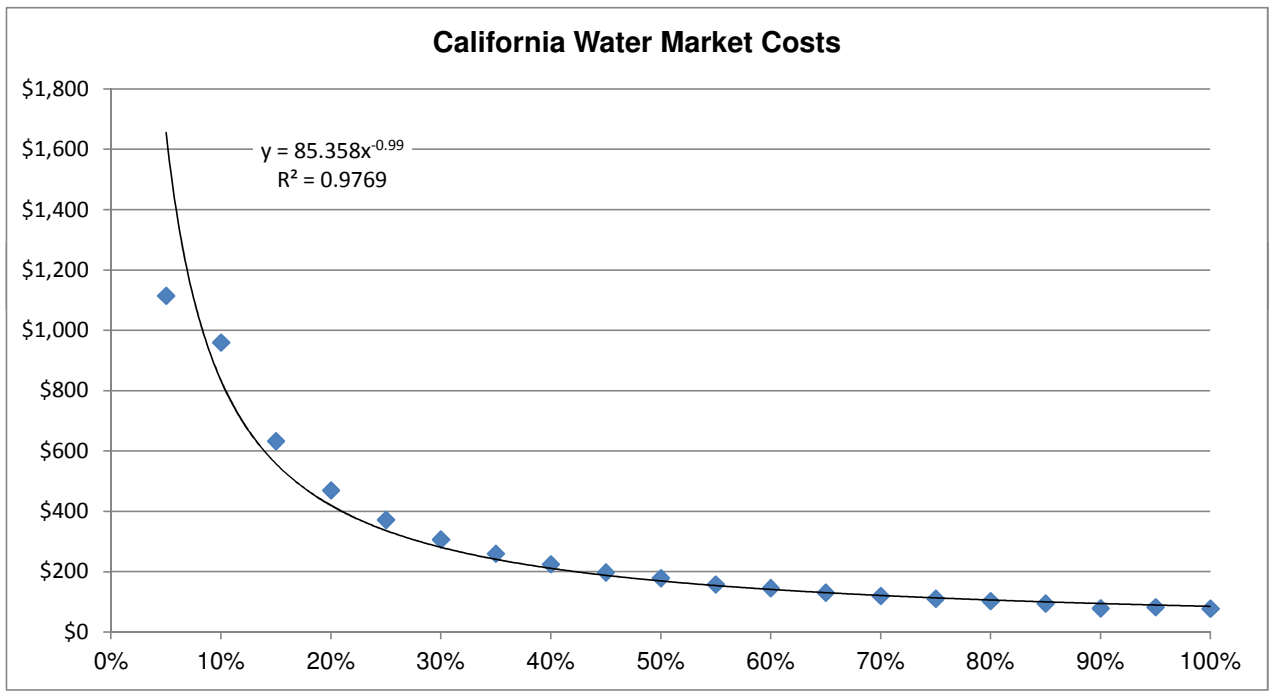
NOTES:

/1 Analysis Water Contract Year [Col (A)] and corresponding State Water Project Model Year [Col (B)] used for the 50-year benefits analysis.
/2 SWP percent allocation for analysis year [Col (A)] based on State Water Project model year [Col (B)].
/3 Annual Drought Relief Water Supply Produced (Project Physical Benefit #1) during corresponding analysis year [Col (A)].
/4 California water market water costs for delivery to Kern County based on percent SWP allocations [85.358*{Col (C)$^{-0.99}$}].
/5 Project capital costs.
/6 Annual cost to pump groundwater from Project wells [{1.46 KWh/af-ft x 100 ft x Col (D) x $0.155/KWh} + {Col (D) x $6/af}].
/7 Cost to purchase available surface water supplies to match groundwater supply produced [Col (D) x Col (E)].
/8 Discount factor based on 6% interest rate.
/9 Difference between price to purchase available surface water supply and price to implement the Project [Col (I) x { Col (H) - Col (F) - Col (G) }].

California Water Market Costs by % SWP Allocation

% SWP	$/ac-ft	
100%	$78	1/
95%	$83	1/
90%	$79	1/
85%	$95	1/
80%	$103	1/
75%	$111	1/
70%	$120	1/
65%	$131	1/
60%	$146	1/
55%	$158	1/
50%	$179	1/
45%	$198	1/
40%	$225	1/
35%	$260	1/
30%	$307	1/
25%	$372	1/
20%	$470	1/
15%	$633	1/
10%	$960	1/
5%	$1,115	2/

1/ Historical water prices based on percent SWP allocations (Dale Melville, 2014)
2/ From BVWSD 2013 Water Sales (Average $/af)



Pumping Costs

Average Pumping Lift =	100	ft
Well Operating Efficiency =	70%	
KWh/af-ft =	1.46	KWh/af-ft
Power Cost = $	0.155	/KWh
Operations & Maitenance =	$6	/af

Capital Costs

Capital = $	1,517,100	
Interest Rate =	6%	

2.5 GHCSD Antelope Conjunctive Use Project (Steuber Phase)

2.5.1 Project Physical Benefits

PROJECT BENEFIT 1 (PRIMARY) – WATER RELIABILITY

Peak Demands

GHCSD currently has twelve operating wells. If the largest capacity well, Iriart Well, is out of service, then they will not be able to meet peak summertime demands. The California Department of Public Health (CDPH) requires that water systems have the ability to meet maximum-day-demand with the highest capacity well out of service, for systems that rely solely upon groundwater (Section 64554(c) of the California Waterworks Standards). Iriart Well is a high-producing well, but is also 68 years old. A video inspection showed some well casing damage indicating that the well may have a limited life expectancy. The new proposed well could help GHCSD meet peak demands if Iriart Well is out of service.

Tehachapi Emergency Supply

The City of Tehachapi and GHCSD, like all water agencies, are susceptible to water supply shortages from natural disasters, droughts, facility malfunctions, water contamination and many other reasons. As a result, several years ago they built an interconnection between the two agencies. Water was delivered to the City through the interconnection approximately five years ago to help them meet demands. In addition, several years ago there was an offer to transfer water during some extensive brush fires in the area, but in the end the water was not needed. The interconnection has proven to be a valuable tool to improve water reliability for both agencies, and will continue to be important.

In fact, the City of Tehachapi and GHCSD are planning ways to integrate their water systems in a manner that: (a) makes sense from a regional planning perspective, (b) maximizes the joint use of existing resources available to each agency, (c) improves the reliability of service to the customers of each agency, and (d) minimizes costs to the ratepayers of each agency. The construction of the proposed transmission pipeline is a fundamental component of this plan.

According to the Tehachapi Regional UWMP (GEI, Inc., 2011), the City's water demands are expected to increase by about 50% from 2015 to 2040 (p 129). The increasing demand will create greater risks of an outage, making the proposed project more valuable as an instrument of water reliability. The existing interconnection has a capacity of 800 gpm, and the new well will add 500 gpm of capacity that could help meet demands in the City. The City has agreed to be a project sponsor and fund 50% of the pipeline cost. The well will be 100% owned by GHCSD. The pipeline will provide access to emergency supplies when the full capacity of the new well is not needed by GHCSD, and provide capacity for future City wells that will ultimately be constructed and connected to the new pipeline.

TCCWD Recovery Water

TCCWD is the regional Water Master according to a 44-year old adjudication agreement. The agency relies on State Water Project (SWP) water to meet the water demands of its customers. Much of the SWP water is recharged and later recovered. TCCWD is seeking to increase its groundwater pumping capacity to retrieve the recharged water, especially in drought years, so they can meet customer demands. TCCWD has expressed interest in connecting to the well in the future to increase their groundwater recovery capacity, especially in droughts. GHCSD has provided TCCWD with well capacity in the past, including the current drought years. This is not part of the proposed project, but is a planned future benefit of the project.

PHYSICAL BENEFIT 2 (SECONDARY) – WATER BANKING

Groundwater Banking Recovery

GHCSD currently needs greater groundwater recovery capacity in the vicinity of Antelope Dam. Antelope Dam is used to recharge imported State Water Project water, since GHCSD does not have a surface water treatment plant. The limited well recovery capacity has left Antelope Dam as an underutilized facility with only minimal recharge

performed. The District's Urban Water Management Plan (GEI Consultants, Inc, 2011) predicted that GHCSD's SWP water use will increase by 917 AF/year from 2015 to 2040. The District will therefore need an equivalent increase in recharge and recovery capacity. The Urban Water Management Plan also stated that "*Additional conjunctive use programs….will continue to be pursued*" (p 158). The proposed project will increase recovery capacity by an estimated 400 AF/year of previously banked groundwater and/or groundwater rights. The basis for this well yield is discussed in the section below entitled "Description of Methods used to Estimate Physical Benefits."

Table 2.5-1: Project 3 Annual Project Physical Benefit 1

Table 5 – Annual Project Physical Benefits Project Name: GHCSD Antelope Conjunctive Use Project - Steuber Phase Type of Benefit Claimed: Improved Water Reliability - Primary Benefit Units of the Benefit Claimed : AFY Additional Information About this Benefit: 50-year life expectancy, Benefit based on well capacity operated 50% of time			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years	Without Project	With Project	Change Resulting from Project (b) – (c)
2017 - 2066	0	400	400
Comments:			

Table 2.5-2: Project 3 Annual Project Physical Benefit 2

Table 5 – Annual Project Physical Benefits Project Name: GHCSD Antelope Conjunctive Use Project - Steuber Phase Type of Benefit Claimed: Groundwater Banking - Increase in Recovery Capacity Units of the Benefit Claimed : AFY Additional Information About this Benefit: 50-year life expectancy, Benefit based on well capacity of operated 50% of time			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years	Without Project	With Project	Change Resulting from Project (b) – (c)
2017 - 2066	0	400	400
Comments:			

2.5.2 Technical Analysis of Physical Benefits Claimed

[10 Pages Maximum]

Technical Basis of Project

The following documents were used to document the technical basis for the benefits claimed:

Document Name	Author/Source, Year	Appendix
2010 Tehachapi Regional Urban Water Management Plan	GEI Inc., 2011	**
Water Supply Assessment Review for the Golden Hills Community Services District	Provost & Pritchard Consulting Group, February 2010	**
Tehachapi Groundwater Basin Study Final Report	Fugro West, 2009	**
CEQA Initial Study/Mitigated Negative Declaration	Provost & Pritchard Consulting Group, 2014	**

*** Documents not included as an Appendix due to page restrictions, but can be provided upon request.*

Recent and Historical Conditions

Project beneficiaries in the region include:

Golden Hills Community Services District (GHCSD). GHCSD is a retail water agency, located west of the City of Tehachapi. GHCSD began in 1966 and is governed by a five-member Board. GHCSD encompasses approximately 5,400 acres consisting of approximately 4,000 parcels ranging in size from ¼-acre to over 20 acres (2010 data). The District supplements their groundwater allocation from the Tehachapi Basin with recharge water purchased from Tehachapi-Cummings County Water District. GHCSD has a goal of purchasing enough supplemental supply in advance, and storing it in Tehachapi Basin to assure adequate supplies are maintained to meet at least their five-year demand.

City of Tehachapi (City): The City was incorporated in 1909, and is located in the Tehachapi Mountains between Bakersfield and Mojave in Kern County, California. The City provides urban water supplies to its respective community. The City serves a population 8,673 (2010) and maintains 2,965 water service connections (2010). The City also provides wastewater collection and treatment within its service area.

Tehachapi-Cummings County Water District (TCCWD): The TCCWD is located in the Tehachapi Mountains, east of the Southern San Joaquin Valley and encompasses approximately 266,000 acres. The TCCWD provides imported water supplies (from the State Water Project (SWP)), water resource management, and flood protection in the greater Tehachapi area. The three groundwater basins managed by TCCWD include the Brite, Cummings and Tehachapi Basins. TCCWD imports supplemental water through the California Aqueduct, and sells this SWP water to several communities including the City of Tehachapi and GHCSD. The TCCWD Service Area has a population of 36,300. The estimated annual water demand for the service area in 2010 is approximately 12,314 AF. TCCWD water resources management responsibilities include Watermaster services for the Tehachapi, Cummings and Brite Groundwater Basins. TCCWD is a potential future beneficiary of the project.

History of Water Resources in the Region

In the 1960's TCCWD pursued SWP water as an imported water supply to help supplement dwindling groundwater supplies. In December 1966, TCCWD executed two contracts with Kern County Water Agency for access to the SWP supplies. One contract was for 5,000 AF of agricultural water and the second was for 15,000 AF of M&I water. Construction of the water system to deliver SWP water began in May 1972. On November 4, 1973, the first imported water was pumped from the State Aqueduct into the Tehachapi area. TCCWD makes direct deliveries of SWP water to agricultural users and delivers water through conjunctive use to urban water purveyors. Customers within the City of Tehachapi and GHCSD are the predominant urban water users in the basin. As mentioned, these urban water purveyors utilize their allowed pumping allocations and supplement with SWP water through

conjunctive use by artificial recharge in the Water Canyon (also known as China Hill) recharge area for GHCSD, and the Antelope Dam recharge area for GHCSD and the City.

Regional Needs of Adjudicated Groundwater Basin

The Tehachapi Groundwater Basin is an adjudicated groundwater basin under California Superior Court Order. Adjudication of the basin was determined to be necessary due to dwindling groundwater supplies. The basin has been actively managed by TCCWD, the court designated Watermaster, for over 40 years. Since the groundwater basin is adjudicated, and the region relies on imported surface water, overall water supplies are almost always limited. The proposed project will facilitate additional groundwater banking and help the region as a whole to meet their water demands.

The project is critically needed for the following reasons:

Inadequate Well Capacity. GHCSD currently has inadequate capacity to meet their demands if their largest well is out of service. See the later section on *Description of Methods Used to Estimate Physical Benefits* for detailed well statistics. A 2010 water supply assessment report for GHCSD stated: "*Currently, the District is considering options to develop an additional well east of the City of Tehachapi; based on existing usage rates, a new well supply will be need to be operational by May 2011*." No wells have been completed since the report was completed, and the proposed project has therefore been overdue for at least 4 years. Low well capacity also threatens GHCSD's ability to provide emergency water to the City of Tehachapi when they request it.

Susceptibility of Leased Water Rights. The District currently leases water rights to meet a large part of their demand, but the lease is short-term and vulnerable. The water rights are called 'Lehigh Rights', after the water rights holder, the Lehigh Cement Company. These water rights are groundwater allocations assigned to the Lehigh Cement Company, which is located in the same groundwater basin. The Cement Company does not currently need all of their groundwater allocation, and has been leasing the surplus to GHCSD. However, the contract is short-term and renewed annually. GHCSD has offered to permanently purchase the water right, but Lehigh Cement has not accepted their offers. GHCSD uses the Lehigh water because it is substantially less expensive than State Water Project water ($46/AF versus $456/AF), and is more convenient since it is local versus imported. The Tehachapi Regional Urban Water Management Plan predicted that the Lehigh Water rights would no longer be available after 2020. This creates a need to expand groundwater banking capacity to meet future needs.

As the wholesale water agency for the area, TCCWD does not typically use all of their State Water Project allocation, and more is currently available to GHCSD for recharge (Water Supply Assessment Review for the Golden Hills Community Services District, 2010). TCCWD takes several measures to ensure water reliability to the local agencies, such as participation in the Kern Water Bank in the San Joaquin Valley. GHCSD will be more dependent on the SWP water supply if the Lehigh Water Rights are cancelled. Since GHCSD does not have a surface water treatment plan they must recharge and then extract the water. Information on TCCWD's SWP supply is provided in the 2010 Tehachapi Regional Urban Water Management Plan (GEI, Inc., 2011). The District has a SWP Table A allocation of 20,000 AF/year. Long-term reliability of the SWP water was estimated to be about 60% in the Urban Water Management Plan, resulting in an average of 12,000 AF/year. However, TCCWD has never used more than about 9,000 AF in a given year. As a result, there is sufficient water available for GHCSD to recharge 400 AF/year or more at Antelope Dam, except for in very dry years.

*Inadequate Recovery Capacity at Antelope Dam Recharge Facility***.** The Antelope Dam is located about a mile to the southwest of the project site. The Antelope Reservoir enables the City of Tehachapi and GHCSD to purchase State Water Project (SWP) water from TCCWD, spread and percolate the water in the reservoir, and extract the water for beneficial use. The new well will be near the reservoir, and be able to capture water that recharges in the reservoir. The District operates 12 wells, but only one is in the vicinity of the Antelope Dam Recharge facility. As a result, virtually no water has been recharged at Antelope Dam since 2003, despite water being available, due to lack of recovery capacity. Additional wells are needed in the vicinity of Antelope Dam.

In 2005, the GHCSD constructed the Morris Park Well and transmission pipeline (shown as Segments 1 and 2 on **Figure 2.3-3**) to recover water recharged at Antelope Dam. It was anticipated that the Morris Park Well would have a capacity of 1,000 gpm; when the well was constructed it could only reliably produce 400 gpm. More capacity is needed to recover banked groundwater in the area, leading to this proposed project.

Estimates of Without-project Conditions

The following conditions would occur without the project:

GHCSD Peak Demands. GHCSD may not be able to meet peak demands during summer months, or fire flow demands, if their largest well, Iriart Well, is out of service. Iriart Well is 68 years old and beyond its life expectancy, making a water shortage a realistic situation. This is discussed in the 2010 Tehachapi Regional Urban Water Management Plan below:

> *"In accordance with industry standard practices and the CDPH criteria for "Adequate Source Capacity" on water supply, the source should be sized to serve at least the Maximum Day Demand (MDD). Standby production is required for system reliability. Under normal operating conditions, it is possible that many of the agency's smaller wells can be rotated out of service during MDD conditions due to equipment malfunctions, servicing, or for water quality concerns, without imposing shortages. However, larger wells, such as the Iriart and Morris Park wells for Golden Hills CSD, cannot be rotated out without imposing shortages."* (p 158)

Groundwater Recharge and Recovery. The District has limited ability to recover water recharged at Antelope Dam. As a result, recharge in the area has essentially been zero for the past ten years, and will continue to be minimal.

Tehachapi Emergency Supply. If the City of Tehachapi needs an emergency water supply, GHCSD may have limited or no capacity to send water through the existing interconnection.

Reduced Revenue. Both the City and GHCSD may lose revenue if they have inadequate capacity to meet demands, or need to enforce mandatory water restrictions due to an outage or catastrophic water supply interruption.

*Impacts from Power Outages***.** The District's wells are on two different electric grid systems. Most of the wells are located within the District boundary and are all on a single grid system, but the Steuber Well is located in a different electric grid. Without the project the District's water supply can experience a substantial reduction in capacity when the electric service is out.

Description of Methods used to Estimate Physical Benefits

Following is a discussion on how the physical benefits were estimated.

The life expectancy of the project is estimated to be 50 years, in accordance with industry standards. Underground pipelines can last longer than 50 years. The District's Iriart Well is still producing at high capacity and is 68 years old. As a result, a 50-year life expectancy is considered reasonable.

Physical Benefit 1

Category: Water Supply Reliability, Water Conservation, and Water Use Efficiency

Description: Improve Water Reliability

The project will improve water reliability by providing extra peaking capacity for GHCSD, and an emergency water supply for the City of Tehachapi.

Additional Well Capacity in GHCSD

The existing well capacities in GHCSD are shown in the table below.

Table 2.5-3: Well Capacities (2015)

Well	State I.D. #	Well Capacity (gpm)	Status
A	32S/33E-19N01	160	
B (Sunnybrook)	32S/32E-14F01	125	Inactive due to water quality problems
C	32S/32E-25F01	100	Standby due to water quality problems
D (Meadowbrook)	32S/33E-19C02	80	
F	NA	110	
Iriart	32S/33E-30K01	780	
L-2 (Lamb)	32S/33E-19D02		Inactive due to water quality problems
RA-1 (Red Apple)	32S/33E-19L01	200	
S1	32S/33E-19P01	80	
S2	32S/32E-13R01	175	
P (Poor)	32S/33E-18D01	50	
V (Vukich)	32S/33E-19L02M	80	
Morris Park	32S/33E-28J02	390	
	Total (gpm)	2,330	

Table 2.5-4 includes a comparison of peak demands and well capacities in GHCSD. The table shows that if the District's largest well, Iriart Well, is out of production, then GHCSD cannot meet peak demands. They could also fail to meet peak demands if several smaller wells are out of production.

Table 2.5-4: Comparison of GHCSD Supplies and Demands

Description	Value	Notes
Max. Month Water Demand	62 MG	
Max. Month Water Demand	2.00 MGD	
Max. Day Demand Factor	1.5	
Max. Day Demand	**3.00 MGD**	
Potential Water Pumping Capacity	3.72 MGD	
Current Water Pumping Capacity	3.32 MGD	(w/o B or Lamb Wells)
Pumping Capacity w/o Iriart Well	**2.15 MGD**	(w/o Iriart, B or Lamb Wells)

<u>Well Capacity</u>

The assumed well capacity of 500 gpm is based on experience constructing other wells in the area and their capacities. Below is a list of other nearby wells:

- GHCSD: Morris Park Well - 400 gpm
- TCCWD: Denisson Well - 1,050 GPM
- TCCWD: Nunes Well - 450 GPM
- City of Tehachapi: Snyder Well - 750 GPM

The assumed well capacity of 500 gpm capacity can yield 2.21 AF/day or 806 AF/year. On a more practical level, due to maintenance and lower demands in the winter, it is assumed that the well will only operate half time, so the well yield would be about 400 AF/year.

Well Location

The proposed well is located in an area recommended for new wells to prevent imbalances in the basin. The *Tehachapi Groundwater Basin Study Final Report* by Fugro West, Inc., dated June 2009 included the following statement:

> *"…locating high production wells in areas southeast and east of the City of Tehachapi and north of the Antelope Basin appears to mitigate against significant declines in groundwater levels that could occur if these wells were located in the western and southwestern areas of the Basin [in the southern areas of GHCSD]*." (p 41)

This validates the proposed benefit of managing and reducing the cone of depression currently occurring in the District. Also, the well is located sufficiently far away enough from other nearby wells to prevent significant production impacts. The nearest well is a private domestic well and is approximately a quarter mile away. It is important to note that GHCSD will only extract groundwater from the new well to the extent that (a) they have previously recharged surface water at Antelope Dam or (b) GHCSD is extracting its adjudicated water rights.

Emergency Water Supply to the City of Tehachapi. The City of Tehachapi will fund 50% of the pipeline cost, and thus have opportunities to obtain water from the new well during emergencies and outages. The water would be delivered through an existing interconnection between GHCSD and the City. The interconnection has a capacity of 800 gpm, which exceeds the assumed well capacity of 500 gpm. As shown above, GHCSD has insufficient redundancy in their well system. If one or more wells are out of service they might have insufficient capacity to provide requested emergency water to the City. The new well will increase the likelihood that GHCSD can deliver water to the City when requested.

Physical Benefit 2

Category: Water Banking, Exchange, Reclamation, and Improvement of Water Quality

Description: Increase Groundwater Banking Capacity

The project will enhance the District's ability to bank groundwater by addressing current limitations in groundwater recovery capacity, which limit the volume that can be practically recharged at one of the facilities. The District has two recharge facilities: Water Canyon and Antelope Dam. Only one of the twelve wells in **Table 2.5-3** above is near Antelope Dam. **Table 2.5-5** shows the volume of water recharged in the two banks.

Table 2.5-5: Historical Groundwater Recharge (AF/year)

Year	Water Canyon Recharge	Antelope Dam Recharge[1]
2003	160	0
2004	249	0
2005	5	0
2006	0	0
2007	0	0
2008	50	0
2009	168	0
2010	0	0
2011	399	0
2012	200	0
2013	403	0
2014	150	0

1 - Recharge at Antelope Dam has been limited to less than 50 AF, and was not documented in the records.

The District generally does not use the Antelope Dam recharge area due to limited recovery capacity. This data clearly shows that the Antelope Dam is underutilized. The TCCWD, who is the wholesale water agency for imported SWP water, often has extra SWP water to sell to local water agencies. With additional recovery capacity, GHCSD will have opportunities to bank more water in Antelope Dam, and create greater water reserves for the future. This would result in up to 400 AF/year either stored or recovered from the groundwater bank.

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

Facilities

The facilities needed to obtain the physical benefits include the well, pipeline and appurtenances listed in the project description. Some other necessary facilities already exist, including the interconnection with the City of Tehachapi, and the Antelope Dam recharge facility.

Policies

Project operation and maintenance will be possible under the District's current policies. The District will need to finalize a Joint Agencies Agreement with the City of Tehachapi and TCCWD (the agreement is currently in draft form), which will include approval to use an existing easement for the pipeline.

GHCSD will only extract groundwater to the extent they are allowed by their adjudicated rights, or have previously recharged the water, likely at the nearby Antelope Dam. This is based on the current rules of the groundwater basin adjudication.

Action

Actions needed include completing the design, obtaining permits, constructing the projects, performance testing, and long-term monitoring to verify intended benefits. Some project tasks are already complete, including a preliminary assessment and evaluation, final well design and the CEQA Initial Study.

Potential Adverse Physical Effects

The potential adverse physical effects of the project were investigated in a CEQA Initial Study that was adopted on April 18, 2014. A copy of the Initial Study can be provided on request and is available on the GHCSD website *(http://ghcsd.com/)*. **Table 2.5-6** summarizes the results of the Initial Study under seventeen CEQA topics.

Table 2.5-6: Summary of CEQA Initial Study

Topic	Potential Impact	Notes
Aesthetics	None	Project in disturbed agricultural area. Pipeline and well would be underground with other mechanical components inside a small building.
Agricultural Resources	Less than significant	Well would be located on land designated as Grazing Land. Pipeline would be in Prime Farmland, but buried underground within existing access road. Site is zoned for Exclusive Agriculture. Impacts would be temporary.
Air Quality	Less than significant	Estimated pollutant concentrations (VOC = 0.9 tons/year, NOx = 0.6 tons/year and PM_{10} = 0.4 tons/year) would not pose a hazardous threat to any sensitive receptors, and would be below local significance thresholds.
Biological Resources	Less than significant	Project site is already disturbed grazing and farm land. No viable habitat for sensitive species. Database search did not find any sightings on project land. No wetlands or riparian lands on site. No habitat conservation plans cover lands.
Cultural Resources	Less than significant with mitigation	Archaeological and historical investigations did not identify any archaeological resources, cultural resources, or human remains, significant or otherwise, within the proposed project site or surrounding area. Some cultural resources are present in the general area, so mitigation measures are documented in case something is found.
Geology and Soils	Less than significant	Land is relatively flat. No or less than significant risk of landslides, liquefaction, soil erosion, lateral spreading, subsidence, high soil expansion, or septic system problems.
Greenhouse Gas Emissions	Less than significant	Temporary construction emissions would be minimal, and project operations would not exceed any thresholds of significance in local Specific Plan or General Plan.
Hazards and Hazardous Materials	Less than significant	A search of the Envirostor and Geotracker databases found no known hazardous waste generators or hazardous material spill sites on the project site. No hazardous materials would be used for construction.
Hydrology and Water Quality Resources	Less than significant	The project site does not include any lakes, streams, floodplains, or other bodies of water. Since the groundwater basin is adjudicated, groundwater pumping is restricted, and the project will not contribute to overdraft. The area has good groundwater quality and is not near any other wells.
Land Use Planning	No Impact	The project would not conflict with any applicable land use plans, policies or regulations.
Mineral Resources	No Impact	The site is not classified as a Mineral Resource Zone by the State of California or local plans. There are no known mineral resources on the site.
Noise	Less than significant	No long-term noise would be generated due to the well using a submersible pump and mechanical components enclosed in a small building. The project will only produce temporary construction noise.
Population and Housing	Less than significant	The project would supply water for existing residents and the growth already anticipated under the General Plan and Greater Tehachapi Area Specific Plan build-outs.
Public Services	No Impact	The project would not require the addition or alternation of any public services.
Recreation	No Impact	The project would not increase the demand for recreational facilities nor put a strain on any existing recreational facilities.
Transportation and Traffic	No impact	Construction would be temporary and no roads would be modified.
Utilities and Service Systems	No impact	Groundwater pumping will be limited to District's adjudicated limit. The project will not generate solid waste, wastewater, or stormwater.

The project would not be growth-inducing and is meant to help meet existing demands and demands for already planned growth. This topic is addressed in the Initial Study as follows:

> *"Since the GHCSD's capacity goals are based on the potential number of housing units and residents that could be accommodated within the District's service area, as projected by the County's General Plan and the GTA Specific Plan, the proposed Project would only serve to meet the District's capacity goals and not exceed them. While additional water would be supplied under the proposed Project, it would be for existing residents and the growth already anticipated under the General Plan and GTA Specific Plan build-outs."*

The Initial Study includes the following Findings of Significance:

> *"…the proposed project would not be expected to significantly degrade the quality of the environment, substantially reduce the habitat or population of any plant or wildlife species, or eliminate important examples of California history or prehistory….. All potential impacts would be reduced to a less than significant through the implementation of basic regulatory requirements, and/or conditions of approval incorporated into future project design. Therefore, the proposed project would not have any direct or indirect adverse impacts on humans."*

How Project Effectively Addresses Long-Term Drought Preparedness

The proposed project can help to address long-term drought preparedness as follows:

1. The project includes a new 500 gpm water supply that can help the region meet demands when water is in short supply.
2. A large cone of depression is forming in GHCSD where most of their wells are located. The proposed well would be several miles east of the District, in an area with higher and more stable groundwater levels. The new well could be an important water supply in droughts if other wells in the cone of depression temporarily go dry.
3. The well will provide a water supply to deliver up to 500 gpm to the City of Tehachapi (through an existing 800 gpm interconnection) during emergencies and droughts.
4. The District has the opportunity to recharge water at Antelope Dam, but has very limited capacity to recover recharged water. In 2006, GHCSD constructed the Morris Park Well in the area, but the capacity was only 400 gpm, compared to an anticipated 1,000 gpm. This has limited how much water can be banked at Antelope Dam, and additional well capacity is needed in the area. The well will provide 500 gpm of recovery capacity, which equates to 400 AF/year if operated 50% of the time (considered a reasonable assumption). Therefore the well will provide much needed recovery capacity, and facilitate the banking and recovery of up to 400 AF/year in drought years.
5. The Joint Agencies Agreement has been drafted so that TCCWD can connect the new well to their own pipeline in the future (with State approved backflow prevention equipment). This will provide the TCCWD greater groundwater recovery capacity in droughts when surface water supplies for agriculture are limited. In the past, GHCSD has provided TCCWD well capacity in drought years, including the use of Iriart well in the spring months under the current drought year. The agreement for the new well will be similar to their past agreements.

2.5.3 Direct Water-Related Benefit to a DAC

[1 Page Maximum]

The project will benefit an area that is over 25% disadvantaged community. For more information on how DAC eligibility was determined please refer to Attachment 7 – Disadvantaged Community Assistance. The project will meet a critical water supply need in GHCSD by helping them to meet peak demands and prevent water shortages. It will also provide an emergency water supply for the City of Tehachapi, and help to ensure they have continuous and reliable water in the event of an outage, emergency or water quality problem. The pipeline will also be 50% owned by the City of Tehachapi, and their share of the capacity will also be reserved for future well construction and future demand in the City. The project is also similar to one of the example projects that meet a critical water supply need in Table 9 of the IRWMP guidelines – "*Replacement of Water Supply Wells that have exceeded their useful life (older than 50 years)*." The proposed well is meant to backup the 68-year old Iriart Well in case of a short-term or long-term outage, since the Iriart well is the highest capacity well for the District.

2.5.4 Project Performance Monitoring Plan

DWR Proposal Solicitation Package (PSP) Table 6 lists the proposed physical benefits, targets, and measurements tools and methods.

Table 6 – Project Performance Monitoring Plan

Project Name: Antelope Conjunctive Use Project – Steuber Phase

Proposed Physical Benefits	Targets	Measurement Tools and Methods
Water Reliability - Total Well Pumping	400 AF/year long-term average	Flowmeter placed on well
Water Reliability - Well Pumping during Outages	It is not possible to predict the frequency of outages. However, the target is to provide up to 500 gpm during each outage to help meet demands.	Flowmeter placed on well
Water Reliability - Emergency Deliveries to Tehachapi	It is not possible to predict the frequency of emergency events. However, the target is to provide up to 500 gpm whenever requested by the City.	Flowmeter in interconnection between GHCSD and City of Tehachapi
Water Banking - Increase in Groundwater Recharge over Historical Deliveries	400 AF/year long-term average	Flow measuring facilities at Antelope Dam

Interim Targets. The project does not include interim or short-term targets that differ from long-term targets. Rather, the full benefits should be available as soon as the project is constructed. Some long-term benefits, which are planned but not part of the proposed grant project, include the addition of a new City of Tehachapi Well, which would use some of the excess capacity in the pipeline and the use of the well by TCCWD in drought years.

Data Collection. The data will be collected directly at the flow measuring devices described in PSP Table 6.

Analysis Used. Only minimal analysis will be needed for the monitoring. When estimating the contribution of well pumping during GHCSD outages, it will require an evaluation of all well pumping to determine if, and how much, the new well is helping to prevent water shortages. Emergency deliveries to Tehachapi will also require an evaluation of total well pumping capacity, to determine if the new well is making deliveries to Tehachapi possible.

Appropriateness of Targets. 400 AF/year represents the well operating at the design capacity 50% of the time. This is appropriate based on lower demands in the winter and the occasional need for maintenance. Meeting emergency and peak demands whenever needed is appropriate, since these occurrences may not be common and satisfying them is a very high priority.

Measurement of Performance. Performance will be measured by the ability to meet the targets. The pumping and recharge values will be compared to the targets and reported as a percentage of the target. Likewise the ability to provide water supplies during outages and emergencies will be based on the percentage of incidences that the new well can meet the requested demand.

2.5.5 Cost Effective Analysis

Table 7 - Cost Effective Analysis **Project Name: Antelope Conjunctive Use Project – Steuber Phase**	
Question 1	Types of benefits provided:
	Improved water reliability to meet peak demands for GHCSD and provide emergency supplies to the City of Tehachapi.
	Expand groundwater recovery capacity to allow greater groundwater banking at the Antelope Dam.
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: The proposed project includes construction of a new well and pipeline to provide up to 500 gpm capacity to help meet peak demands in GHCSD and provide an emergency supply to the City of Tehachapi. The project is estimated to cost $1.35 million. The following alternatives were considered: 1. Construct Wellhead Treatment on Existing Inactive Wells. Three wells in the District are not used due to water quality problems. A cost estimate was prepared in 2013 to install wellhead treatment for manganese on Well B. The new facilities were estimated to cost $420,000 and have annual O&M cost of $22,000. Well B only has a capacity of 125 gpm. The well capacity is only 25% of the estimated capacity of the new well, but has 30% of the cost (not including additional O&M costs). As a result, this option is less economical than the proposed project. Pumping water from Well B would also exacerbate cone of depression problems inside the District. 2. Construct New Well in District Boundaries. A new well could be constructed in the District boundaries and eliminate the need for a long pipeline. The new well would likely cost the same as the proposed Steuber Well, which is about $650,000 for planning, design and construction. This is about half the cost of the proposed project, however, wells in the District have capacities less than 200 gpm, compared to the estimated 500 gpm proposed well east of the District. This is due to unfavorable geology and lower groundwater levels. Several wells inside the District boundary are inactive or on standby due to water quality problems from manganese, iron, arsenic, nitrates and PCE. However, wells east of the District have shown no water quality problems. Due to less favorable economics, and potential water quality problems, this option is not preferred.

	3. External Groundwater Banking. Water could be banked in an external groundwater bank in the San Joaquin Valley and then delivered when needed to the area. Since the District has no surface water treatment plant, and limited regulation storage, the banked water would still need to be recharged and recovered from District wells, making this option illogical.
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 least cost alternative.
Comments:	

2.6 Lake of the Woods Water Main Replacement & Meter Installation Project

2.6.1 Project Physical Benefits

The LOWMWC Project will result in the following physical benefits:

- **Physical Benefit 1 (Primary) – Water Conserved**: Installing new water mains will save a minimum of 4.0 percent of current water usage or approximately 1.2 million gallons (MG) (3.5 AF) per year (over a 50 year period). Installing water meters will save approximately 15 percent of current water usage or approximately 4.3 MG (13.2 AF) per year (over a 20-year period). This is accomplished by incentivizing water conservation through the implementation of 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 and potential leaks on their property for repair, thereby reducing non-essential water use. Over the life of the project an estimated 442 AF of water will be conserved (average annual volume over 50 years = 8.8 AF/year).
- **Physical Benefit 2 (Secondary) – Energy Saved**: The energy benefit will be accomplished through the reduced electricity use for pumping 8.8 AF/year less of water on an average annual basis. The resulting annual average energy saved is estimated at 23,700 kilowatt-hours/year (kWh/year). The energy savings over the 50 year life of the project is 1,187,000 kWh. As a different type of energy saved, the project will also eliminate the need to truck water to the community, which required 2,355 gallons of diesel fuel in 2014 (Not included in Physical Benefit 2 quantification).

Table 2.6-1: Project 4 Annual Project Physical Benefit 1

Table 5 – Annual Project Physical Benefits Project Name: LOWMWC Water Main Replacement & Meter Installation Project Type of Benefit Claimed: Water Conservation - Primary Benefit Units of the Benefit Claimed : AFY Additional Information About this Benefit: Water conserved through reduction in water main losses are based on a 50 year water facility service life. Water conserved through meter implementation are based on a 20 year water meter service life.			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years	Without Project	With Project	Change Resulting from Project (b) – (c)
2017 - 2036 (20 years)	88.1	71.4	16.8
2036 - 2066 (30 years)	88.1	84.6	3.5
Comments:			

Table 2.6-2: Project 4 Annual Project Physical Benefit 2

Table 5 – Annual Project Physical Benefits Project Name: LOWMWC Water Main Replacement & Meter Installation Project Type of Benefit Claimed: Energy Saved - Secondary Benefit Units of the Benefit Claimed : kWh/year Additional Information About this Benefit: Energy conserved is directly proportional to water conserved. This is a conservative estimate as the energy intensity is expected to reduce after conservation as discussed in the Technical Analysis of Physical Benefits Claimed			
(a)	(b)	(c)	(d)
	Physical Benefits		
Years	Without Project	With Project	Change Resulting from Project (b) – (c)
2017 - 2036 (20 years)	237,000	191,921	45,079
2036 - 2066 (30 years)	237,000	227,471	9,529
Comments:			

2.6.2 Technical Analysis of Physical Benefits Claimed

[10 Pages Maximum]

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

Document Name	Author/Source, Year	Appendix
LOWMWC Preliminary Engineering Report	Dee Jaspar & Associates, April 2014	**
Groundwater Conditions at Lake of the Woods	Kenneth D. Schmidt & Associates (KSA), January 2014	**
Compliance Order No. 03-19-14O-002 – Waterworks Standards Violation	Division of Drinking Water - SWRCB, September 2014	**
Manual of Water Supply Practices, M36 – Water Audits and Loss Control Programs	American Water Works Association (AWWA), 2009	**
California Single Family Home Water Use Efficiency Study	Aquacraft Water Engineering & Management, 2011	Document Link

** Documents not included as an Appendix due to page restrictions, but can be provided upon request.

Recent and Historical Conditions

Lake of the Woods Mutual Water Company serves domestic water to a small mountain community of approximately 750 residents located in Southern Kern County. The Water Company currently has 4 groundwater wells that pump from the Cuddy Ranch Area Basin and conveys the water to 406 customers through unmetered water services. The groundwater basin is primarily dependent upon deep percolation of local precipitation, along with ephemeral streamflow in Cuddy Creek. Due to the current 4-year drought, limited rain and snowfall has occurred in the area, further reducing the groundwater supply in the basin, and resulting in the current water supply emergency.

Kenneth Schmidt & Associates, a local hydrogeologist has reviewed the hydrogeology of the basin and reported the following in their review: “One problem has been that during prolonged periods of no streamflow in Cuddy Creek, the alluvial deposits become substantially dewatered, and water production from hardrock has been limited.” The declining groundwater levels due to the current drought can be seen in **Figure 2.6-1**. Because of this condition, the Water Company’s groundwater well production has been reduced from 310 gpm in 2011 to the current capacity of 72 gpm (a 77% decrease). **Figure 2.6-2** is a graph of the well production capacity; note that the loss of Well 5 in late 2012 and dropoff in production from the other wells has severely impacted the Water Company’s supply, requiring mandatory water restrictions and hauling of water from a nearby community. In addition to the mandatory water restrictions, water conservation information was distributed to all users in 2013. In 2014, water conservation kits were delivered to all occupied services.

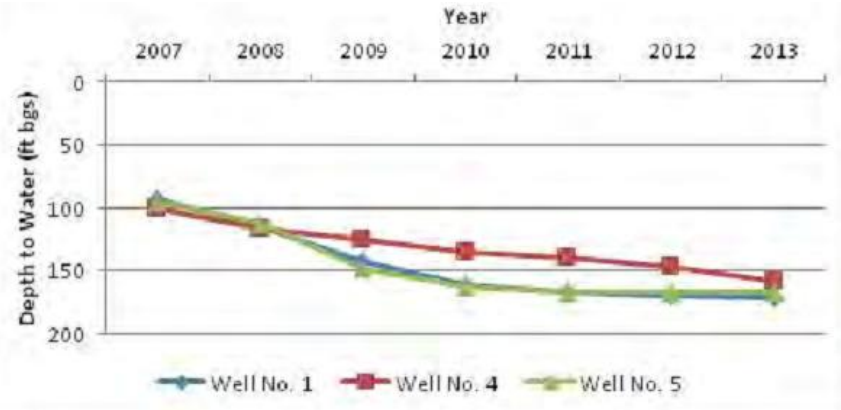


Figure 2.6-1: LOWMWC Well Pumping Water Levels (2007-2013)
Source: Dee Jaspar & Associates

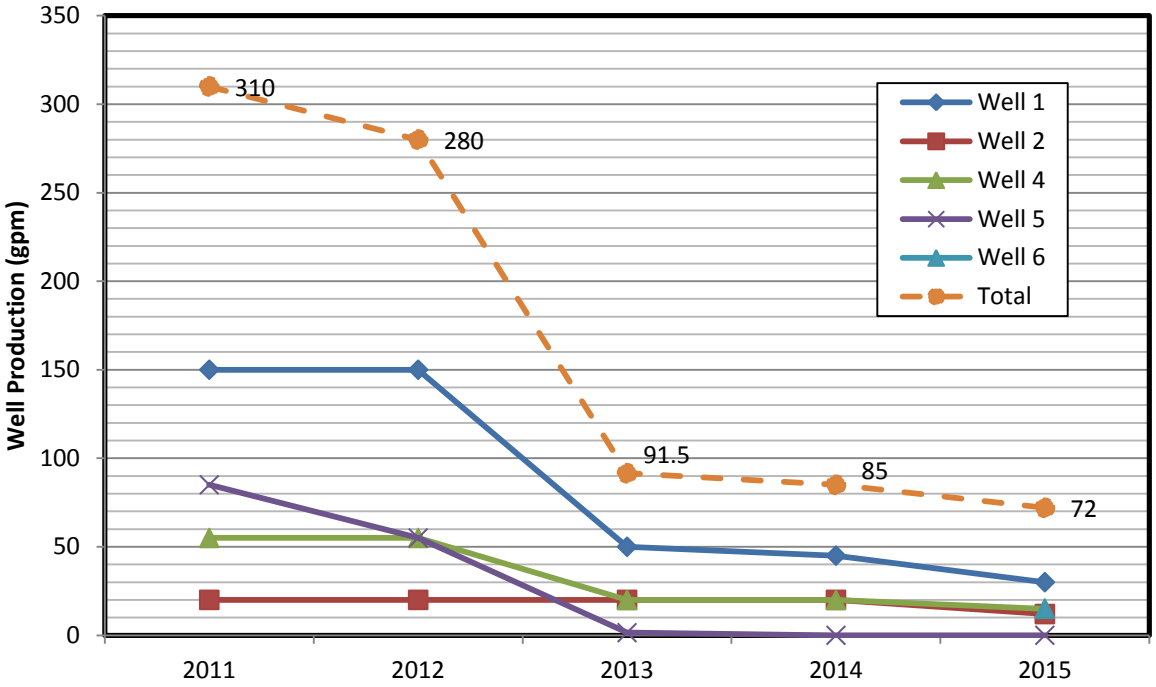


Figure 2.6-2: LOWMWC Well Production (2011-2015)

The monthly well production and water hauling required in 2014 is compared to the average well production of 2011 and 2012 in **Figure 2.6-3**. As shown in the figure, the LOWMWC customers have been able to reduce water use by 30,000 to 40,000 gallons/day in the summer months through water restrictions. Water restrictions have mandated that customers not use water for landscaping or outdoor cleaning (e.g. washing cars, cleaning driveways). However, conservation efforts are not enough to meet system demands in the summer months. In order to prevent water distribution outages and resulting health and safety emergencies, the Water Company has contracted with RMR Water Trucks out of Castaic (37 miles away) to haul water from Lebec County Water District's wells (8 miles to the east). From the period of May to September an average of 430,000 gallons per month are hauled (2.2 MG total in 2014). The cost of purchasing water from Lebec CWD and trucking the water to LOWMWC was $122,000 in 2014 ($0.056/gallon) The estimated fuel use for transportation was 2,355 gallons of diesel in 2014 (approximately 3.5 gallons per trip, carrying 3200 gallons of water each trip).

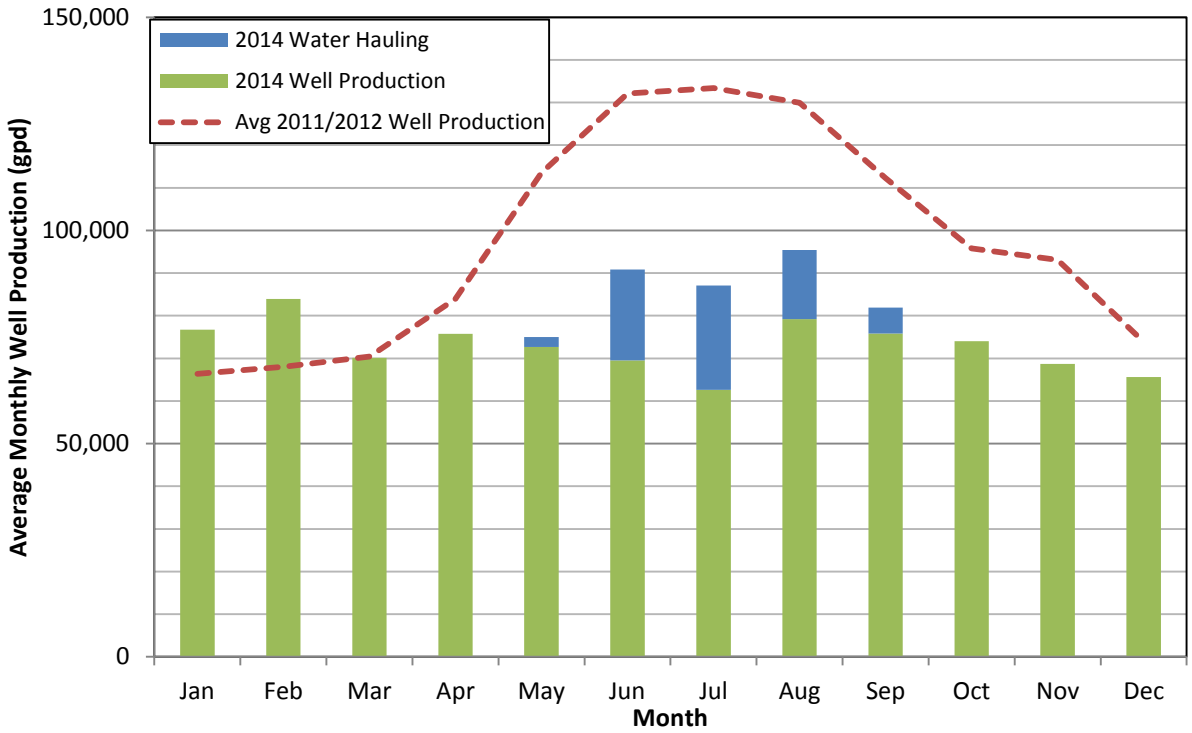


Figure 2.6-3: LOWMWC Well Production and Water Hauling – Average of 2011/2012 vs. 2014

The Water Company has been searching for additional groundwater supply capacity. This has included the unsuccessful well rehabilitation of Well No. 3 and drilling of 5 test holes that were found to be dry. Recently a private well was purchased and put into service in March 2015 (Well 6, also known as the Dark Canyon Well). In July, the most recent attempt at drilling a test hole resulted in finding a water source that is currently being placed into service as Well No. 7 at a flowrate of 12 gpm. However, initial water quality analysis indicates a high nitrate level in the new well which may affect its use and require blending with other well sources. With Well No. 7, LOWMWC will have an estimated well production capacity of 84 gpm. However, some of these wells can only be run for reduced periods of time in a day or else the pumps run dry and suck air; therefore, the maximum average monthly production capacity is 90,000 gallons/day (with Well No. 7). This flowrate is still below the peak summer demands, much less than the historical water use of the service area without mandatory water restrictions.

A significant portion of the water supply is lost through water system leakage. Based on approximate estimates, the background water system losses are approximately 37% of the water supply (11 MG per year). In general, these background losses are considered to be underground leaks that do not rise to the surface where it can be reported. In 2014, approximately 30 reported leaks were repaired by the Water Company as indicated on **Figure 2.3-4**. The water lost from these reported leaks were not estimated at the time of repair. Water leaks occur more often along certain water mains in the Water Company that are comprised of older steel pipe material or inadequately installed PVC pipe material. Some of these water mains date back to the 1960s, with some pipes potentially dating back to the 1940s (Dee Jaspar, 2014). Pipeline leakage also creates a potential water contamination concern as low pressure situations (water outage or pipe break) can introduce bacteriological contaminants into the water system.

Many of these same leaky water mains in the service area are less than 3 inches in diameter (e.g. some ¾ to 1-½ inch) and prevent the Water Company from having adequate fire protection water capacity. As shown in **Figure 2.3-4**, the Kern County Fire Department has found that 12 fire hydrants generate flows less than 400 gpm (500 gpm is the minimum required flowrate). Fire protection is especially a concern as the community is in a mountainous region that is subject to brush and forest fires.

Example of an Existing Leaky Water Line With Multiple Repairs

As mentioned previously, the water system does not have water meters at the 406 customer services. Some customers may be conserving water in the current water supply emergency, but without water rates based on their own water use, water restrictions cannot be entirely effective. An impact to a customer's wallet is generally a better motivator for conservation than just civic responsibility. Additionally some customers may not realize that they have a leak on their water plumbing. AWWA reports that the "majority of leakage events and majority of leakage volume losses occur in customer service connection piping, not on the water main piping" (AWWA M36, 2011). Some of the causes mentioned include greater number of fittings and threads, variable installation practices, lesser caliber of workmanship, and disinterest/lack of knowledge or funds in making leak repairs.

In providing water to the service area, approximately 237,000 kilowatt-hours (kWh) were used in 2014 for powering the well pump motors. The average energy intensity for 2014 was 9 kWh per 1,000 gallons of water pumped. In comparison, the 2013 average energy intensity was 7 kWh/1,000 gallons. The increased energy intensity can be attributed to the reduced well production. As an example, operating staff typically have to throttle the pump control valve to limit the flow rate, or else the well will go dry, creating an unavoidable energy loss. Electricity costs have increased due to the increased energy intensity and the reduced ability to pump during off-peak electrical time periods (most of the wells pump around-the-clock to maximize production).

Estimates of Without-project Conditions

Without-project conditions are assumed to be similar to recent historical conditions where groundwater supply is limited. Factors such as groundwater table gain or decline, climatic conditions, and leakage from the distribution system affect future water supply and delivery; therefore, accurate prediction of these factors are not feasible. Nevertheless, based on the current water supply emergency, conservation measures will need to become a way of life for the community in order to maintain a greater balance in the groundwater basin.

It is expected that the contract operator will continue to perform more repairs on the water system as the facilities continue to age. If groundwater supply in the basin continues to decline and affect well capacity, or if one of the Water Company's wells were to become inoperable, water shortages would be more significant and potentially catastrophic (e.g. excessive costs from water hauling). Water restrictions would still be mostly unenforceable without water meters. Contamination of the water system is of continuing concern as well.

No significant increase to service areas population is expected over the project life. No new housing developments (or even individual homes) are planned for the community.

As discussed previously, a study is being conducted by Dee Jaspar & Associates regarding a potential interconnection with Frazier Park PUD. Frazier Park PUD is located in the adjacent Cuddy Canyon Valley Groundwater Basin (Basin No. 5-82 per DWR Bulletin 118) that has more groundwater contained in the aquifer. The PUD could potentially serve the water demands of Lake of the Woods in addition to Frazier Park's own water demands. However, before the interconnection can be implemented, Frazier Park PUD will require that LOWMWC repair its leaky water system and install meters on all of the customer services. Therefore, this option is not feasible without the Project.

Description of Methods used to Estimate Physical Benefits

Provost & Pritchard Consulting Group prepared the analysis regarding the physical benefits of the Project in the subsequent sections. For the analysis, we have used 2014 well production, water use, and energy use as a baseline condition. It is unlikely that well production volumes will increase even with a wet 2015/16 winter and it is more likely that conditions could become worse until the groundwater aquifer is recharged sufficiently. It should be noted that by using 2014 data, the analysis is considered to be more conservative; for instance, the typical industry water use reduction from installing water meters is approximately 15% of water use, which results in a lower yield based on 2014 data compared to older historic water use.

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 information obtained from water meter manufacturers. 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 – Water Conserved:</u>

Component 1: Conservation from Water Main Replacement

Currently there are no customer-side meters installed to monitor water distribution and water leakage in the distribution system. To obtain an approximate estimate of water conserved through the replacement of 7,300 feet of water mains, a field test was conducted by Provost & Pritchard in July 2015. With all groundwater wells turned off, the drop in water tank levels were observed from 11 PM to 1 AM to estimate the outflow from the tanks. As shown in **Figure 2.3-4**, the water system is served by two pressure zones (generally divided at Foothill Drive), North and South (with their respective water tanks). As shown in **Table 2.6-3** the South and North tanks dropped an average of 0.5 and 0.6 inches per hour, respectively. This equated to an overall outflow of 1,600 gallons/hour. An estimate of 75% of this outflow is attributed to water main losses or approximately 11 MG/year. To estimate losses conserved by the replacement water mains, these losses were equally apportioned over all the water mains in each pressure zone. With approximately 24% of the all the system's water mains replaced an estimated 1.2 MG (<u>3.5 AF/year</u>) will be conserved each year. As discussed, this annual water conservation amount is applied over a 50-year project life associated with the new water mains.

This estimate has been prepared conservatively based on the following reasons:

1. A similar prior test was conducted from 1 AM to 2 AM in December 2014 that found the South and North tank levels fall 1 inch/hr and 3 inch/hr, respectively. The more conservative test was utilized for this benefit analysis.
2. The 75% losses attributed to mains is conservative. Based on Aquacraft's *2011 California Single-Family Water Use Efficiency Study* sponsored by DWR, residential water use at this time period is approximately 0.5% of daily water use (percentage includes leaks downstream of customer meter but excludes irrigation as this is prohibited in LOW) (pg. 171 of the Study). This equates to approximately 20% of the flow from the tank at this time period for customer demand and 80% attributed to water mains.
3. The water losses have been equally apportioned to all water mains while losses are expected to occur to a greater extent on the water mains to be replaced. These water mains have been specifically identified for replacement due to higher repair occurrences and older age of the pipe.
4. Water losses conserved from reduced occurrence of major leaks visible at the surface have not been factored into this water loss estimate.

It should be noted that the estimated water loss percentage of 37% based on 2014 water use may seem high. In comparison with the 2012 water use of 38 MG, the percentage would be 29%.

Table 2.6-3: Estimate of Water Conserved by Replacement Water Mains

Description:	South PZ	North PZ		Total
	South Tank	*North Tank 1*	*North Tank 2*	
Storage Volume, gal	85,000	225,000	450,000	760,000
Diameter, ft	30	40	56	
Tank Level Drop per hour, inch/hr	0.5	0.6	0.6	
Tank Outflow, ft^3/hr	29	63	123	215
Tank Outflow, gal/hr	220	470	921	1,611
% of Outflow attributed to Main Losses	75%	75%	75%	
Estimated Main Losses, gal/hr	165	352	691	1,208
Estimated Main Losses, MG/yr	1.4	3.1	6.0	11
2014 Water Use, MG/yr				27
% of 2014 Water Use				40%
Exist. Mains to Remain in PZ, ft	4,572	18,406		22,978
Prop. Mains to Replace in PZ, ft	2,837	4,451		7,288
% of Mains Replaced	38%	19%		24%
Est. Main Losses Saved w Prop. Mains, gal/hr	63	69		132
Est. Main Losses Saved w Prop. Mains, MG/yr	0.6	0.6		1.2

Component 2: Conservation from Meter Installation

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,* municipalities in California 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 and notify customers of leakage (and subsequent repair of leaks). The Water Company will also implement home leak detection education outreach to system users, enabling them to eliminate in-home and property water leaks and waste. The water conservation from implementing a metered system is 4.3 MG/yr or 13.2 AF/year (based on 15% of 2014 water use and therefore more conservative). As discussed, this annual water conservation component is applied over a 20-year project life associated with the water meters.

Overall Water Conservation Benefit

The amount of water conserved by the proposed Water Main Replacement and Water Meter Installation Project is estimated to total 336 AF for the first 20 years and 105 AF for the remaining 30 years. For the 50 year project life, the total water conserved is 441 AF (average annual volume = 8.8 AF/year). The Cuddy Ranch Area Basin aquifer has a relatively small storage capacity and reduction of water losses will help reduce groundwater overdraft in the basin.

Figure 2.3-3 graphically represents the reduction in water use based on the conservation benefits of the project. Based on the projected demands with the Project (using 2014 demands as a baseline), the Water Company is not expected to have to haul water into the water system assuming that well production does not decrease significantly.

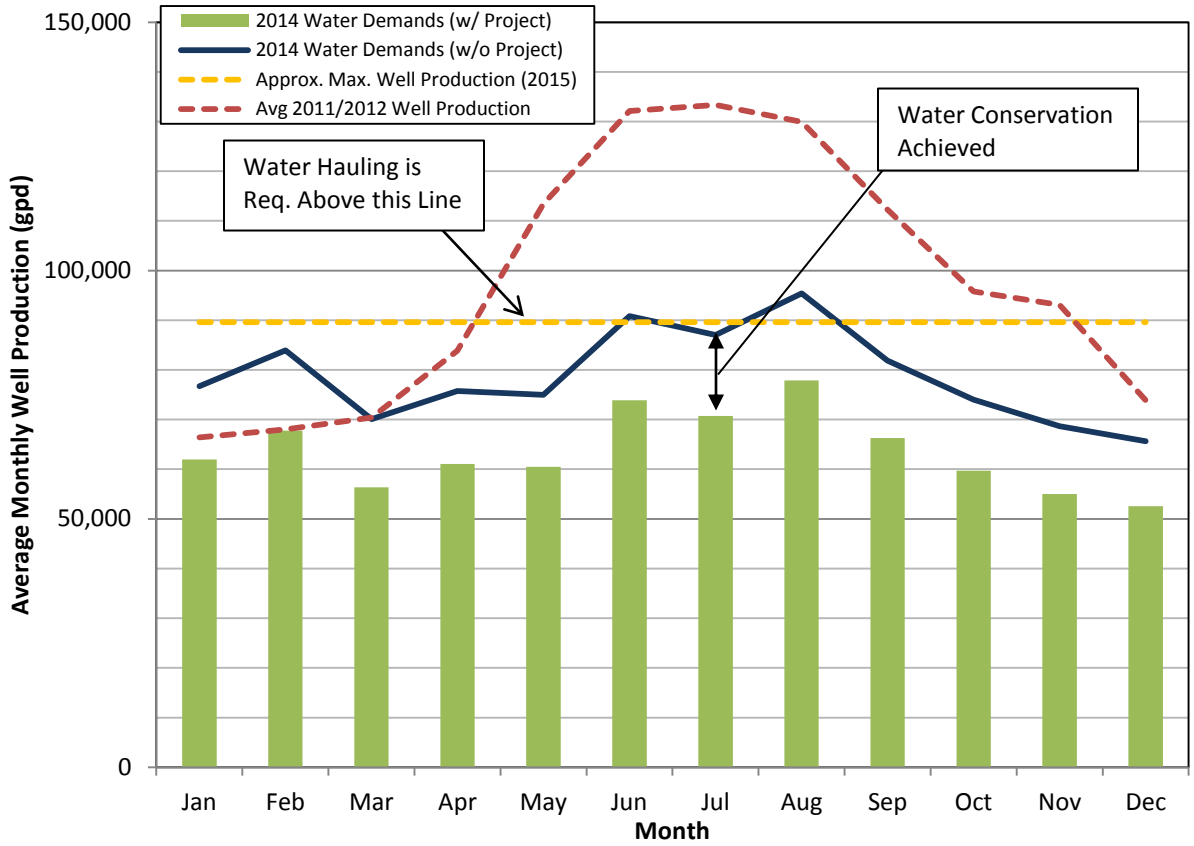


Figure 2.6-3: LOWMWC Well Production and Water Hauling – Average of 2011/2012 vs. 2014

Physical Benefit 2 – Energy Saved:

Based on a simplified and conservative analysis, the estimated electrical usage savings is assumed to be proportional to the estimated water savings. The current annual electrical usage to pump groundwater from the Water Company's wells is 237,000 kWh/year. Using a 19% reduction in water use in correlation to energy use, the estimated annual energy savings is 45,100 kWh/year for the first 20 years of the project. The total energy saved over the 50 year project life is 1.19 megawatt-hrs (MWh).

This analysis is also conservative as the average energy intensity is expected to be reduced as groundwater can be pumped more efficiently. This reduction in energy intensity is not included in the benefit analysis. Also, this benefit analysis does not account for the additional energy saved from the elimination of diesel fuel used in hauling water. In 2014, approximately 2,355 gallons of diesel fuel were used. Based on the estimated water conservation from Benefit 1, hauled water will not be needed after the implementation of the project.

It should also be noted that there is a corresponding decrease in greenhouse gases (GHG) from the reduction in electricity use. Using the estimated energy saved, the project results in a proportional reduction in GHG based upon a factor of 0.423 Metric Tons (MT) CO2/MWh. This factor is from a 2010 Environmental Protection Agency study of greenhouse gases associated with energy generation in California (eGRID GHG Annual Output Emission Rates). Using this factor, the energy reduction results in a GHG avoidance of 0.50 MT CO2 over the life of the project. Additional GHG are avoided by ceasing truck operations related to water hauling.

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

The proposed project would include the installation of approximately 406 water meters for the entire service area. The Water Company would shift from its current flat rate charge to a volumetric charge based on water usage. In times of shortage, a metered system 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 and provide the following additional 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 the Water Company's water management and not significantly impact the labor expenses of the Water Company.
- Bill disputes can be quickly resolved by showing 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, the Water Company will be able to manage and conserve water supply through enforceable restrictions.
- The Water Company will be able to use this additional data and information for a variety of purposes such as planning, customer service, conservation, and rate development.
- Customers' meters accurately identify water loss within the distribution system by making total usage date available on an hourly basis, which can be compared to flow meters at the wells in a water audit.

As part of the Project, a rate study will be performed in order to provide the basis for the conversion to water rates based on water consumption. The rate study will determine a recommended 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. After these steps are completed a hearing will be conducted to implement the new rate structure. *It should be noted that Proposition 218 proceedings are not applicable for a Mutual Water Company.*

Potential Adverse Physical Effects

Customers that use excessive amounts of 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. However, it may be difficult for customers who are financially unable to fund their bill to conserve water, when they are already taking measures to reduce their water use.

The Project is expected to have minimal environmental impacts. Water main construction will occur along existing road right-of-ways and is not expected to disturb native habitat. The construction specifications will include appropriate measures for protection of endangered species and cultural resources. Construction impacts including noise, traffic, and air quality, will be minimized to the extent possible and will be temporary in nature. The contractor will be required to follow the Stormwater Pollution Prevention Plan and Dust Control Plan to mitigate against stormwater pollution and dust generated during construction. For the long term, repairs will be significantly reduced for the water mains replaced, resulting in fewer future construction impacts.

How Project Effectively Addresses Long-Term Drought Preparedness

This project effectively addresses long-term drought preparedness by promoting water conservation through the installation meters and reducing the amount of water lost due to leaks. Once meters are put into operation, the Water Company will be able to estimate the amount of water used per individual household and notify the customer of potential leaks and provide water conservation education and analysis of individual home usage/water losses. Customers will then gain knowledge of how much water they consume, thereby providing an understanding of when excessive water is used and when leaks need to be repaired. Additionally, by installing meters, the Water Company is able to locate water users who choose to irrigate landscape, despite the Water Company's no outdoor watering regulation.

2.6.3 Direct Water-Related Benefit to a DAC

[1 Page Maximum]

Approximately 750 residents live in Lake of the Woods, and make on average 79.8% of the Statewide Median Household Income (MHI) as documented in Attachment 7. Due to the water supply issues, the Water Company's financial viability is threatened. The Water Company has been fortunate to receive grant funding to seek additional groundwater production capacity even though the results have been less than anticipated due to the drought impacted aquifer. Additionally, grant funding has paid for water hauling costs to date, but the funding is expected to run out this summer. With current water rates of $50 per connection per month, the LOWMWC's annual operating budget is approximately $240,000 per year; however, gross receipts for 2014 have only been $222,500 due to vacancies and non-payments. This budget cannot accommodate additional increased expenses, especially $122,000 (or more) in annual water hauling costs without raising water rates significantly. If another well becomes inoperable or if well production is reduced even further, additional water hauling would be needed increasing these costs to a greater degree.

The Project is clearly needed for the community. By implementing this Project, the following objectives will be met:

(1) Water losses will be reduced by replacing existing leaking water mains.
(2) Water will be conserved by installing meters and implementation of water rates based on actual customer use. Without meters in the system and insufficient staff to monitor water use, it is difficult to enforce the current water restrictions.
(3) Without these reductions in water use, water will continue to be hauled to the system in the summer in order to prevent water outages. The Project will eliminate the need for hauled water and its high cost, which is not sustainable for an economically disadvantaged community.
(4) The threat of system outages and low pressure situations will be reduced. This will also reduce the risk of bacteriological contamination of the water supply where contaminants enter the water system through leaks or breaks.
(5) The increased water main sizes, including some backbone water mains, will improve fire hydrant flowrates. Through the proposed scope of work the hydrant flow rates will be estimated and documented through the preparation of a WaterCAD hydraulic model.
(6) To realize a fully sustainable groundwater supply, an interconnection is needed with Frazier Park PUD. The installation of water meters and replacement of leaky water mains are the primary conditions that are required in order for the PUD to consider an interconnection.
(7) Energy use, greenhouse gases, air pollution, and operating costs are reduced. With the conserved water that is retained in the groundwater basin, groundwater levels will improve to a certain extent reducing energy costs and operating costs for items such as pump repairs.

With the project helping to address water shortages and water quality concerns with deteriorating water mains, the project qualifies for the Critical Water Supply Program Preference "Infrastructure renovations to a public water supply water system necessary to assure continued reliability of the minimum quality and quantity of water" (2015 IRWM Drought Solicitation Guidelines). The projected water conservation and delivery improvement is considered necessary to assure continued reliability of the minimum quality and quantity of water for this DAC.

2.6.4 Project Performance Monitoring Plan

Table 6 – Project Performance Monitoring Plan **Project Name: Lake of the Woods Water Main Replacement & Meter Installation Project**		
Proposed Physical Benefits	**Targets**	**Measurement tools and methods**
Benefit 1 Water Conservation	16.7 AF/year conserved through 2035 (3.5 AF/yr from water main loss reduction and 13.2 AF from conservation through water meter implementation), 3.5 AF/year thereafter (water main loss reduction only).	Tools: Meters at Well Pumps, Customer Meters, and Hauled Water Volume Delivered (if needed) Methods: (1) Conservation from Water Main Replacement: This water savings will be determined by comparing the well production water meters in total vs. the customer meters. A secondary test of the leakage rate based on tank drawdown (similar to the analysis described in this application) will be used to check the validity of the metered water comparison. (2) Conservation through Water Meter Implementation: This water savings will be determined by comparing the overall water use to historical water use.
Benefit 2 Energy Savings	45,100 kWh/year through 2035; 9,500 kWh/year thereafter	Tools: PG&E electricity usage records Method: The annual water conserved as estimated under Benefit 1 will be used to estimate the proportional annual energy usage to quantify energy savings.

Interim Targets: The project is expected to immediately achieve the targets after completion of the Project.

Data Collection. The data will be collected monthly at the flow measuring devices described in Table 6 and identified in **Figure 2.3-4** along with the hauled water volume (if needed). Additional data that will be collected include estimated water volumes from fire hydrant/blowoff use, reported water leaks, and other unmetered water uses. Tracking logs will be developed and utilized by operators throughout the year. Electricity usage at the well sites will be collected for the analysis of Benefit 2.

Analysis Used. The Water Main Loss Reduction Component analysis is straight forward as water losses can be estimated by comparing metered well production to total customer demand, factoring out unmetered water use as appropriate. A secondary test will be performed based on tank drawdown as discussed in Table 6.

The Conservation through Water Meter Implementation component analysis will depend upon the status of the water supply for LOWMWC as discussed in the Methods used to Estimate Physical Benefits for Benefit 1. The estimated water conservation will need to be compared to either 2014 demands if the current low water supply condition continues. Should the water supply condition improve (e.g. if the groundwater supplies improve), then the average water demands from 2011/2012 should be used for the comparison.

Benefit 2 will be analyzed as described in PSP Table 6.

Appropriateness of Targets: Based on the conservative factors discussed in the Description of Methods used to Estimate Physical Benefits section, the water savings is expected to be greater than projected.

Measurement of Performance. Performance will be measured by the ability to meet the targets. The two water conservation components and the energy savings component will be estimated based on the conditions reported for the year, and will be compared to the targets estimated for the Project.

2.6.5 Cost Effective Analysis

Table 7 - Cost Effective Analysis **Project Name: Lake of the Woods Water Main Replacement & Meter Installation Project**	
Question 1	Types of benefits provided:
	Water Conservation – The estimated water savings by reducing water leakage with replacement water mains (3.5 AF/year) and conservation through metered water rates (13.2 AF/year) for a total estimated groundwater pumping reduction of 441 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 1.2 MWh 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 PVC pipe for the water mains. The cost associated with the pipelines is $292,000. (See Table 4.4-1 in Attachment 4.)** **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 $88,000). 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 $392,000 for purchasing and installing water meters throughout the Water Company service area. This also includes the purchase of remote read equipment for the operator to drive through the Water Company collecting meter readings.** **2. Alternative Project - Direct Read Meters – The cost for a direct read meter system is approximately $333,000. The incremental cost difference between the AMR meters and the manual read units is approximately $75,000 ($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 ($60,000 over 20 years using today's labor cost rates).** **With the AMR system, additional water conservation is accomplished as described in the Technical Basis of Project section above.**