ATTACHMENT 2: PROJECT JUSTIFICATION

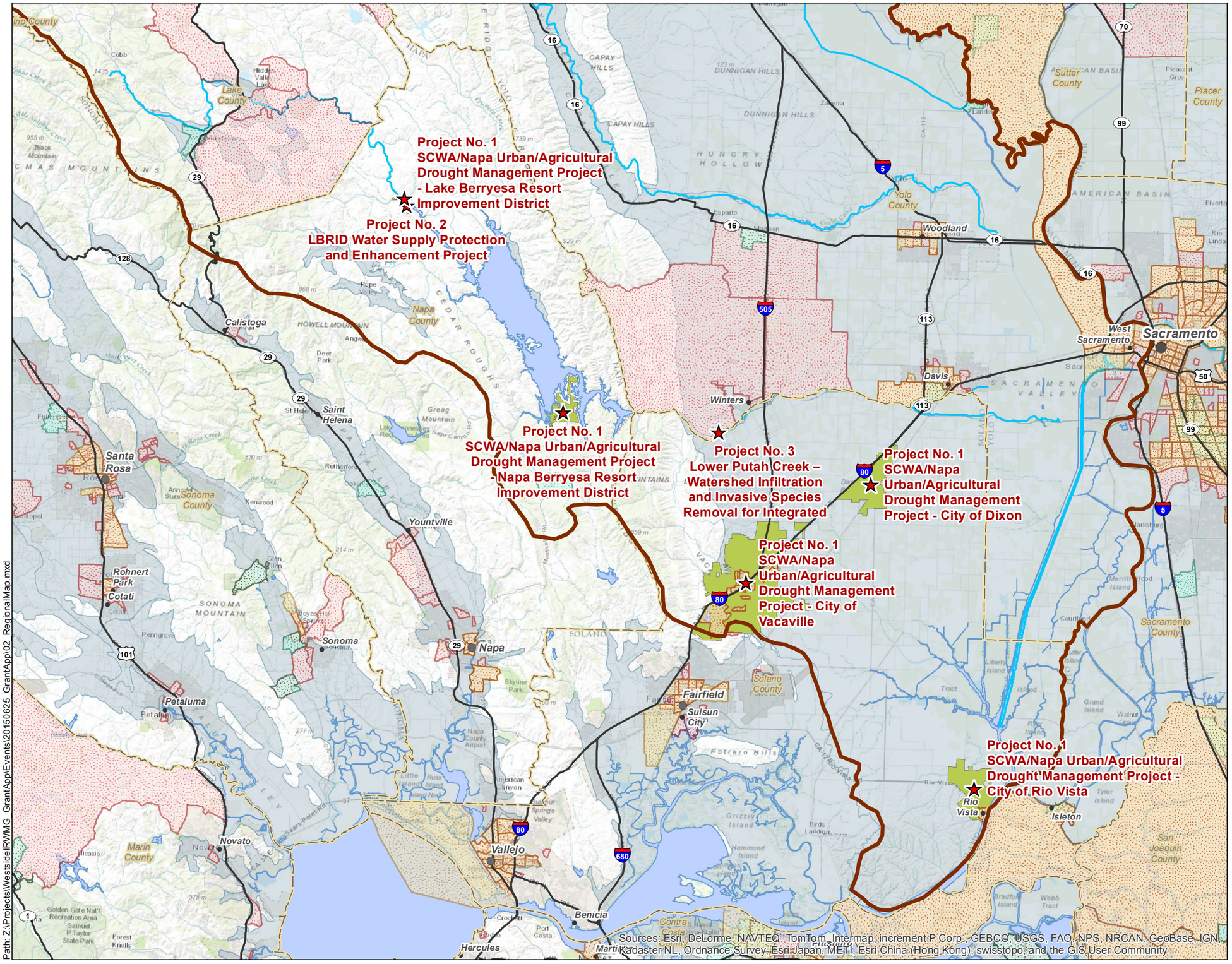
Project Summary Table and Regional Map

Table 2.1: 2015 IRWM Grant Solicitation Project Summary Table

IRWM Project Element		SCWA/Napa Urban/Agricultural Drought Management Project	LBRID Water Supply Protection and Enhancement Project	Lower Putah Creek – Watershed Infiltration and Invasive Species Removal for Integrated Regional Water Management
		#1	#2	#3
IR.1	Water supply reliability, water conservation, and water use efficiency	X	X	
IR.2	Stormwater capture, storage, clean-up, treatment, and management			
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands			X
IR.4	Non-point source pollution reduction, management, and monitoring			
IR.5	Groundwater recharge and management projects			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			
IR.8	Planning and implementation of multipurpose flood management programs			
IR.9	Watershed protection and management		X	X
IR.10	Drinking water treatment and distribution		X	
IR.11	Ecosystem and fisheries restoration and protection			X

IRWM Project Explanations are in each individual Project description.

The three (3) projects with their associated elements are shown on the following Regional Project Location Map.



Legend

- Project Location
- Westside Regional Boundary
- Disadvantage Community Tracts
- Disadvantage Community Places
- Disadvantage Community Block Group
- Groundwater Basins
- Streams
- Water Bodies
- Counties

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Miles

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Westside Sacramento IRWM Group and County of Yolo Flood Control and Water Conservation District
2015 Prop 84 IRWM Implementation Grant Application
Yolo, California

Regional Map

K/J 1570012.00
August 2015
Figure 2

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ATTACHMENT 2: PROJECT JUSTIFICATION

Project 1: SCWA/Napa Urban/Agricultural Drought Management Project

Project Description

The SCWA/Napa Urban/Agricultural Drought Management Project will promote high-efficiency technologies and best water conservation practices to improve indoor/outdoor water use efficiency within Solano/Napa counties.

Expanded Project Description

The Solano County Water Agency (SCWA) and Napa County is proposing the SCWA/Napa Urban/Agricultural Drought Management Project (Project), which will leverage and expand the implementation of existing water conservation education and consumer incentive programs and build on regional water conservation initiatives supported by prior Proposition 84 IRWM funding. The Project includes a suite of program elements that promote high-efficiency technologies and best water conservation practices to improve indoor and outdoor water use efficiency, targeting the Cities of Vacaville, Dixon, and Rio Vista in Solano County, and the communities served by the Lake Berryessa Resort Improvement District (LBRID) and Napa Berryessa Resort Improvement District (NBRID) in Napa County. Program elements proposed include: 1) Water-Efficient Landscape (WEL) Rebates, 2) High-Efficiency Toilet and Urinal (HET/U) Direct Installation, 3) HET/U Rebates, 4) High-Efficiency Washer (HEW) Rebates, 5) In-Farm Soil Moisture Sensors and 6) Irrigation Management Weather Station. Combined, these program elements target significant indoor and outdoor end uses of water in residential and agricultural sectors.

The WEL Rebate Program will replace 325,000 square feet of turf with climate appropriate landscaping. The HET/U Direct Installation and Rebate Programs will replace 725 older, high water use toilets and urinals with HET/Us that use 1.28 gallons per flush or less. The HEW Rebate Program will replace 650 washers with CEE Tier 3 units. In addition to the urban programs, this Project will install 104 In-Farm Soil Moisture Sensors at 26 sites (farms) and an Irrigation Management Weather Station. These programs are already in place, and this Project will continue to encourage water conservation in urban and agricultural water use sectors.

Current Need of the Region

With California in the midst of an on-going drought of historic proportions, the Project's elements will help the region achieve its long-term water conservation goals. The program elements described in the Project proposal are needed now due to the nature of the current long-term drought. Solano cities within the Westside region have conservation targets ranging from 28% to 36% as set by the SWRCB. More than half of urban water use throughout the project area is for landscape irrigation. Lawns also require regular mowing which results in CO_2 emissions from mechanized landscape maintenance. The end use of water for toilet flushing is approximately 25% of indoor household usage. There remains a significant amount of older high-water-use toilets that, when replaced with HETs, reduce toilet water usage by approximately 60%. Standard washing machines account for approximately 25% of indoor water use. Studies have shown HEWs can reduce water consumption for clothes washing by approximately 50% and energy consumption by 60%.

As with urban sectors, agricultural water users are looking for ways to become more efficient with their water use. Agriculture takes place on 62% of the land in Solano County, with irrigated agriculture comprising half of the county's agricultural lands. With increased pressures on local groundwater and surface water supplies, farmers are working to stretch water suppliers further by operating smarter. Currently there are no weather stations in the area east of Vacaville, which is a productive agricultural region encompassing 20,000 acres of diverse crops. The installation of a research-grade weather station with website and phone access would provide local growers with weather data valuable for efficient irrigation scheduling and operational management. The installation of In-Farm Soil Moisture Sensors will enable growers to measure soil moisture conditions quantitatively and utilize scientific data towards irrigation management, optimizing water use and reducing irrigation runoff.

Project Map

The project map that follows shows all of the projects major elements described in Attachment 3 – Work Plan.

Project 1 Physical Benefits

Overview of Benefits of Project 1

The specific program elements that will result in quantifiable and sustainable water savings include: 1) HET/U Direct Installation and rebates, 2) WEL Rebates, 3) HEW Rebates, 4) On-Farm Soil Moisture Sensors, and 5) Irrigation Management Weather Station. In addition, the project elements will result in avoidance of CO_2 emissions associated with the treatment and transmission of water to end users and household appliances such as lawnmowers and washing machines.

Primary Benefit: High-Quality Water Conservation

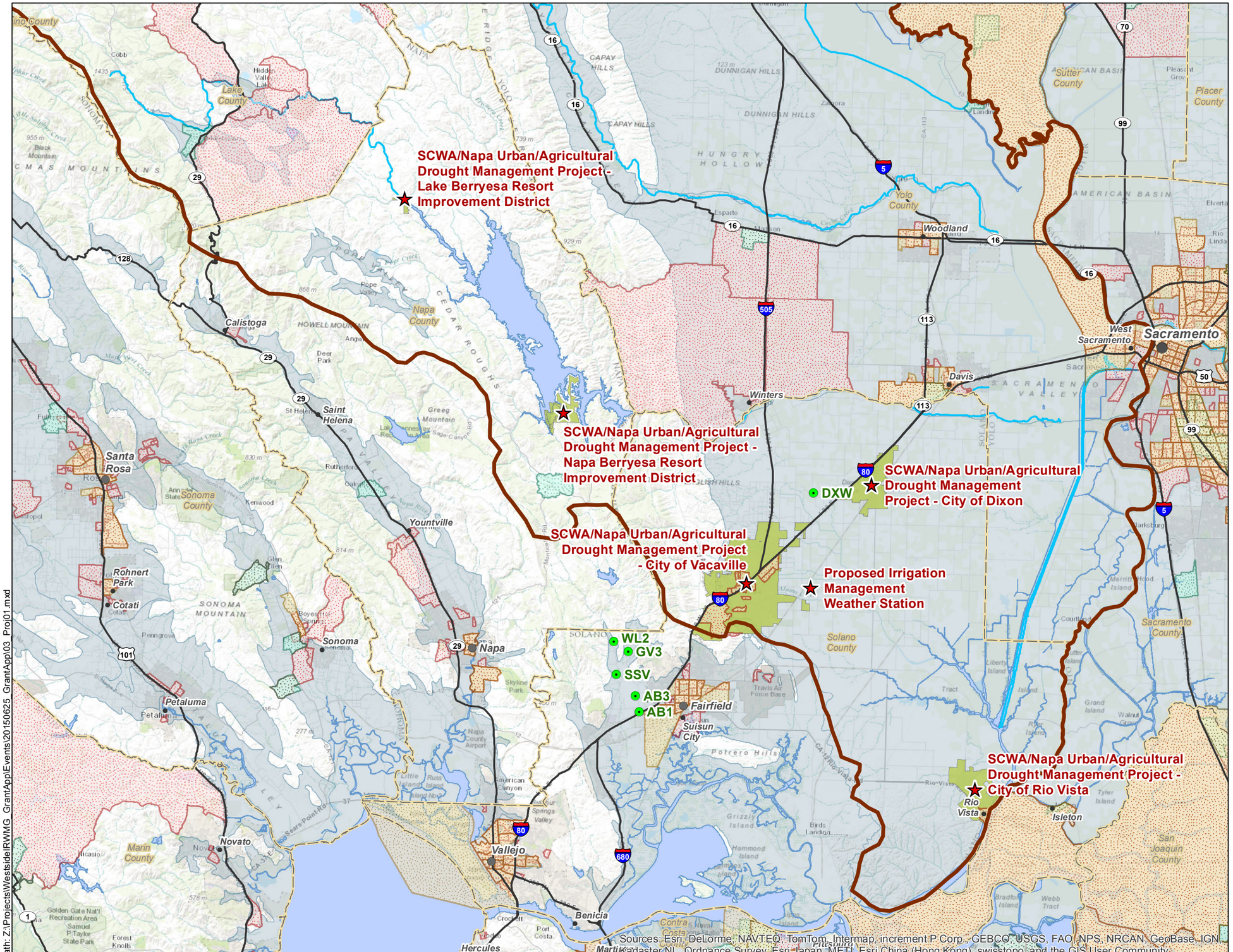
When fully implemented, it is expected that water savings from all of this project's elements will total about 224 million gallons per year (689 AFY). The element with the shortest useful life is urinal installation/rebates with a useful life of 12 years; however benefits from the remaining elements are expected to last well beyond.

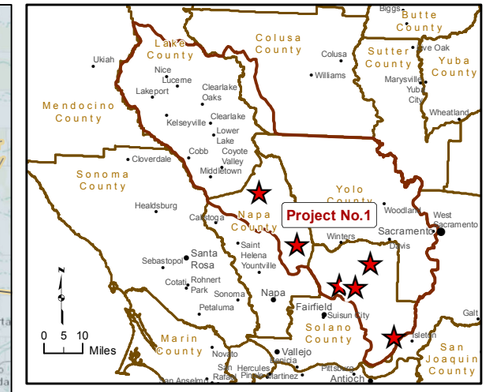
Table 2.2: Annual Project Physical Benefits

Project Name: SCWA/Napa Urban/Agricultural Drought Management Project Type of Benefit Claimed: Water supply saved Units of the Benefit Claimed : acre-feet per year (AFY) Anticipated Useful Life of Project (years): 12+								
(a)	(b)	(c)						(d)
Year	Physical Benefits							
	Without Project	With Project						Change Resulting from Project
		WEL	HET/U	HEW	Soil Moisture Sensors	Agricultural Weather Station	Total	(c) – (b)
2015	0	14	10	15	0	0	38	38
2016-2026	0	25	10	15	240	400	689	689
Comments: Service life of the individual program elements range from 12 to 20 years. For the purposes of this table, project life is 12 years, the shortest of the range, with additional benefits extending beyond. Agricultural water savings will begin during the next irrigation season after installation of the weather station and soil moisture sensors and data loggers in 2016.								

Secondary: Avoided Carbon Dioxide (CO_2) Emissions

Based on the above water savings, this project is expected to avoid over 34 tons of CO_2 emissions related to water supply, conveyance, treatment, distribution, and wastewater treatment.





Legend

- Solano Irrigation District Weather Stations
- Project Location
- Westside Regional Boundary
- Disadvantage Community Tracts
- Disadvantage Community Places
- Disadvantage Community Block Group
- Groundwater Basins
- Streams
- Water Bodies
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2015 Prop 84 IRWM Implementation Grant Application
Yolo, California

SCWA/Napa Urban/Agricultural Drought Management Project
Project No. 1

K/J 1570012.00
August 2015
Figure 3

Table 2.3: Annual Project Physical Benefits

Project Name: SCWA/Napa Urban/Agricultural Drought Management Project Type of Benefit Claimed: Carbon Dioxide Emissions Avoided Units of the Benefit Claimed : Tons of CO_2 (Tons CO_2) Anticipated Useful Life of Project (years): 12+			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
2015	0	+3	+3
2016-2026	0	+34	+34

Source: PG&E, 2015; USDOE, 2006
Note: Estimated benefits do not include CO_2 emissions avoided by decreased use of SWP water or by decreased groundwater pumping.

Technical Analysis of Physical Benefits Claimed

Technical Analysis and Description of Primary Physical Benefit: Annual Savings of High Quality Water

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

The Westside IRWM Region, like the rest of California is in the fourth year of a severe drought. Overall, surface water deliveries to cities within Solano County are being curtailed by SWRCB by 28-36%. More locally, small water suppliers, including LBRID and NBRID are subject to a 25% conservation standard or must restrict outdoor watering to no more than two days per week. The Project will continue and expand existing programs that are being implemented in Solano and Napa Counties. SCWA has implemented a variety of water conservation programs since 2007. Investments to develop administrative structure and marketing of water conservation programs have previously occurred, and some of these programs have been funded by the prior IRWM Implementation Rounds 1 and 2 Grants. Funding the proposed projects will build on the successful implementation of existing water conservation programs.

Since the water conservation program inception in 2007:

- Rebates were disbursed to Solano County and Napa County residents for over 4,600 HETs and 8,500 HEWs.
- SCWA conducted 4,000 Water use Surveys in Solano County.
- Over 150,000 sq. ft. of turf replacement in Solano County.
- Over 2,500 HETs were installed in hotels, apartments, and other businesses in Solano County.
- Smart controllers were installed at shopping malls, retail outlets, and city parks in Solano County.

This project will continue existing Solano county-wide agricultural water conservation efforts that assist growers with irrigation management and water use efficiency at the farm level. These existing activities are free to growers and include:

- Operation of eight automated weather stations for use by growers for irrigation scheduling and farm management.
- Weather information is accessible by website or telephone. Weather website with local agricultural irrigation information; www.westernwx.com/sid.
- Weather forecast services focusing on Solano County. The comprehensive agricultural forecast is available daily ($120/year).
- Soil moisture monitoring.
- Soil sensor installations and training.

The Soil Moisture Monitoring Program has been in existence in Solano County since 2003. Implementation of the program involves providing soil sensors and hand-held meters to growers to allow for the determination of accurate soil moisture levels in their fields. Soil moisture monitoring and sensor installation and training is provided to growers free-of-charge on a first come, first served basis. As a result of the program, growers gained knowledge about crop water demand and applying

water more precisely to their crops which allowed more accurate timing and duration of water delivery to minimize waste.

The Program has expanded in scope each year, with many new growers and monitoring sites added since 2003. Currently there are (62) farmers equipped with sensors and meters at (130) monitoring sites. The Program holds a strong interest among growers and there is a waiting list among farmers for new sensors and meters. Growers are utilizing the moisture data for regular irrigation scheduling, and benefitting the region by conserving water while growing more productive crops.

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project

Solano and Napa County already conduct activities to conserve water use such as outreach and education, water-saving partnerships, water use surveys, and pilot testing new water conservation technology. Without this project, water conservation will continue, but not at the rate that is needed to meet the mandatory water reductions of 2015, nor to ensure water supply security. Therefore, the savings estimated will not occur.

In the long term, as population increases and communities reach buildout, water use will continue to grow, with greater peak demands, which will increase stress on the current water supply. Cities will have a choice of either paying high prices for additional water or limiting growth and reducing economic activity. Agriculture in the region would also be adversely affected leading to job losses and an economic downturn.

Provide a description of methods used to estimate physical benefits.

Water Efficient Landscape Rebate

This project will offer financial incentives to encourage the replacement of 325,000 square feet of turf with climate appropriate or other drought-tolerant landscaping. Water use savings for landscape replacement can be estimated based on replacing plants of medium to high evapotranspiration rates (ETo) with those of low to medium ETo:

Table 2.4: WEL Savings Basis - ETo

Relative Plant ET	Average Annual ETo[a] (in)	Landscape Coefficient	Plant Species Coefficient	Plant Density Coefficient	Microclimate Coefficient	Landscape Requirement (in)
High	57.12	1.638	0.9	1.3	1.4	93.6
Moderate	57.12	0.5	0.5	1	1	28.6
Low	57.12	0.025	0.1	0.5	0.5	1.4

a. Annual ETo for Zone 14 (Solano and Napa Counties) in inches per year
Source: UCCE, 2000.

Landscape requirement is based on the region's average annual ETo, which is then corrected using a landscape coefficient based on plant species, plant density, and microclimates. Using the calculated landscape requirements, replacing high water use turf (with moderate to high ETo rates) with drought-tolerant landscaping (with low to moderate ETo rates) is expected to save 17 to 41 gallons per square foot annually, or 17 to 40 AFY for the estimated 325,000 ft^2 of replaced turf. In a recent grant application, the City of Roseville, a city within the same ETo Zone as the Project, reported savings from turf removal of 30 gallons per square foot, which falls within the estimated range of savings based on ETo Zone. Therefore, this program assumes a savings of 25 gallons per square foot of water due to turf removal.

It is anticipated that 180,000 sq. ft. will be converted in 2015, a savings of 14 AFY, and the remainder in 2016, an additional savings of 11 AFY, for a total of 25 AFY once 325,000 ft^2 of turf has been replaced. Water savings are assumed to persist for 20 years, for a lifetime savings of 500 AF (8.1 million gallons).

High-Efficiency Toilet/Urinal Rebates and Direct Installation Programs

These programs will be marketed to replace older high volume toilets (3.5 to 5 gallons per flush) with HETs, which use of 1.28 gallons per flush (gpf) or less. These programs will also replace existing urinals using from 1.0 to 2.5 gpf with HEUs that use 0.5 gpf or less. Water savings are assumed to persist for 12 years. See the tables below for detailed unit savings estimates.

Table 2.5: HET/U Savings Basis

	Flush Volume (gal)	Average Flushes Per Day/Person	Average Persons Per Household	Water Use/Toilet (gal/year)
Existing Toilet Stock	3.5	5.0	2.9	8,405
HET	1.3	5.0	2.9	3,074
Source: CPUC, 2013; U.S. Census Bureau; USEPA.				

	Flush Volume (gal)	Average Flushes Per Day	Use Per Year (day)	Water Use/Toilet (gal/year)
Existing Urinal Stock	1	18	260	4,680
HEU	0.5	18	260	2,340
Source: CPUC, 2013.				

It is estimated that these programs will see a water savings of 8 AFY for 475 toilets and 2 AFY for 250 urinals, a total of 10 AFY for 725 units, and a lifetime savings of 115 AF.

High-Efficiency Washer Rebate Program

The project will provide rebates for 650 Tier 3 HEWs. Unit savings (S) are calculated using the current maximum water factor of new washers (WFavg), the water factor for Tier 3 washers (WFT3), average capacity of new washers (CU), and the average number of cycles per single-family residence (Cycles):

$$S = (WF_{\text{avg}} - WF_{T_3}) \times CU \times Cycles$$

Table 2.6: HEW Savings Basis

	WF[a] (gal/Cycle/ft³)	Water Use[b] (gal/load)	CU[b] (ft³)	Cycles[b] (per yr)	Water Use/ Washer (gal/yr)
Baseline Washer	9.5[c]	28.5	3	392	11,172
Tier 3 Washer	3.2[d]	9.6	3	392	3,763

a. Water Factor – Total water consumed per load of wash divided by capacity of washer. A more efficient machine will have a lower number.
b. Assumed based on CEC Staff Report, September 2003.
c. Current conservation standards for residential clothes washers manufactured after January 1, 2011. USDOE.
d. CEE high efficiency specification for Tier 3 washer, effective March 7, 2015.

Total Program water savings is expected to be 4.8 MG per year, or 14.8 AFY for the 650 washers. Savings are estimated to persist for 14 years, the average useful life of a new washer, for a lifetime savings of 206.9 AF.

Agricultural Weather Station and Soil Moisture Sensor Program

Existing agricultural efficiency program components include irrigation system evaluations, irrigation scheduling services, pump efficiency testing, annual irrigation efficiency workshops, annual newsletter The Irrigator, and Spanish language workshops. This grant will provide the funding to expand the weather station network to the unmonitored area east of Vacaville and provide soil moisture monitoring services to 26 farms, covering about 800 acres. Based on the performance of the existing weather station program and additional research, SCWA anticipates a water conservation savings of 400 acre feet per year from the installation of the Irrigation Management Weather Station. The installation of a research-grade weather station with website and phone access would provide local growers with more specific weather data that accounts for more local weather effects is invaluable for efficient irrigation scheduling and operational management. The planned location, east of Vacaville, is a productive agricultural region encompassing 20,000 acres of diverse crops. A new station would

complement the existing network of county-wide weather stations, of which eight provide comprehensive irrigation management information. The project would accomplish water conservation by providing crop evapotranspiration (ET) data to growers through an established agricultural weather website.

The installation of additional soil sensors allows more farmers and ranchers to accurately measure the soil moisture content of their fields resulting in greater precision with irrigation management and reduced irrigation water runoff. A study by DWR in 1986 documented water savings from a program implementing weather-based irrigation scheduling, soil moisture monitoring, and sprinkler system optimization. The 1986 study found during grower audits those farmers participating in the program irrigated 2,500 acres and conserved 2,424 acre-feet, or approximately 1 acre-feet/acre. With consideration to new advances in irrigation practices, a water savings of 240 acre-feet per year based on 4,000 acres is conservatively estimated for Solano County due to additional soil moisture monitoring. Water savings would begin to show in the 2016 irrigation season and are expected to persist for 20 years.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

The installation of HET and HEW in the residential facilities will occur in existing facilities. The only new facility anticipated for this project will be the new Irrigation Management Weather Station east of Vacaville and soil moisture sensing stations. The weather station will be located on private property with a written agreement and have a footprint no greater than 10' x 5' x 10' tall. A 10W solar panel will provide all of the electrical power. Weather data will be transmitted through an established agricultural weather website. The station will also include a data logger, solar radiation shield and temperature/relative humidity probe, cellular modem, all contained within a 12" x 14" enclosure. The Weather Station is not considered a CEQA project.

Soil moisture metering will also have a minimal footprint. The footprint for each monitoring site is approximately 9 sq. feet. A typical installation would be a square pattern with one sensor per corner. A shallow sensor would be buried 1' deep, another at 2', one at 3' and a deep sensor at 4'.The sensors will be monitored via handheld. Soil moisture metering is not considered a CEQA project.

This project is a continuation of existing PG&E water conservation programs in Solano and Napa counties. Solano County will take over administration of the Solano and Napa programs and the project elements will continue to use the existing tracking and administration mechanisms.

Provide a description of any potential adverse physical effects as a result of the project

Each project element is a continuation of an existing program, and no permanent adverse physical effects are anticipated from this project. Temporary impacts during construction of the weather tower will be minimized by using sediment/erosion control if appropriate, and construction will take place during dry weather to prevent impacts of runoff.

Description of whether the proposed project effectively addresses long-term drought preparedness

The Project will implement a series of programs that will:

- Promote water conservation.
- Improve landscape and agricultural irrigation efficiencies.
- Achieve long-term reduction of water use to achieve long-term drought preparedness.

Outdoor water use can account for 50-60% of residential water use. The WEL Rebate Program will achieve water conservation and improve landscape irrigation efficiencies by reducing outdoor water use through converting turf to drought-tolerant landscaping. Agricultural irrigation efficiencies are achieved by constructing a local weather station and installing soil moisture sensors. The end use of water for toilet flushing and clothes washing is approximately 50% of indoor household usage. The installation of HEWs and HETs will maximize indoor water use efficiency. These programs target both indoor and outdoor water use and will reduce water demand thereby reducing reliance on imported water and increasing reliability. The water savings associated with these programs are expected to continue for 12-20 years. Beyond the life of the programs, implementation of the Project will influence and transform markets and standards towards higher efficiency and foster long-term "passive" water savings after implementation is complete.

Technical Analysis and Description of Secondary Physical Benefit: Avoided CO_2 Emissions

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

Producing and delivering urban and agricultural water supplies requires energy, much of which is derived from fossil fuels and therefore results in CO_2 emissions. In 2006 Assembly Bill 32 (AB 32), the California Global Warming Solutions Act was passed requiring a reduction of GHG emissions to 1990 levels by 2020. The Air Resources Board (ARB) developed a Scoping Plan which recommends strategies to meet these goals including monetary incentives such as rebates to consumers to encourage efficient energy usage. Saving water reduces energy usage and therefore reduces GHG emissions. In addition, certain devices such as HEWs also directly save energy with associated GHG emission reductions.

According to the California Energy Commission, water use accounts for almost 20% of California's total energy consumption, including supply, conveyance, treatment, distribution, end-use, and wastewater treatment for all water use sectors. Moreover, increasingly stringent water quality standards will create more pressure on energy suppliers to keep up with demands.

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project

Without this project, the energy use and GHG emissions associated with not saving water will continue at their current rate, or they may increase if global climate change continues to bring dryer, hotter weather requiring additional outdoor watering. Without this project, other ways to reduce GHG emissions will be needed in order to meet AB 32 emission reductions goals. Other methods to reduce greenhouse gases include the use of renewable energy including solar power, additional government regulations such as vehicle, fuels, and land use policies, infrastructure improvements. These other methods can be taken regardless of whether this project is implemented; however, they may not be as financially accessible to all.

Provide a description of methods used to estimate physical benefits.

Carbon dioxide is the main component of human-caused greenhouse gas emissions. CO2 emissions avoidance can be calculated based on energy savings from reduced water consumption. The method used to estimate the physical benefit of CO_2 emission avoidance is to first estimate water savings and identify the associated segments of the water use cycle. An estimated energy requirement can be attributed to each segment of the water use cycle. The U.S. Department of Energy (DOE) provides estimated average electrical energy requirement for water supply and treatment in California, including supply and conveyance, treatment, distribution, wastewater collection and treatment, and wastewater discharge. Energy savings are converted to CO_2 emissions avoidance based on the region's energy provider's estimated emissions rate per megawatt-hour (MWh).

The Project will not only reduce potable water use but wastewater processing, as well. Less water and wastewater to pump and treat, in turn, will reduce energy consumption. In addition, the HEW rebate program directly encourages the use of energy efficient machines. By reducing overall water use, energy demand and costs associated with the pumping of raw water, treatment plant operation, the distribution of finished, potable water, and wastewater collection and treatment are all likewise reduced. Reduction in treatment process chemicals also means less energy needed to produce and transport the chemicals. We can expect valuable reductions in summer energy demand due to implementation of these proposed water use efficiency measures. The reduction in energy demand reduces the carbon footprint of overall water delivery. The HEW Program will reduce energy use and carbon emissions by reducing pumping and treatment for water and wastewater and reducing hot water end use.

Reduced Energy Requirement Due to Reduced Urban Irrigation

If we assume that there is no runoff of the water applied to water-efficient landscape, then the DOE average electrical energy required for water supply and treatment in California is reduced to 800 kWh/million gallons, and estimated energy savings for implementation of the turf replacement element of the project is:

8 million gallons/year X 800 kWh/million gallons = 6,400 kWh/year = **6 MWh/year**

Reduced Energy Requirement Due to Reduced Indoor Water Use (HET/U, HEW)

Indoor water supply would require energy for every segment of the water cycle and is estimated to be about 1,900 kWh/million gallons (DOE 2006). Therefore, estimated energy saving for the replacement of toilets, urinals, and washing machines with high water-efficiency models would be:

4.8 million gallons/year X 1,900 kWh/million gallons = 9,164 kWh/year = **9 MWh/year**

Reduced Energy Requirement Due to Reduced Agricultural Water Use (Soil Moisture Sensors, Irrigation Management Station)

Assuming agricultural water use requires energy for supply and conveyance and distribution segments only, then the DOE average electrical energy requirement is 700 kWh/million gallons (DOE 2006). The estimated energy savings from implementing soil moisture sensors and the Irrigation Management Station is:

208 million gallons/year X 700 kWh/million gallons = 145,981 kWh/year = **146 MWh/year**

Based on the DOE energy requirements, the total estimated energy savings from implementation of the project elements is 173 MWh/year.

Conversion of Energy Savings to Avoided CO_2 Emissions

Pacific Gas & Electric Company (PG&E) is the primary energy provider for the Counties of Solano and Napa. In 2013, PG&E's emissions rate was 427 pounds of CO_2 per MWh (PG&E 2015). Therefore, the avoided CO_2 emissions, based on the (conservative) expected water savings from this project is:

161 MWh/year X 427 pounds of CO2 = 68,747 pounds of CO2 = **34 tons of CO_2/year**

This calculation does not take into account energy used to divert State Water Project supplies or to pump groundwater. Therefore, total CO_2 emissions avoided is expected to be much higher due to implementation of this project.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

As described in the Primary Benefit discussion, the only new facility anticipated for this project will be the new Irrigation Management Weather Station east of Vacaville and soil moisture sensing stations.

The weather station will be located on private property with a written agreement and have a footprint no greater than 10' x 5' x 10' tall. A 10W solar panel will provide all of the electrical power. Weather data will be transmitted through an established agricultural weather website. The station will also include a data logger, solar radiation shield and temperature/relative humidity probe, cellular modem, all contained within a 12" x 14" enclosure. The Weather Station is not considered a CEQA project.

Soil moisture metering will also have a minimal footprint. The footprint for each monitoring site is approximately 9 sq. feet. A typical installation would be a square pattern with one sensor per corner. A shallow sensor would be buried 1' deep, another at 2', one at 3' and a deep sensor at 4'. The sensors will be monitored via handheld devices and data will be transmitted through an established agricultural weather website. Neither are considered a CEQA project. Soil moisture metering is not considered a CEQA project.

This project is a continuation of existing PG&E water conservation programs in Solano and Napa counties. Solano County Water Agency will provide administration of the Solano and Napa programs and the project elements will continue to use the existing tracking and administration mechanisms.

Provide a description of any potential adverse physical effects as a result of the project

Each project element is a continuation of an existing program, and no permanent adverse physical effects are anticipated from this project. Temporary impacts during construction of the weather tower will be minimized by using sediment/erosion control if appropriate, and construction will take place during dry weather to prevent unwanted impacts of runoff.

Description of whether the proposed project effectively addresses long-term drought preparedness

As described in the discussion for the Primary Benefit, the Project will implement a series of programs that will:

- Promote water conservation.
- Improve landscape and agricultural irrigation efficiencies.
- Achieve long-term reduction of water use to achieve long-term drought preparedness.

Outdoor water use can account for 50-60% of residential water use. The WEL Rebate Program will help reduce outdoor water use by converting turf to drought-tolerant landscaping. The end use of water for toilet flushing and clothes washing is approximately 50% of indoor household usage. The installation of HEWs and HETs will maximize indoor water use efficiency. These programs target both indoor and outdoor water use and will reduce water demand thereby reducing reliance on imported water and increasing reliability. The water savings associated with these programs are expected to continue for 12 – 20 years. Beyond the life of the programs, implementation of the Project will influence and transform markets and standards towards higher efficiency and foster long-term "passive" water savings after implementation is complete.

Direct Water-Related Benefit to a DAC

Although DACs make up less than 25% of the geography or population of the Cities of Vacaville, Dixon, Rio Vista, and the communities served by the LBRID and NBRID, the WEL, HET/U, and HEW Programs will benefit those citizens that live in the DACs that do exist as discussed in Attachment 7. The community served by LBRID is 100% DAC based on income survey results, and portions of Vacaville and Rio Vista are made up of DAC. These DACs will be eligible for the programs in this Project.

The Cities of Vacaville, Dixon, and Rio Vista are all required to cut back water consumption by the SWRCB by 32%, 28%, and 36%, respectively, and the SWRCB have ordered small water suppliers, including LBRID to be subject to a 25% conservation standard, or must restrict outdoor watering to no more than two days per week.

This Project will provide rebates to communities including DACs for water saving devices and landscapes that they may not otherwise be able to afford. Without the Project, the remaining methods to conserve water could prove more costly, especially as the current drought continues.

Project Performance Monitoring Plan

Establishing monitoring measures will help ensure the proposed project will meet its intended benefit. The Project Performance Monitoring plan describes the tools that will be used to monitor project performance and set interim targets (or milestones) that will be used to track the Project's pace in meeting the benefits claimed in Tables 2.2 and 2.3. Table 2.7 indicates the data that will be collected and the types of analyses to be used; explains how the monitoring tools and targets are appropriate for the benefits claimed; and includes how monitoring data will be used to measure performance.

Table 2.7: Project Performance Monitoring Plan

Project: SCWA/Napa Urban/Agricultural Drought Management Project		
Proposed Physical Benefits	**Targets**	**Measurement Tools and Methods**
Water savings from high-efficiency irrigation and drought tolerant landscaping.	Replacement of approximately 325,000 sq. ft. of lawn with water-efficient landscaping.	Staff will track number of rebates issued, square feet of lawn converted and associated water savings.
Water savings through direct installation of high-efficiency toilets that use 1.28 gallons per flush and urinals that use 0.125 gallon per flush, primarily in multi-family residential units and commercial.	Install about 725 high-efficiency toilets and urinals	Staff will track number of toilets and urinals installed and associated water savings.
Water and energy savings and avoided CO_2 emissions through the installation of high-efficiency clothes washers.	Install about 650 HEWs	Staff will track number of rebates issued and associated water savings.

Project: SCWA/Napa Urban/Agricultural Drought Management Project		
Proposed Physical Benefits	**Targets**	**Measurement Tools and Methods**
Water savings through improved irrigation management and soil moisture sensors.	Install 104 soil moisture sensors, distribute 26 handheld meters and a weather station.	Staff will download collected data and produce soil moisture monitoring graphs. Staff will track farmer and rancher participation with Weather Station Program and monitor water use.

Cost Effective Analysis

This analysis evaluates whether the physical benefits provided by the project are provided at the least possible cost (see Table 2.8).

Table 2.8: Cost Effective Analysis

Project: SCWA/Napa Urban/Agricultural Drought Management Project	
Question 1	Types of benefits provided as shown in Tables 2.2 and 2.3 Primary Benefit: 389 AFY of High Quality Water Conservation Secondary Benefit: 34 Tons Per Year of Avoided Carbon Dioxide Emissions
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? No. If no, why? There are no alternatives to this project. Water conservation is a low-cost source of water supply with positive environmental impacts and benefits including energy savings, pollution prevention, solid waste reduction, and reduced carbon emissions. In addition, there is no other project that would provide the same water supply benefit – additional groundwater pumping is not allowed, nor is there transmission capacity to deliver addition outside sources of surface water, nor is there a wastewater treatment plant nearby that can provide recycled water. Even if these alternative projects were available, none of them could provide the same environmental benefits (CO_2 emissions avoidance) as the proposed project. If yes, list the methods (including the proposed project) and estimated costs.
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. N/A.

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ATTACHMENT 2: PROJECT JUSTIFICATION

Project 2: LBRID Water Supply Protection and Enhancement Project

Implementing Organization: Napa County Flood Control and Water Conservation District

Project Description

The proposed project consists of improving the residential sewer collection system to eliminate sewage spills and reusing backwash wastewater from the community's water treatment plant.

Expanded Project Description

Lake Berryessa Resort Improvement District (LBRID), a special-purpose District owns a wastewater (WW) collection, treatment and disposal system, most of which was installed in the 1960s, and a surface water treatment plant (SWTP) that serve the Berryessa Estates Subdivision in Napa County and is operated and maintained by Napa County Flood Control and Water Conservation District. WW from the community flows via gravity to lift stations where it is pumped to an aboveground WW storage tank. From the tank, the WW is pumped approximately 1.2 miles through a 6-inch diameter force main into a manhole, from where it gravity flows to facultative treatment ponds, a stationary pump station, and is transferred to the two final ponds prior to disinfection and disposal via spray irrigation to land application areas. The SWTP intake is located downstream of the lift stations and filter backwash water from the SWTP is discharged into the WW lift station for treatment and disposal rather than being beneficially reused.

The overall WW project elements, which are divided into 2 phases, were mandated in 2011 by Administrative Civil Liberty (ACL) Order R5-2011-0538 and include WW system upgrades such as identifying/ repairing sources of Inflow/Infiltration and upgrading hydraulic limitations of the WW collection infrastructure for both 10-year and 100-year storms (RWQCB 2011). The proposed project includes elements of Phase 2 of improvements to the LBRID WW system. Phase 1 construction was completed in June 2015 and consisted of expanding WW facultative pond storage, adding pumping and yard pipe systems, renewing chemical feed equipment, and expanding the acreage for land application and disposal. Phase 2 concludes the near-term capital upgrades for WW, and this project will improve the existing WW lift stations by upgrading pumps, adding backup power supply, and upgrading electrical systems and replace approximately 3,000 feet of the existing force main with new 8-inch High Density Polyethylene (HDPE) pipe and appurtenances. This project will also equip LBRID's current SWTP to treat filter backwash wastewater for beneficial reuse as a potable water supply. Completion of the proposed project elements will both protect and enhance LBRID's drinking water supply by eliminating sources of WW contamination and reusing treated backwash water from the SWTP.

Current Need of the Region

The LBRID WW collection system has a history of deficiencies and raw sewage spills into Upper Putah Creek during major rain events in the 1990s and 2000s ranging from 7,500 gallons to 5.5 million gallons, which are summarized and documented in ACL Order R5-2011-0538. The Upper Putah Creek water intake for the LBRID SWTP which serves Berryessa Estates is only about 1,500 feet downstream of Lift Station A and the WW storage tank, which has had a history of spilling raw sewage into Putah Creek. Furthermore, in 2014, the months of July, August and September saw zero baseflow in Upper Putah Creek and LBRID imposed an Emergency Drought Declaration, limiting residents to 50 gallons per day per household water consumption. While the drought declaration was lifted in November 2014, if the current drought continues, LBRID may enact restrictions again in 2015. As of July 29, 2015, flow in the creek at the Putah Creek near Guenoc, upstream of LBRID was 0 cfs (although there remains pools of water fed by groundwater at the intake that provide supply in the near term). With such limited surface water flows and likely future drought declarations, any water that can be protected and made available is highly valuable. LBRID's water supply, especially during these times of drought, is limited by the lack of flow through Putah Creek during the dry season but is also compromised by wet season WW overflows. In addition, LBRID had been forced to shut down operation of their SWTP to avoid discharging filter backwash water when the WW system was close to or already spilling due to a severe rainstorm event.

Project Map

The project map that follows shows all of the projects major elements described in Attachment 3 – Work Plan. Phase 1 of the sewer project increased WW storage capacity from 9.1 MG to 27.1 MG as shown in Figure 4. A sewer force main conveys collection wastewater within the community from Lift Station A traversing below an unimproved roadway adjacent to Upper Putah Creek. The surface water withdrawal intake rests in the creek bed alluvium in proximity to the sewer force main. Treatment of surface water occurs within the structure abutting sewer Lift Station A. Coagulation, flocculation, membrane filtration and disinfection treat water to potable standards.

Physical Benefits

Overview of Benefits

Implementation of this project will primarily protect water supply by reducing and eliminating nutrient loads originating from spills from the LBRID sewer system. A secondary benefit is using treated backwash wastewater to supplement the current surface water supply.

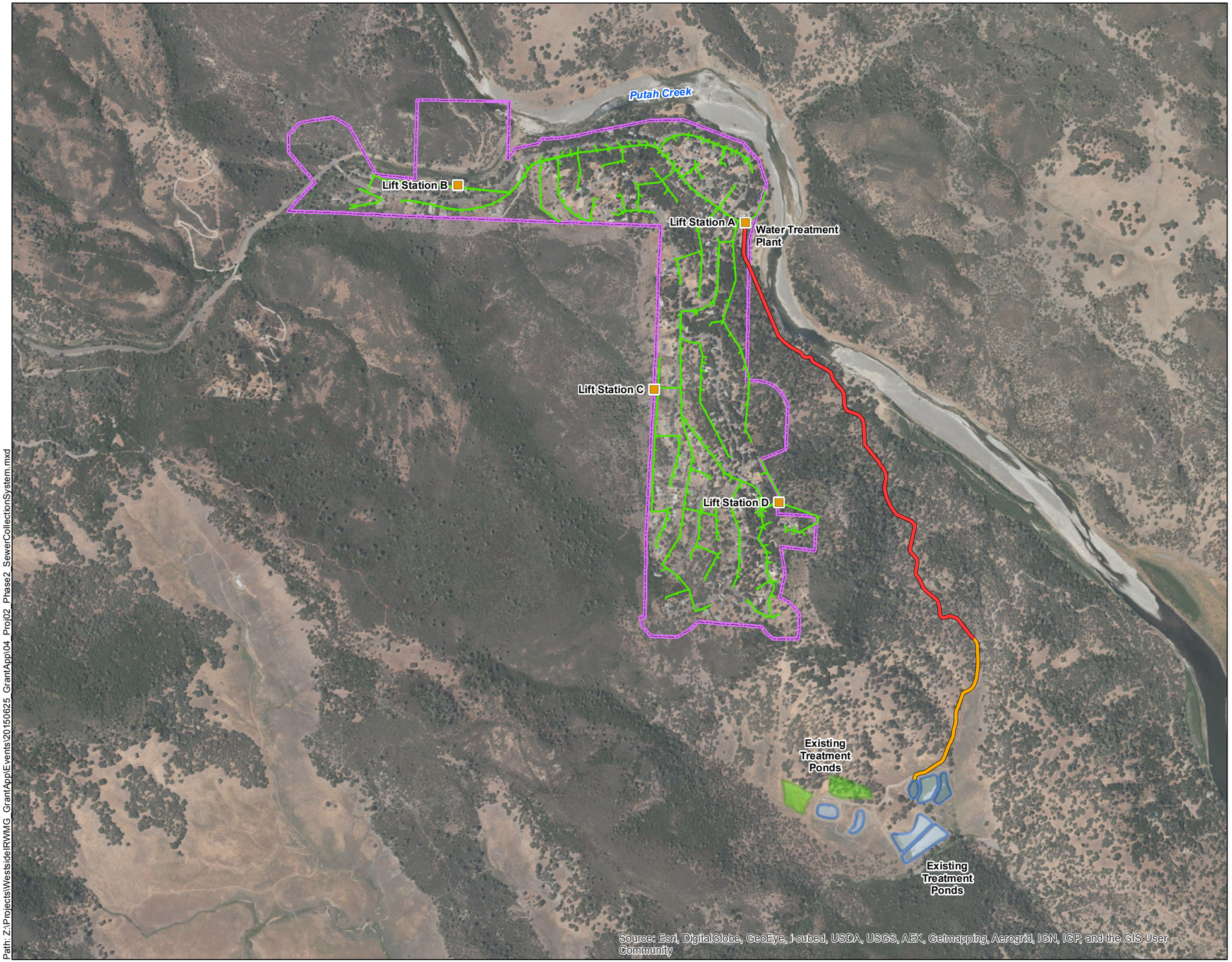
Primary Benefit: Reduced Biological Oxygen Demand (BOD) Nutrient Load to the Upper Putah Creek

LBRID's water supply intake in Upper Putah Creek is downstream of historical raw sewage spills into the watershed. Critical upgrades to the WW system would eliminate sewage spills entirely, protecting the community's sole water supply.

Table 2.9: Annual Project Physical Benefits

Project Name: LBRID Water Supply Protection and Enhancement Project Type of Benefit Claimed: BOD Nutrient Loading Reduction (primary benefit) Units of the Benefit Claimed : mg/L BOD5 Anticipated Useful Life of Project (years): 30			
(a)	(b)	(c)	(d)
Year	Physical Benefits		
	Without Project	With Project	Change Resulting from Project (c) – (b)
2017	110	0	-110
2018	0	0	0
2018-2066	110	0	-110
	0	0	0

a. The first full year of benefits will be 2017. The new pipelines and force main will have an expected service life of 50 years, but the booster pumps are expected to need replacing after 30 years.
b. Benefits are shown using an estimated 2-year recurrence interval of sewage spill events based on historic spill record.
c. Metcalf & Eddy 2013 states that the concentration of BOD5 in sewage ranges from 110 mg/L to 350 mg/L. Project physical benefits are based on the minimum concentration. 110 mg/L BOD5 per spill event translates to 772 to 2,457 lbs avoided per spill event.



Legend

- Lift Stations
- LBRID Sewer Line
- Force Main
- Gravity Trunk Line
- Existing Spray Areas
- Existing Treatment Ponds
- Lake Berryessa Resort Improvement District

N

0 500 1,000 Feet

Kennedy/Jenks Consultants

Westside Sacramento IRWM Group and County of Yolo Flood Control and Water Conservation District
2015 Prop 84 IRWM Implementation Grant Application
Yolo, California

LBRID Water Supply Protection and Enhancement Project
Project No. 2

K/J 1570012.00
August 2015
Figure 4

Path: Z:\Projects\WestsideIRWMG_GrantApp\Events\20150625_GrantApp\04_Proj02_Phase2_SewerCollectionSystem.mxd

Secondary Benefit: Beneficial reuse of 3 acre-feet per year of filter backwash water.

In the operation of the SWTP which is a membrane filtration plant, after conducting membrane clean-in-place (CIP), the spent filter backwash water is discharged to the sewer collection system. This project would return the filter backwash water, which is currently wasted, to the coagulation tanks to blend with raw surface water for treatment. The backwash water contains citric acid and highly concentrated chlorine to descale aluminum, iron, manganese, and calcium and to disburse biological foulants.

This project is estimated to provide up to 3,200 gpd of additional water supply, which is about 71% of average daily water demand based on the reduced demand of 50 gpcd. For the purposes of Table 2.10, it is assumed that 90% of 3,200 gpd or 2,880 gpd can be captured for an average annual supply of 1,051,200 gallons/year (3 AFY).

Table 2.10: Annual Project Physical Benefits

Project Name: LBRID Water Supply Protection and Enhancement Project Type of Benefit Claimed: Filter Backwash Water Reused (secondary benefit) Units of the Benefit Claimed : Acre-feet per year (AFY) Anticipated Useful Life of Project (years): 50			
(a)	(b)	(c)	(d)
Year	Physical Benefits		
	Without Project	With Project	Change Resulting from Project (c) – (b)
2017	0	3	3
2018-2066	0	3	3
Comments: Benefits shown are based on average production and 90% of backwash flows and is accordance with the EPA Filter Backwash Rule, FBRR 66 FR 31086, June 8, 2001.			

Technical Analysis of Physical Benefits Claimed

Technical Analysis and Description of Primary Benefit: Reduced Biological Oxygen Demand (BOD) Nutrient Load to the Upper Putah Creek

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

The LBRID sewage collection system has a history of deficiencies and raw sewage spills into Putah Creek during major rain events in the 1990s and 2000s ranging from 7,500 gallons to 5.5 million gallons, which are summarized and documented in ACL Order R5-2011-0538. Moreover, the surface water intake for the LBRID SWTP is in the portion of Upper Putah Creek near the sewer collection system, and only about 1,500 feet downstream of Lift Station A and WW storage tank. The greatest risk to the SWTP, and the environment as a whole, has been spills from the LBRID's wastewater storage tank. In 1995, the wastewater storage tank spilled raw sewage into Upper Putah Creek, upstream of the water intake, during a power outage. Up until 2009 there have been insufficient financial reserves to sufficiently maintain, rehabilitate, or replace WW collection and storage equipment and facilities, which are either nearing or beyond the intended age of service or have already failed.

The ACL required the District to submit a report for the LBRID sewer collection system that included results of an inflow/infiltration (I/I) evaluation, defined sustainable I/I flow rates as the basis for design of capacity improvements, and prioritized the needed improvements to reduce I/I and contain volumes and flows for dry weather and long-term precipitation events. The I/I evaluation found that the LBRID's sewer collection system Rainfall Derived I/I (RDI/I) was about 10% of each rainfall event entering the system, significantly greater than what is expected from a typical sewer system of 1-3%.

The LBRID Phase 2 Wastewater Improvements Pre-Design Report (PDR 2015) identifies the basis for design and considerations for Phase 2 improvements as follows:

- None of the lift stations have the pumping capacity to convey I/I from the 10-year design storm, the 100-year design storm, and buildout as required by the ACL. During rainstorms, the WW system has discharged sewage due to the inability of the pumps in the lift stations to keep up with the increased flow rate. LBRID keeps a portable pump onsite during the rainy season.
- Neither Lift Station A, B, nor C have backup power supply, making them vulnerable to power outages during significant rainstorms.

- The lift stations are equipped with a type of pump that is vulnerable to grit and other solids typically found in raw wastewater, reducing reliability and increasing maintenance costs. Moreover, the lift stations are unable to pass, macerate, or remove larger solids typically found in raw wastewater that can accumulate in lift station wet wells and clog or damage pumps making them susceptible to overflows.
- The existing force main has been in service for about 50 years and is constructed of asbestos cement pipe of unknown condition and pressure class.

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project.

The ACL documents the occurrence and extent of sewage spills from the LBRID sewage collection system between 1995 and 2010. On average spills have occurred every two years with a median volume of 840,000 gallons of sewage spilled to the land or waterways. Without the project, sewage spills continue to be a risk because the potential for overflows at the lift stations is high even with rehabilitation of approximately 2.6 miles of gravity sewer mains (37% of total) and completion of Phase 1 between 2007 and 2010. Although rainfall derived inflow and infiltration (I&I) has reduced about 23% from 398,000 gallons/inch to 140,000 gallons/inch; this reduction is not enough to ensure capacity of the sewer collection system to convey the 100-year design storm without the Phase 2 facilities mandated by the ACL (West Yost Associates 2015). If Phase 2 is not completed, sewage flows during a significant rainstorm will continue to spill or LBRID will need to truck excess wastewater, as they did in 2007 to Napa Sanitation District at a cost of $100,000 (RWQCB 2011).

These actions are ordered by ACL Order R5-2011-0538 and there is no alternative project that would be taken if not for the project.

Provide a description of methods used to estimate physical benefits.

The methods used to estimate physical benefits are the recorded sewage discharge volumes estimated to have been released into the watershed and the range of typical wastewater nutrient concentrations to calculate mass of nutrients. From 1995 through 2010 there have been 8 recorded spills, at a recurrence interval of about one spill event every 2 years. Spill event volumes have ranged from 7,500 gallons to 5.5 million gallons per event, an average discharge volume of 1,687,500 gallons and a median discharge of 840,000 gallons.

According to Metcalf & Eddy 2013, BOD5 concentration in wastewater flows ranges from 110-350 mg/L. Using this estimate, the range of mass of BOD5 avoided is:

110 mg/L x 3.79 L/gal x 840,000 gal = 350,196,000 mg = **772 lbs** (low)

350 mg/L x 3.79 L/gal x 840,000 gal = 1,114,260,000 mg = **2,457 lbs** (high)

Because the spill volume is affected by the duration and intensity of rainstorms and other sources of irregular inflow and infiltration, the lower mass value is used to estimate avoided BOD5. Therefore, it is assumed that 772 lbs/year of nutrients will be avoided per rainstorm event with the completion of this project, at a concentration of 110 mg/L in wastewater. It is estimated that this benefit will occur every two years, which is the frequency of sewage spill based on historic spill records as explained in the discussion of the without-project baseline.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

The Draft Phase 2 PDR contains details on the planned improvements to eliminate risk of sewage spills. The proposed project will include:

- Replacing the pumps at Lift Station A with two (2) rotary lobe pumps (one pump will be a standby pump) and 75 hp motors.
- Replacing the pumps at Lift Stations B, C, and D with chopper-style pumps to macerate wastewater solids.
- Electrical improvements at the lift stations including installation of stationary standby power and upgrades to the existing combination motor starter units, motor controls, and conduit/conductors to the upgraded pumps.

- Replace approximately 3,000 feet of the existing 6-inch asbestos cement force main with new 8-inch High Density Polyethylene (HDPE) pipe and appurtenances.
- Renew yard piping, fittings, and valves.

Provide a description of any potential adverse physical effects as a result of the project.

No permanent adverse physical effects are anticipated as a result of the project. However, some limited construction phase effects may occur. The effects of construction will be mitigated by constructing improvements during the dry season on LBRID-owned sites that are already developed and limiting ground disturbance to the greatest extent feasible. All appropriate erosion and environmental protection measures will be taken during construction to minimize physical impacts.

Description of whether the proposed project effectively addresses long-term drought preparedness.

Once completed, this project will address long-term drought preparedness by: a) promoting water conservation, conjunctive use, reuse and recycling and b) proving solutions that yield a new water supply. The project achieves drought preparedness by treating, storing, and beneficially reusing the water from LBRID's SWTP filter backwash system and creating a new potable water supply from a potential source which currently is sent to the sewer system as wastewater. The project also protects LBRID's sole water supply by eliminating sources of sewage contamination. Finally, this project will ensure that SWTP can maintain drinking water operations even during rainstorm events when there is a high volume of wastewater flows into the sewer system.

Technical Analysis and Description of Secondary Benefit: Beneficial reuse of 3 AFY of filter backwash water

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

In 2014, the months of July, August and September saw zero baseflow in Upper Putah Creek and LBRID imposed an Emergency Drought Declaration, limiting residents to 50 gallons per day per household water consumption. The drought declaration was lifted in November later that year; however if the current drought continues, LBRID may enact restrictions again in 2015. As of July 29, 2015, flow in the creek at the Putah Creek near Guenoc river station was 0 cfs. With such limited surface water flows and likely future drought declarations, any water that can be made available is highly valuable.

The LBRID SWTP is a membrane water treatment facility that includes flocculation, clarification, filtration, and disinfection. Raw water is pumped from Upper Putah Creek to the LBRID SWTP at a flow rate in the range of 50 to 150 gpm. Raw water is pumped through strainers and a mixer into a 1,000 gallon flocculation/coagulation tank prior to entering the two filter trains. After filtration, the water enters the chlorine contact basin and is then stored in a 10,981 gallon clearwell prior to pumping to distribution. The design treatment plant capacity is 360,000 gpd, but daily production ranges from 25,000 to 65,000 gpd.

The filter backwash system discharges from 1,500 to 6,000 gpd of backwash water with an average rate of 3,200 gpd. Aluminum hydroxide solids readily settle from the daily waste stream. More than 80% of the volume could be recycled. Every 45 to 60 days, membranes are soaked with solutions containing citric acid and highly concentrated chlorine. The CIP waste volume is discharged to the sewer collection system for treatment at the wastewater treatment plant and will continue to be discarded because the chemistry would impair supernatant quality.

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project.

Without this project, SWTP filter backwash water will continue to flow directly into the sewage collection system.

Other water reuse/recycling projects that could be completed if this project is not completed would be for wastewater recycling and would require significantly more funding for tertiary treatment and recycled water distribution infrastructure and could not occur until after Phase 1 and Phase 2 is complete.

Provide a description of methods used to estimate physical benefits.

The physical benefits are estimated using SWTP records that show that filter backwash flows average about 3,200 gal/day. Daily water production for Berryessa Estates is about 45,000 gpd at the current stage of development and under current water conservation measures demand has declined to approximately 55 - 60 gpcd. In accordance to the EPA Filter Backwash Rule (FBRR, 66 FR 31086, June 8, 2001), LBRID is allowed to reuse 2,500 to 6,500 gpd of backwash wastewater, which is 10% of the WTP's production flow. The table below shows the expected and allowable reuse flows, assuming 90% of backwash wastewater is treated and reused.

Table 2.11: LBRID SWTP Flows

	Low	High	Average
Daily WTP Production (gpd)	25,000	65,000	45,000
10% of Production Flow (gpd)	2,500	6,500	4,500
Daily Backwash Wastewater (gpd)	1,500	6,000	3,200
90% Return	**1,350**	**5,400**	**2,880**
% of Production	**5**	**8**	**6**

This Project will produce about 3 AFY of recycled water, ranging from 2 AFY to 7 AFY depending on water use conditions. Therefore, this project could reduce the amount of water pumped from Putah Creek by about 6% on a daily average, or, during a dry year, supplement their supply by 5% of dry weather flows.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

Filter backwash water will be returned to the head of the SWTP to the coagulation tank via a new decant pump and additional new pipeline after sufficient time to settle the solids in a tank. The raw water coagulation tank has a capacity of 1,000 gallons, which is sufficient volume to receive the filter backwash water and raw water. The coagulation tank is appropriate for treatment of the filter backwash water that contains citric acid and highly concentrated chlorine.

Implementation of the project will require LBRID to amend its existing CDPH permit to operate the SWTP. The necessary forms will be completed and submitted to CDPH and LBRID staff will coordinate, as necessary, to acquire the permit. No additional permits are anticipated to be required.

Provide a description of any potential adverse physical effects as a result of the project

Permanent adverse physical effects of the project are not expected but will be verified during the environmental document which is currently under preparation. Because the filter backwash recirculation element of the project involves minor alteration of existing facilities at the water treatment plant site, no permanent significant impacts are expected to result from the project. Therefore, a Categorical Exemption is anticipated for CEQA compliance. A Notice of Exemption will be completed and filed with the State Clearinghouse and/or County Clerk.

Temporary construction effects may occur. In order to minimize these effects, construction will occur in dry season on LBRID-owned sites that are already developed with limited ground disturbance. All appropriate erosion and environmental protection measures will be taken to minimize temporary construction impacts.

Description of whether the proposed project effectively addresses long-term drought preparedness.

As noted in the Primary Benefit discussion earlier, once completed, this project will address long-term drought preparedness by: a) promoting water conservation, conjunctive use, reuse and recycling and b) providing solutions that yield a new water supply. This project will achieve long-term drought preparedness through water reuse and recycling by treating, storing, and beneficially reusing the water from LBRID's SWTP filter backwash system and creating a new potable water supply from a potential source which currently is sent to the sewer system as wastewater. This project can provide at least 6% of LBRID's minimum demand of additional water based on 50 gallons per household per day.

Direct Water-Related Benefit to a DAC

As detailed in Attachment 7, the proposed project and its benefit area is the LBRID service area of Berryessa Estates. Although the LBRID service area is not a DAC per the American Community Survey

results described in Appendix G of the 2015 IRWM Grant Program Guidelines, an income survey was conducted within the LBRID service boundaries for the year 2011 (RCAC 2012). The MHI for this survey only counted residences occupied for more than six months of the year. In 2011, the Median Household Income for Berryessa Estates was $45,000, which was less than $45,830 which is 80% of the Statewide median household income in 2011 of $57,287. Therefore, by population, 100% of the project area, Berryessa Estates, is a DAC based on Appendix B of the 2015 IRWM Grant Program Guidelines. A summary of the results are listed below with more detailed information in the Berryessa Estates MHI Final Report: December 2012.

The 2011 income survey found that there are a total of 164 parcels within the project area. Eleven (11) parcels were vacant, zero (0) parcels were commercial, and 12 were vacation homes; leaving 141 parcels to survey. Of the 141 residences, 102 responded to the survey; 39 did not respond or refused to participate. The 102 responses account for a 72.3% response rate. State and Federal guidelines established by USDA-Rural Development states that households in a universe from 116–153 requires a sample size of 72%.

This project will provide two direct water-related benefits by providing 1) critical water quality need (found in Appendix G of the 2015 IRWM Grant Program Guidelines of "wastewater treatment necessary to abate or prevent surface or groundwater contamination" and "wastewater treatment required to protect beneficial uses or meet a discharge standard". The project reduces and eliminates the nutrient loading into the LBRID water supply (Upper Putah Creek). The project also provides a water supply benefit of "Infrastructure renovations to a public water supply system necessary to assure continued reliability of the minimum… quantity of water". By treating and reusing the SWTP filter backwash water, especially during the dry season when surface water flows are so limited, the project facilitates reliability providing a minimum quantity of water.

In 2014, the months of July, August and September saw zero baseflow in Upper Putah Creek and LBRID imposed an Emergency Drought Declaration, limiting residents to 50 gallons per day per household water consumption. The drought declaration was lifted in November later that year; however if the current drought continues, LBRID may enact restrictions again in 2015. As of July 29, 2015, flow in the creek at the Putah Creek near Guenoc river station was 0 cfs. With such limited surface water flows and likely future drought declarations, any water that can be made available is highly valuable.

Project Performance Monitoring Plan

Project Performance Monitoring will align with monitoring as required by Waste Discharge Requirements (WDRs). LBRID follows the monitoring requirements as set forth in Monitoring and Reporting Program (MRP) R5-2008-0068, which includes daily records of lift station condition and metered flow into the main collection tank. LBRID also keeps a record of sanitary sewer overflows, manhole inspection reports, sewer line inspection reports, major equipment and process failures, and condition of the forcemain.

The ACL includes monitoring and reporting requirements for improvements to the sewer collection system, including waste discharge, written spill reports, and quarterly groundwater monitoring reports.

Table 2.12: Project Performance Monitoring Plan

Project Name: LBRID Water Supply Protection and Enhancement Project				
Proposed Physical Benefits	**Targets**			**Measurement Tools and Methods**
Reduced nutrient load (BOD) to the Upper Putah Creek	# Sewage/Wastewater Spills = 0			Sewer system to contain all flows during a 10-year and 100-year rainstorm event in full compliance with WDR.
Beneficial reuse of 3 acre-feet per year of filter backwash water	1,350 gpd <	Average backwash water treated	< 5,000 gpd	Metered flows returning to coagulation tank.

In addition, LBRID already employs SCADA to monitor their water treatment plant performance, as documented in their Water System Operations Plan. LBRID will continue to monitor treatment operations, in addition to the return flow to the coagulation tank. Daily records are already kept for the

amount of water treated, total time the plant is in operation, flow rate through the plant, chlorine residual, dose rates of chemicals, turbidities of raw water/filter effluents/finished water, and backwash time and rate.

Cost Effective Analysis

This analysis evaluates whether the physical benefits provided by the project are provided at the least possible cost compared to other alternatives. See Table 2.13.

Table 2.13: Cost Effective Analysis

Project Name: Phase 2 Sewer Collection System Upgrades	
Question 1	Types of benefits provided as shown in Tables 2.10 and 2.11 Primary Benefit: BOD Nutrient Loading Reduction Secondary Benefit: Filter Backwash Water Reused
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? No, these sewer system improvements are mandated by the ACL. In addition to these improvements, the ACL mandated the evaluation and design reports serve as the basis for these improvements. Even if not mandated by the ACL, full replacement of the facilities is the only other alternative and are not feasible in this DAC because of costs that are much higher than facility rehabilitation.
	No other water supply projects can provide the immediate water supply and water use reduction benefit within the project time frame. Previous investigations into groundwater supplies have yielded zero supply, shown by dry boreholes. This is likely due to the geology of the area: fractured volcanic formations and tillish soil of rocks and cobbles. Water conservation programs would not have as great an impact as backwash water reuse – due to the drought the community already has reduced water use to 50 gpcd in 2014, and if drought conditions do not improve, this restriction will be in place again. Recycled water could be implemented for irrigation reuse although irrigation demands are very low in the LBRID service area. Recycled water for direct potable reuse is not feasible at this time as the regulations currently do not exist.
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.

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ATTACHMENT 2: PROJECT JUSTIFICATION

Project 3: Lower Putah Creek - Watershed Infiltration and Invasive Species Removal for Integrated Regional Water Management

Implementing Organizations: Solano County Water Agency on behalf of the Lower Putah Creek Coordinating Committee.

Project Description

The project provides infiltration buffer strips at 24 sites to reduce upland/channel erosion and removes 500 occurrences of invasives in 34 acres of riparian forest.

Expanded Project Description

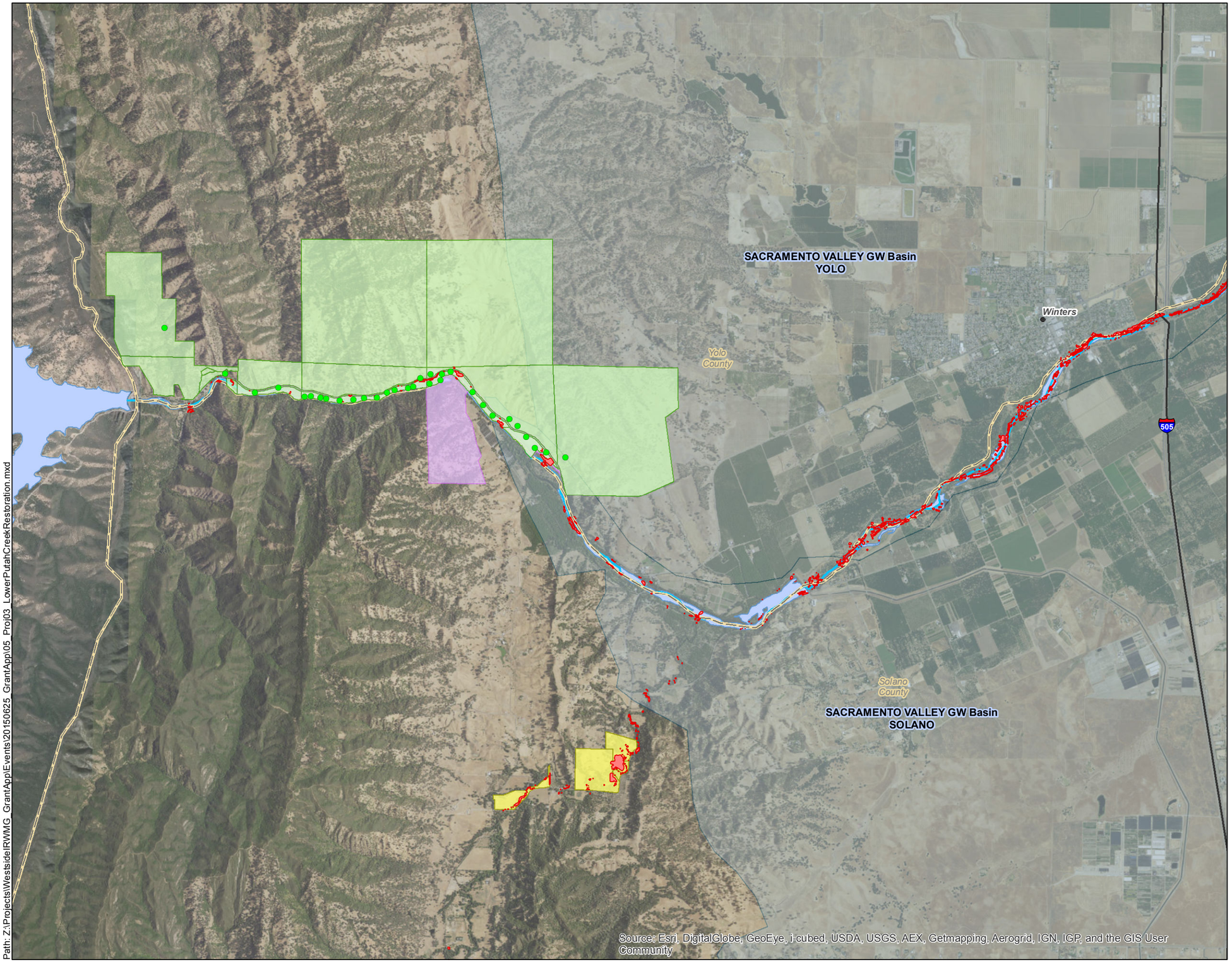
This project maximizes efforts in the Lower Putah Creek watershed to control erosion, which has significant downstream impacts, by locally distributing and infiltrating highly erosive flows. While watershed-wide improvements may be merited, they are often impractical for financial and other reasons. This method implements, on a sub-watershed scale, integrated upstream infiltration measures that result in erosion, habitat, and water supply improvements downstream through the watershed resulting in truly Integrated Regional Water Management. Specifically, the project implements a multi-step process: 1) an assessment to determine the most highly erosive locations, often associated with compacted soils, in the Bobcat Ranch and Pleasants Creek sub-watersheds, 2) addressing concentrated (highly erosive) flows first through improving soil infiltration by tilling and integration of organics and 3) as a result of soil restoration, establishing robust native savannah-type vegetation on the treated sites. This work will be done on 24 sites determined by the Monticello Post Fire Assessment completed in 2015, and assessment work done on Pleasants Creek in 2013. The project will also remove/control 34 net acres (500 occurrences) of 20 primary invasive weeds such as Himalayan blackberry, Tree of Heaven, and arundo on 600 acres of riparian forest from in a 5 mile reach of Lower Putah Creek from Monticello Dam (at Lake Berryessa) to Winters.

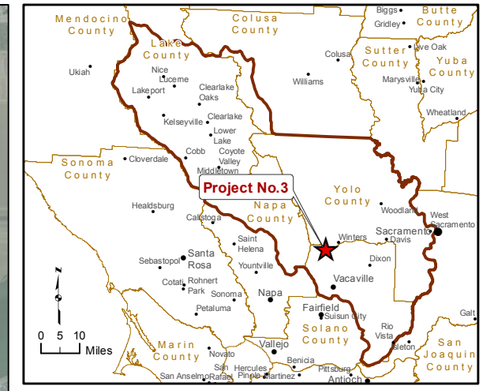
Current Need of the Region

The project elements will address current needs of the Region to reduce erosion and riparian invasive species and improve water supply. Addressing erosion reduces sedimentation of vital downstream water supply facilities including Lake Solano (an impoundment upstream of the Putah Diversion Dam used as a balancing reservoir) and the Putah South Canal; reducing the presence of riparian invasive species reduces instability in the creek channels and impacts to infrastructure as well as improves ecosystem function and enhances water supply through increased infiltration for groundwater recharge. The erosion improvement sites selected in Bobcat Ranch are on steep slopes while Pleasants Creek is the most prolific input of sediment into the Solano County Water Agency's raw water system (NHC, 2008, p. Es. 4). Soil compaction resulting from grazing during wet periods have resulted in range lands that are impervious surfaces similar to urbanized environments that create peak runoff flows and associated erosion. Sediment loading of Lake Solano has increased steadily since construction in the 1950s with the lake nearing capacity to absorb sediment inflows. Peak turbidity events reached a twenty year high in 2002 of 3200 NTU and peaked above 4,000 NTU in 2006 and again in 2008 resulting in temporary shutdowns of drinking water treatment facilities (NHC, 2008, p. Es. 3). Capacity of water treatment sediment drying ponds at Northbay Water Treatment Plant in Fairfield has doubled since 2012 from two acres to four acres to accommodate the increased sediments.

A watershed assessment completed in 2005 documented 600 occurrences of 20 primary invasive weeds in 600 acres of riparian forest on the main channel of Putah Creek from Monticello Dam to Winters. The presence of invasives such as Himalayan blackberry and arundo obstruct the channels such that: flows accelerate damaging bridge and road infrastructure and limit access for engineering assessments for future channel restoration projects, displace native vegetation, impede wildlife migration, and further degrade wildlife habitat by hosting black rats that prey on nesting birds.

During this recent four year drought period, reduced water supplies are critical not only to urban and agricultural downstream users but also to the ecosystem as occurs when the groundwater table is lowered and no longer provides base flow. The project will enhance groundwater infiltration such that, over time, base flow with associated benefits to invertebrates and salmonid rearing are expected to occur.





Legend

- Erosion Watch Sites
- Invasive Weeds
- Bobcat Ranch Parcels
- Erosion Watch Parcels
- Eroding Banks Parcels
- Westside Regional Boundary
- Counties
- Groundwater Basins
- Streams
- Water Bodies

N

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Feet

Kennedy/Jenks Consultants

Westside Sacramento IRWM Group and County of Yolo Flood Control and Water Conservation District
2015 Prop 84 IRWM Implementation Grant Application
Yolo, California

Lower Putah Creek – Watershed Infiltration and Invasive Species Removal for Integrated Regional Water Management
Project No. 3

K/J 1570012.00
August 2015

Figure 5

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Physical Benefits

Overview of Benefits of Project 3 – The two quantifiable benefits of the Lower Putah Creek Sediment Reduction and Watershed Enhancement Project are:

- Enhanced Water Infiltration (Primary)
- Restored Habitat from Invasive Species Removal (Secondary)

Each of these benefits are summarized in Table 2.14 below and detailed in the sections that follow.

Primary Benefit: Enhanced Water Infiltration

Table 2.14: Annual Project Physical Benefits

Project Name: Lower Putah Creek Infiltration and Invasive Species Removal for Integrated Regional Water Management **Type of Benefit Claimed: Enhanced Water Infiltration (primary benefit)** **Units of the Benefit Claimed: acre-feet per year (AFY)** **Anticipated Useful Life of Project (years): 25**			
(a)	**(b)**	**(c)**	**(d)**
Year	**Physical Benefits**		
	Without Project	**With Project**	**Change Resulting from Project**
			(c) – (b)
2016	0.4	2	1.4
2017	0.4	4	3.6
2018-2040	0.4	4	3.6
Comments: The site restoration will occur in 2016 and 2017 and estimates are based on field measurements taken in nearby sites and reduced for conservatism. It is assumed that five acres will be completed in 2016 and the rest in 2017. While the benefit is expected to last in perpetuity as long as maintenance occurs; for the purposes of this analysis expected to end in 25 years.			

Secondary Benefit: Restored Habitat From Invasive Weeds Removal

Table 2.15: Annual Project Physical Benefits

Project Name Lower Putah Creek Infiltration and Invasive Species Removal for Integrated Regional Water Management **Type of Benefit Claimed: Habitat Restored from Invasive Weeds Removal (secondary benefit)** **Units of the Benefit Claimed : Acres** **Anticipated Useful Life of Project (years): 25**			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project**
			(c) – (b)
2016	0	17	17
2017	0	17	17
Comments: The restoration is at 500 discrete locations that total about 34 acres with 17 acres occurring the first year and 17 acres the second year. Even though the acreage benefits are only shown for the two years when the program is first implemented, benefits of the restored habitat will actually be realized for many years following initial site restoration activities, and assuming the sites are periodically checked and maintained will provide benefits up to the entire 25 year anticipated useful life of the project.			

Technical Analysis of Physical Benefits Claimed

Technical Analysis and Description of Primary Benefit: Enhanced Water Infiltration

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

Watersheds in and around the Central Valley of California have been impacted over the long-term since Europeans first brought grazing to these areas; periods of drought increase this impact when cattle and sheep overgraze the sparse forage. Further, winter grazing has created high levels of compaction throughout the watersheds. Bobcat Ranch is a common example of this condition. Compaction and loss of native vegetation reduces the soil organic matter that would occur in an unimpacted soil system. Watershed function is inextricably connected to water infiltration rates that have diminished as soil compaction has increased since European settlement. Field research has shown that infiltration rates on degraded lands ranges from 0.5 to 1 inch per hour (Drake and Hogan, 2013). These rates are appropriate to the Lower Putah Creek watershed and its tributaries.

Diminished infiltration rates results in less stored groundwater/groundwater recharge. Further, soil compaction favors shallow-rooted fast-growing invasive annual weeds over deeper-rooted slower-growing native vegetation. Diminished infiltration rates associated with soil compaction also increases peak runoff which increases erosion and sediment loading into the water supply facilities such as Lake Solano, the Putah South Canal and Northbay Water Treatment Plant in Fairfield.

The increased runoff from compaction was exacerbated by fundamental changes to the Lower Putah Creek watershed hydrology which occurred with the construction of Monticello Dam in the 1960s to form Lake Berryessa. Upstream peak flows were captured in the lake and then released at a rate much lower than the natural peak flow into Lower Putah Creek while the peak flows in the tributaries to Lower Putah Creek remained uncontrolled. This difference in peaks increased the energy gradient of the tributary creek channels resulting in head cutting with associated erosion (Marovich, 2015). Landowners along the tributaries then planted non-native species such as Arundo in an effort to control erosion. Other non-native species such as Himalayan Blackberry also encroached on these eroded areas. There are also infrastructure-related consequences of peak flow runoff such as the five bridges over Pleasants Creek that were expected to last 100 years but instead became obsolete after 50 years as mid-span bridge abutments were lost to scour. In addition, $210,000 was spent on one 200 linear foot emergency road repair due to a bank washout due to increased runoff velocities and volumes.

Furthermore, traditional methods of erosion control such as plantings have often been ineffective and do not address soil compaction and loss of infiltration. In aggregate, rangelands such as the Lower Putah Creek watershed are impervious in ways that are similar to urbanized areas with similar attributes such as minimized infiltration and maximized runoff/sediment delivery. These impacted watersheds export large amounts of sediment to Putah Creek and to both the Solano County water system and the Putah Creek aquatic ecosystem. By increasing infiltration, peak flows are not only reduced but stored water in the watershed is increased that is then released slowly through the season rather than as runoff.

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project

Without the enhanced infiltration resulting from the project, the peak runoff events would continue to erode sediments and the water supply in the Solano Water Agency system (e.g. Lake Solano and Putah South Canal as well as Fairfield's Northbay Water Treatment Plant) would continue to be vulnerable to sediment from extreme runoff events which are taking place more often due to climate change. Further, ongoing drought has put additional stress on already depleted soil water, causing plants to wither and die and to give way to more annual invasive species. Without the infiltration, groundwater recharge is minimized and water supplies remain impacted and are not improved when peak rainfall runs off and erodes stream banks. One of the primary benefits of infiltration, beyond the immediate reduction in erosion, is groundwater recharge, which will become of critical importance as climate change continues. In fact, the techniques that are proposed provide clear and measurable benefits to

offset the impacts of climate change by infiltrating and storing maximum amounts of rainfall. (Grismer et al, 2008, Grismer 2013; Seiler and Gat 2007, and USGS 2015).

Provide a description of methods used to estimate physical benefits.

The methods that are used to estimate physical benefits include the results of field studies (Grismer, 2014 and 2008) that use runoff and rainfall simulators described below. The estimates in Table 2.14 are based on:

- Treatment Area totaling x 5 acres treated for 24 sites (about 10,000 ft^2 per site) (Marovich, 2015)
- Average Annual Precipitation of 24-inches (SCWA, 1999, p. 2-3)
- Pre project % infiltration of annual rainfall that ranges from 4% (1"/24"), 8% (2"/24") up to 38% (9.2"/24") annually, with an average of 17% (Hogan, 2015)
- Post-Project % infiltration of annual rainfall – 40% up to 100% based on field measurements (Hogan, 2013)

Using the assumptions listed above, without and with project infiltration volumes are estimated as follows.

Without project infiltration is estimated as: 4% * 24 "/yr * 5 Ac = 0.4 Acre-Feet (AF) infiltrated per year (AFY) while at 17% of annual precipitation results in an estimate of 1.7 AFY. A value of 4% of the annual precipitation that is infiltrated was selected for this analysis as it represents a worst case condition of the lands to be treated.

With project infiltration is estimated as 40% *24"/yr *5 Ac = 4 AFY while at a less conservative 65% of annual rainfall infiltrated results in 6.5 AFY. The infiltration occurs immediately upon completion of treatment (Hogan, 2015). In order to be conservative, the 4 AFY value was selected for this analysis.

Field confirmation of these physical benefits will include a number of tools including a cone penetrometer (soil compaction), a Time Domain Reflectrometry (TDR) moisture probe (water content and storage), direct assessment of vegetation (cover point or ocular estimates) and most importantly, a rainfall simulator and runoff simulator, either separately or in tandem. These field-based simulators are based on the understanding that direct observation linked with collection of data is much more effective and information rich than predictive models, which is a useful planning tool but does not necessarily represent reality. By contrast, a simulator allows direct observation of runoff characteristics and can provide data on infiltration rates, runoff rates, turbidity, suspended solids, nutrients, organic matter and particle size of the runoff (Grismer, 2012).

In both rainfall and runoff simulators, measurements can include time to runoff, infiltration rates in mm/min, runoff rate in mm/min, turbidity in NTUs, sediment in total suspended solids in mg/l of runoff, total and relative concentrations of sediment and sediment particle size distribution in either gm/l runoff, total gm, etc. The rainfall simulator consists of a frame and over 800 drop forming points, a collection frame and flume where rainfall water is captured in bottles for analysis. The runoff simulator consists of a distribution pipe, flow meter and a laser-cut manifold pipe with distribution shelf that produces runoff that mimics a band of runoff. Both units can be adjusted for more or less rainfall or runoff and can mimic a range of conditions.

The rainfall and runoff field simulators are used to determine infiltration and sediment delivery values before and after treatment and thus offer a repeatable and highly useful set of data and also offer direct observation of the runoff and erosion itself, something that the model does not do. Thus, the combination of direct observation with the collected data offer perhaps the most powerful and defensible approach available to determine effectiveness and also to improve practices where optimal performance is not met. In the end, the usefulness of these simulators is in providing information that supports real, rather than projected outcomes.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

The actions required to obtain the physical benefit of enhanced infiltration include selecting specific sites where measures will be most beneficial and implementing the measures described in the Watershed Management Guidebook (Drake and Hogan, 2013). Site selection in the Bobcat Ranch watersheds were assessed and chosen according to the Erosion-focused Rapid Assessment Methodology (EfRA) described in Drake and Hogan (2013) and the Monticello Post Fire Assessment

(Hogan, 2015). Sites in the Pleasants Creek watersheds have been chosen due to existing erosion and proximity to Pleasants Creek (high propensity to deliver sediment to the creek). These methodologies are based on identifying not only sites that are eroding but sites where erosion will actually reach Putah Creek and thus have a direct effect on water quality, habitat and economics.

Measures to be implemented include applying specific types of organic soil amendment, tilling that in, seeding, mulching and setting up temporary irrigation. Soil is tested to determine carbon, nitrogen, pH, and other parameters, amendment amounts are derived from that, specific types of organic, high carbon soil amendments are added (with carbon sequestration benefits) to the soil surface and those amendments are mixed into the soil using a mini or full size excavator or in some cases a backhoe, to a depth of between 18 and 24 inches in such a manner that the subsurface is rough or 'scalloped'. That loosened material is then smoothed, seeded, raked, mulched (using wood chips or another long lasting surface mulch), and temporary irrigation is applied. Typically, the site is irrigated no more than 6 times in order to encourage seeded material germination and establishment. Given the loosening, once germination occurs, plants have a relatively easy time sending roots deeply into the soil to access deep soil water and nutrients.

SCWA and the Lower Putah Creek Coordinating Council have long-term maintenance agreements with land owners that will participate in this project and maintenance permits with California Fish and Wildlife that will enable the work to be conducted.

Provide a description of any potential adverse physical effects as a result of the project

The type of treatment described provides an immediate benefit to infiltration and sediment reduction, even before vegetation is established so treatment has no adverse effect but instead has an immediate beneficial impact by allowing any rain that is encountered to be completely infiltrated. Further, all sites will be treated with whatever temporary sediment protective measures are appropriate. No impacts will take place to agricultural operations. No road closures will be required. Therefore, no permanent adverse physical effects are anticipated as a result of the project.

Description of whether the proposed project effectively addresses long-term drought preparedness

The proposed Lower Putah Creek Watershed Infiltration and Invasive Species Removal for Integrated Regional Water Management project addresses the long-term drought preparedness measures, which are detailed below, of:

- Promote water conservation, conjunctive use, reuse and recycling
- Improve landscape and agricultural irrigation
- Efficient groundwater basin management

Promote water conservation, conjunctive use, reuse and recycling – as described earlier, when soil is compacted as it usually is in landscaping projects and large agricultural (including grazing land as is Bobcat Ranch), the soil cannot hold much water, perhaps 10%. The remaining 90% of the rainfall runs off. Infiltrating the rainfall achieves direct recharge of surface water to groundwater (estimated at 40% up to 100% increases) which is one of the means of conjunctive use of surface water and groundwater. When the groundwater levels increase, they increase baseflow in the surface streams which allows downstream capture by water diverters and/or for environmental benefit for conjunctive use of groundwater and surface water.

Efficient groundwater basin management – Analogous to the conjunctive use discussion above, enhancing groundwater recharge increases the groundwater supply which facilitates efficient groundwater basin management.

Technical Analysis and Description of Secondary Benefit: Reduction of Invasive Weeds

List any recent and historical conditions that provide a background for the benefit being claimed (i.e., recent water shortages, loss of habitat, water quality problems).

A watershed assessment completed in 2005 documented 600 occurrences of 20 primary invasive weeds in 600 acres of riparian forest on the main channel of Putah Creek from Monticello Dam to Winters. The presence of invasive Himalayan blackberry and arundo obstruct the channel that, in conjunction with high peak flows, results in infrastructure damage such as erosion along channel

banks and around bridge abutments as occurred in Pleasants Creek and restricts engineering assessments for future channel restoration projects. Furthermore, riparian invasives displace native vegetation, impede wildlife migration, and further degrade wildlife habitat by hosting black rats that prey on nesting birds.

Putah Creek provides significant habitat for fish and wildlife including: 31 species of mammals (13% of all species found in California and 63% of all species known to occur in the Central Valley), 10 species of reptiles (11% of all California species and 67% of all Sacramento Valley species), 4 species of amphibians (only 6% of all California species, but fully 80% of all Sacramento Valley species), 31 species of butterflies (56% of all species expected to occur in the Central Valley), and 220 species of birds (67% of all species known to occur in Yolo County) (Marovich, 2015). The Swainson's Hawk is a state special status species and has the highest density of occurrence in the State in the Lower Putah Creek watershed (Hoshovsky, 2015).

Provide a description and estimates of without-project conditions (i.e., the level of the physical benefit in the future, without the project, but with other projects that would most likely be undertaken if not for the project

Without this project, invasive weeds such as Himalayan blackberry and arundo would continue to spread. Arundo, an aggressive invasive plant species, is widespread in the Lower Putah Creek as shown on the attached figure, with associated ecosystem impacts including harboring rats that prey on nesting birds, increases fire risk, increases flood risk, causes streambank erosion, and impairs water quality. In addition, arundo has an extremely high rate of water consumption and transpiration and competes for local water supplies. Studies have shown that arundo can consume up to six times more water than native riparian plant species (Cal-IPC 2011) which is vital at all times but especially during drought.

Apart from reducing water availability for human uses, water consumption by arundo also reduces water availability for critical Lower Putah Creek ecosystem function. As noted Lower Putah Creek is a significant ecosystem habitat for a wide species of fish, birds, and other wildlife. Reduced river flows and excessive sediments discussed earlier, are a direct impediment to anadromous species recovery efforts and impact other ecological restoration and species recovery projects along Lower Putah Creek.

Provide a description of methods used to estimate physical benefits.

The project will restore about 500 occurrences of invasive non-native plant species over about 34 acres of riparian habitat along Lower Putah Creek, between Monticello Dam and Winters, as shown on the project figure. Restoration will occur through eradication of arundo from the project sites and re-vegetation with native plant species. Implementation will occur consistent with methods used on similar projects such as the 2007 City of Winters Vegetation Management Plan, in order to ensure achievement of benefits. Locations of highest arundo density and ecological value will be prioritized to optimize the restoration benefits. Methods used to estimate physical benefits include weed surveys and photo documentation. The benefits are estimated to extend for 25 years based on prior experience of SCWA which has been active in invasives management in the Lower Putah Creek since 2002 and has refined methods for removal and monitoring to ensure success. Since 2005, SCWA has removed about 50 net acres of weed in the first two miles below Putah Diversion Dam using the results of the 2005 Putah Creek Watershed Management Action Plan.

Provide a description of all new facilities, policies, and actions required to obtain the physical benefits.

This project does not require new facilitates or policies in order to obtain ecological restoration benefits. The actions need to obtain the physical benefits include create temporary trails into weed thickets, control weeds with aquatic safe herbicides, remove weed residues and establish native grasses, from the SCWA native plant nursery. SCWA already maintains ongoing agreements with landowners for access for maintenance. The restoration and re-establishment of native riparian habitat within the project area is an integral part of project implementation. Therefore benefits of 34 acres of restored riparian habitat will occur automatically with implementation. Upon completion, SCWA will continue monitoring for the presence of arundo and other invasives in the project area and if necessary, re-treat the areas in order to sustain ecosystem and water-savings benefits.

Provide a description of any potential adverse physical effects as a result of the project

No long-term adverse physical effects are anticipated with this project. On the contrary, the project will provide significant long-term environmental benefits. There will be temporary loss of vegetation in the high-density arundo areas, which could cause temporary disturbances, from vegetative cover loss, to wildlife present in those areas. However, these are unavoidable disturbances during arundo removal activities and these cleared areas will be re-vegetated with native plant species to restore and enhance wildlife habitat. The arundo biomass resulting from removal activities will be taken away from the project areas to further avoid negative project impacts, including potential fire or flood hazards.

Direct Water-Related Benefit to a DAC

The Lower Putah Creek Watershed Infiltration and Invasive Species Removal for Integrated Regional Water Management Project area overlaps slightly with a DAC area as shown on the attached Regional Map, it does not meet the criteria that at least 25% of the project service area (by population or geography) will benefit a water-related need of a DAC. DACs will benefit indirectly from the project.

Project Performance Monitoring Plan

Establishing monitoring measures will help ensure the proposed project will meet its intended benefit. The table bellows identifies the targets to be used to measure the primary and secondary benefits.

Table 2.16: Project Performance Monitoring Plan

Project: Lower Putah Creek Infiltration and Invasive Species Removal for Integrated Regional Water Management		
Proposed Physical Benefits	**Targets**	**Measurement tools and methods**
Enhance Water Infiltration	Up to 3.6 AFY of additional infiltration from 24 sites	Rainfall and Runoff simulator
Restored Habitat from Invasive Species Removal	34 Acres of riparian area restored	Weed maps and photo confirmation

The project has data on baseline watershed conditions for that are described in the Watershed Management Action Plan 2008 including maps of invasive weeds. In addition, fish and wildlife habitat below Putah Diversion Dam have been monitored since 2002 by U.C. Davis and ongoing monitoring is funded in perpetuity. California Department of Fish and Wildlife monitoring is focused on annual electrofishing and salmonids spawning surveys, breeding bird studies in the spring, winter migrant bird studies in the winter, aquatic insect monitoring occurs monthly. Solano County Water Agency had deployed temperature monitoring probes throughout the project area and a water temperature model has been developed. These data could be available to further evaluate benefits of restoration.

The runoff and/or rainfall simulators discussed earlier will be employed immediately after treatment in order to assess immediate post treatment infiltration and sediment reduction benefits and then at one year intervals in order to determine change over time. At those times, macro scale rilling or gullying, plant cover and species mix, and soil density (cone penetrometer) will be assessed.

Cost Effective Analysis

Table 2.17: Cost Effective Analysis

Project Name: Lower Putah Creek Restoration - Monticello Dam to Winters	
Question 1	Types of benefits provided as shown in Tables 2.14 and 2.15 Primary Benefit: Enhanced Water Infiltration Secondary Benefit: Habitat Restored from Invasive Weeds Removal
Question 2	Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified? No. If no, why? • No other project alternative can produce both (1) the enhanced water infiltration and (2) the habitat restoration that will be achieved with high certainty with the proposed restoration project. Other means of erosion control on rangeland do not result in infiltration benefits. If yes, list the methods (including the proposed project) and estimated costs. • Not applicable.

Project Name: Lower Putah Creek Restoration - Monticello Dam to Winters	
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. • Not Applicable
Comments: See discussion below.	

There are a number of alternate, and even 'standard' methods to reduce erosion such as hydroseeding, mulch blankets, and large irrigation systems which are considerably more costly as they require reapplication year after year (M. Hogan, 2015). When measured, these alternates do not produce the desired infiltration effects of the project. The methods proposed allow for direct measurement of the treatments with demonstrated infiltration benefits while measurement of other erosion control do not result in the infiltration benefit.

Restoration projects, such as this proposed project, are unique in that they provide a multitude of benefits that cannot be achieved through any single alternative project. Arundo removal and restoration proposed by this project is the only feasible project option that can provide the anticipated water conservation and habitat restoration benefits along Lower Putah Creek. Arundo is the source of the high water consumption and habitat degradation along Lower Putah Creek. Hence, only removing arundo and the other non-native invasive plant species addressed by this project will address the source of the problem. Similarly, no other invasive or native plant species have close to the same water consumption rate as arundo. Therefore removal of an alternative vegetation type would not provide benefits comparable to this invasive species removal project.

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