PROJECT JUSTIFICATION

This attachment provides the project justification for the various Projects contained in this Proposal. This Attachment is organized as follows:

Project Summary Table – A table showing how each Project meets the various drought elements and IRWM Project Elements of the drought Solicitation. This table is consistent with PSP Table 4.

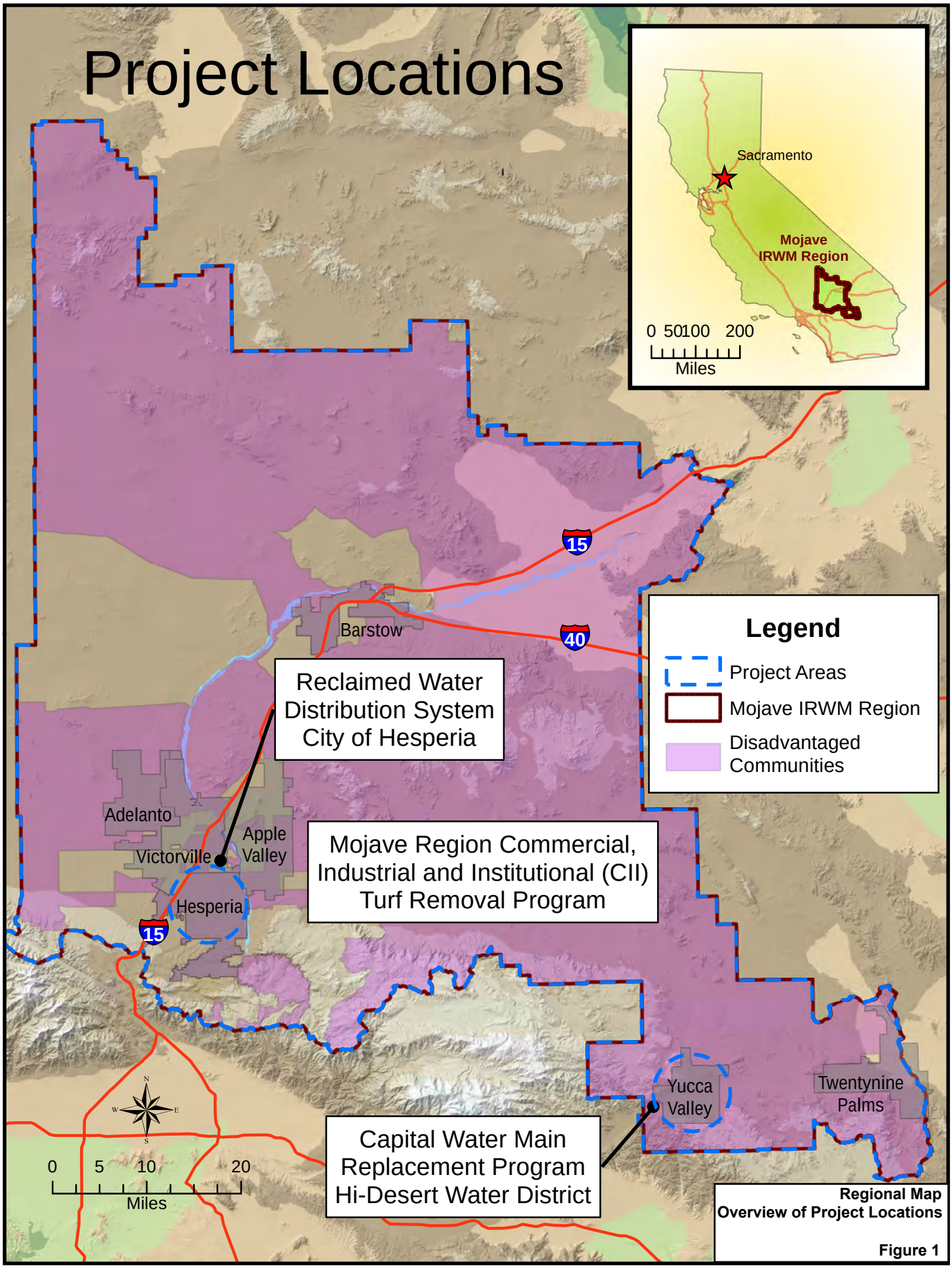
Project Description - A brief Project summary and description of how each Project will help alleviate the drought impact in the Region.

Project Specific Information - The Project description, a description of Project physical benefits, the technical analysis of physical benefits claimed, and cost effectiveness analysis for each Project.

Regional and Project Maps - An illustration of the IRWM regional boundary and the location of each Project is shown on Figure 1 (Page 3-3) as well as a map for each Project (Figures 2, 3, and 4) (Pages 3-5, 3-7, 3-9).

Project Summary Table

Table 4 – 2014 IRWM Drought Solicitation Project Summary Table				
	Drought Project Element	**Mojave Region CII Turf Removal Program**	**Hi-Desert Capital Water Main Replacement Program**	**Hesperia Reclaimed Water Distribution System**
D.1	Provide immediate regional drought preparedness	**X**	**X**	**X**
D.2	Increase local water supply reliability and the delivery of safe drinking water	**X**	**X**	**X**
D.3	Assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective	**X**		
D.4	Reduce water quality conflicts or ecosystem conflicts created by the drought			
	IRWM Project Element			
IR.1	Water supply reliability, water conservation, and water use efficiency	**X**	**X**	**X**
IR.2	Stormwater capture, storage, clean-up, treatment, and management			
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands			
IR.4	Non-point source pollution reduction, management, and monitoring	**X**		
IR.5	Groundwater recharge and management projects			
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users			**X**
IR.7	Water banking, exchange, reclamation, and improvement of water quality	**X**	**X**	**X**
IR.8	Planning and implementation of multipurpose flood management programs			
IR.9	Watershed protection and management	**X**	**X**	**X**
IR.10	Drinking water treatment and distribution		**X**	
IR.11	Ecosystem and fisheries restoration and protection			


Project Locations
Sacramento
Mojave
IRWM Region
0 50100 200
Miles
Legend
Project Areas
Mojave IRWM Region
Disadvantaged
Communities
Barstow
15
40
Reclaimed Water
Distribution System
City of Hesperia
Adelanto
Victorville
Apple
Valley
Hesperia
15
Mojave Region Commercial,
Industrial and Institutional (CII)
Turf Removal Program
Yucca
Valley
Twentynine
Palms
Capital Water Main
Replacement Program
Hi-Desert Water District
N
W
E
S
0 5 10 20
Miles
Regional Map
Overview of Project Locations
Figure 1

Mojave Region Commercial, Industrial and Institutional (CII) Turf Removal Program

This Project is being implemented by the Mojave Water Agency (MWA).

Project Description

This Project is a rebate program to promote turf removal by commercial, industrial, and institutional water users to conserve water in the Mojave IRWM Region.

Alleviation of Drought Impacts

Managing demand is critical to effective water resources management in the Mojave Region, which must balance limited local water supplies with declining State Water Project imports and the recovery from groundwater overdraft through two adjudications. During this recent drought, groundwater production has drawn down banked reserves, because supply from the SWP was insufficient to meet the full replenishment need to offset overdraft, and SWP direct-delivery customers have had to switch part of their operations to groundwater production.

This Project will decrease potable demand by promoting turf (i.e., grass lawn) removal on commercial, industrial, and institutional landscapes (and potentially large residential users). Water savings are estimated at 55.8 gallons per square foot of turf removed and up to approximately 188 acre feet per year (afy) and 1,884 af over its ten year life. The Project will build on the success of the existing residential *Cash for Grass* program. With about 60% of regional water use used for landscape irrigation, and the State focusing on this as the "next step" for conservation programs, implementation of this water conservation Project is a vital complement to ongoing water demand reduction efforts in the Region. Reducing water demand will help extend existing supplies, offset the need for supplemental supplies, reduce runoff and nonpoint source pollution from pesticides and fertilizers, and decrease groundwater overdraft. Gains in groundwater saved would be significant in alleviating threats to aquifers while the long-term demand reductions achieved from this Project are essential to buffer impacts from already stressed and limited water supplies. This will also help prepare for potential future droughts.

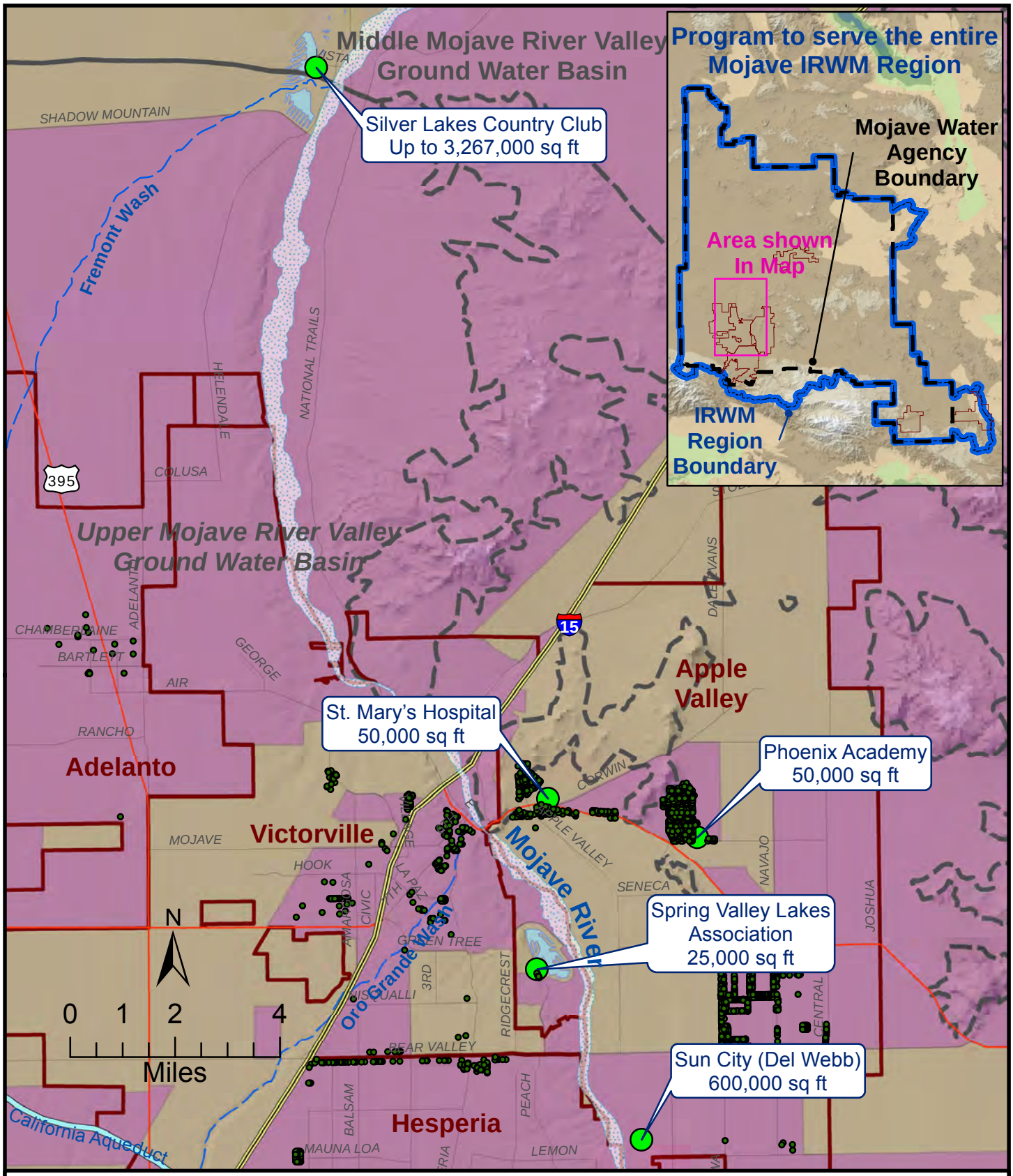
Drought Project Type

This water conservation Project provides immediate drought preparedness removing about 1,100,000 sq ft of turf and reducing water used for irrigation by about 188 afy. The water savings would be seen immediately upon Project implementation and achieve a ten year reduction of 1,884 af. This long-term reduction in water use will enhance the ability to meet demands during water shortages and increase the reliability of water supplies available in the Mojave Region, reduce the burden on the Upper Mojave Narrows and Camp Cady, home to sensitive riparian habitat that is threatened by groundwater overdraft, and help mitigate increasing arsenic concentrations.

The Project makes turf conversions possible for customers who would otherwise not be able to afford it. Although they have been identified as one of the most effective methods of reducing irrigation use, turf conversions are costly and not locally cost-effective. The rebates provided through this Project will help make turf replacement a cost-effective alternative for Mojave Region CII customers

Need for Expedited Funding

Expedited funding is needed as the long-term viability of groundwater is threatened. With landscape irrigation accounting for 60% of municipal use, minimizing the amount of turf in the Region is needed to assure short- and long-term supplies. This Project is ready for immediate implementation. Water savings will begin immediately upon removal of turf, freeing up supplies to meet the Region's drinking water needs.



Potential Multifamily Sites

Potential Commercial, Industrial and Institutional Sites

City boundaries

Disadvantaged Communities

Mojave Region Commercial, Industrial and Institutional (CII) Turf Removal Program

Figure 2

Hi-Desert Capital Water Main Replacement Program

This Project is being implemented by the Hi-Desert Water District.

Project Description

124,515 lineal feet of failing steel water main will be replaced, and new appurtenances will be installed to reduce current water losses.

Alleviation of Drought Impacts

Due to the extreme drought conditions and the potential for continued dry year conditions, water supplies are becoming increasingly limited. The replenishment of supplies, which are solely derived from SWP water supplies in Hi-Desert Water District's (District's) service area, are becoming less and less reliable and plentiful. The replacement of nearly 24 miles of failing steel water main pipeline, planned for this Project, will reduce significant water losses (through leaks) that are occurring, and therefore ease the drought stressed existing water supplies while providing necessary fire flow protection to the citizens of the Town of Yucca Valley that are currently served by the failing infrastructure. The estimated annual savings of the water from the construction of this Project is 226 afy.

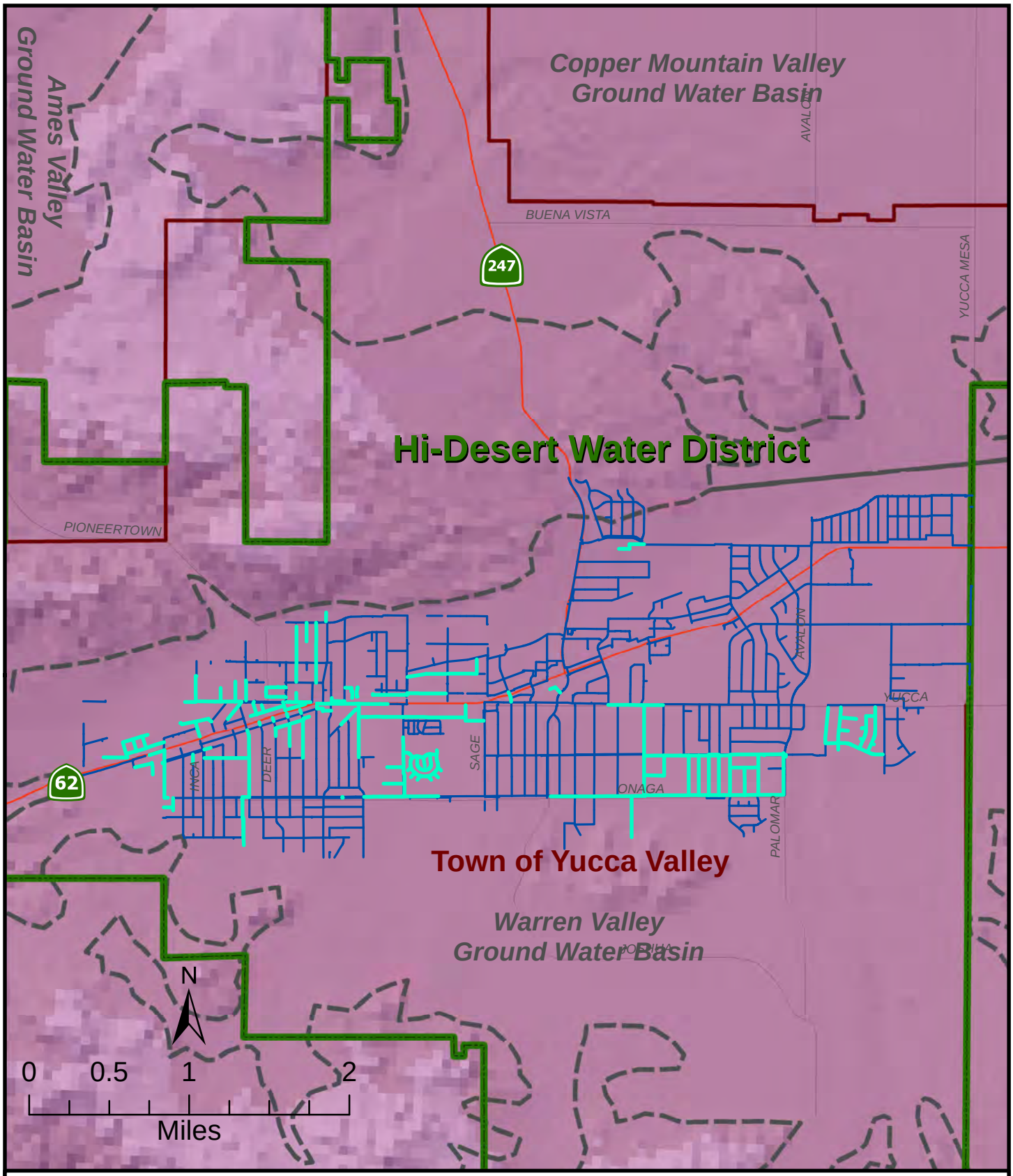
Drought Project Type

This Project provides immediate drought preparedness by achieving an immediate, yet long-term, reduction in water use, thereby enhancing the ability to meet demands during water shortages. Water demands will be effectively reduced by preventing system water losses through the replacement of failing pipeline infrastructure. These infrastructure improvements will allow more water supplies to be available to meet essential water needs and will allow the District to provide drinking water that is unimpaired by high turbidity levels –which is currently impacting the District's ability to provide a reliable, high quality water supply to environs residing within the Project area. As a result, this Project increases local water supply reliability and the delivery of aesthetically pleasing, safe drinking water.

Need for Expedited Funding

The steel pipeline infrastructure currently owned and maintained by the District is, in many cases, over 50 years old, deteriorating, and undersized to meet current demands. As a result, the infrastructure is failing, resulting in excessive water losses due to leaks and breaks. Inferior water quality can also be provided to customers due to high water velocities in the pipes during high demand events or leaks. The high velocities can lead to scouring of the pipe walls that can break apart tubercles and mobilize deposits. This shows up as dirty water complaints and often remedied by flushing the water lines, with associated water losses.

These factors are creating adverse effects on the District's operating budget, conservation efforts, and most importantly the ability to provide a high quality, reliable source of water to meet both normal and peak water demands within the Project area. Under ongoing drought conditions, it is crucial that existing water supplies are used as efficiently as possible in order to continue to adequately meet water needs throughout the District's entire service area. The District's water losses through leaks from the failing water mains are placing excessive demands on existing water supplies. Given these circumstances, expeditious action is imperative to prevent further water losses. With the proposed infrastructure improvements, water demands will be significantly curtailed, thereby extending existing water supplies to provide continued water supply reliability.



Water Mains

Water Mains to be Replaced

Hi-Desert Water District

Disadvantaged Communities

Capital Water Main Replacement Program Hi-Desert Water District

Figure 3

Hesperia Reclaimed Water Distribution System Project

This Project is being implemented by the City of Hesperia/Hesperia Water District (Hesperia).

Project Description

Hesperia will construct the first phase of its Reclaimed Water Distribution System to provide reclaimed water and reduce demand on potable water.

Alleviation of Drought Impacts

Hesperia is party to the Mojave Basin Judgment.[1] As such, the Hesperia Water District has a pre-determined free-production allowance (FPA), which it is allowed to pump from the Basin's regional aquifer. The Hesperia Water District exceeds its FPA every year due to forced ramp-down of the FPA and it is required to purchase make-up water from the Region's water wholesale supplier, the Mojave Water Agency (MWA). Since MWA's allocation of State Water Project (SWP) is extremely low (5%) as a result of the drought, the Hesperia Water District is not able to purchase its make-up water from MWA. For 2014, MWA had the foresight to pre-purchase and "bank" SWP water in the aquifer, so supplies are available for this water year. Should the drought continue into 2015 (and beyond), there is a real possibility that its 25 retail purveyors, including the Hesperia Water District, would have to take drastic measures, such as water rationing, to stay within their FPAs.

Additionally, as a result of ongoing drought conditions and the potential inability to replenish local supplies with SWP water, it may become necessary for the Hesperia Water District to purchase water on the open market at a highly inflated rate. These costly purchases would drastically increase customer rates, which would cause the greatest hardships on our local disadvantaged communities.

Implementation of this Project will allow conveyance of reclaimed water from the Victor Valley Wastewater Reclamation Authority (VVWRA) Water Reclamation Plant (WRP), which will come on-line in 2015. Reclaimed water from this Project will be supplied to Hesperia's highest demand user, the Hesperia Golf Course, for irrigation purposes, which will offset demands on potable water supplies and free up existing supplies for potable uses.

Hesperia has implemented stringent water use regulations, including landscape ordinances and Low Impact Design (LID) standards to help reduce water demands. By providing reclaimed water for irrigational uses, this Project will greatly enhance these ongoing efforts to reduce potable water demands for irrigation. Hesperia is also participating in a number of conservation efforts including the residential turf replacement programs and a variety of outreach and education efforts in collaboration with MWA and AWAC.

Drought Project Type

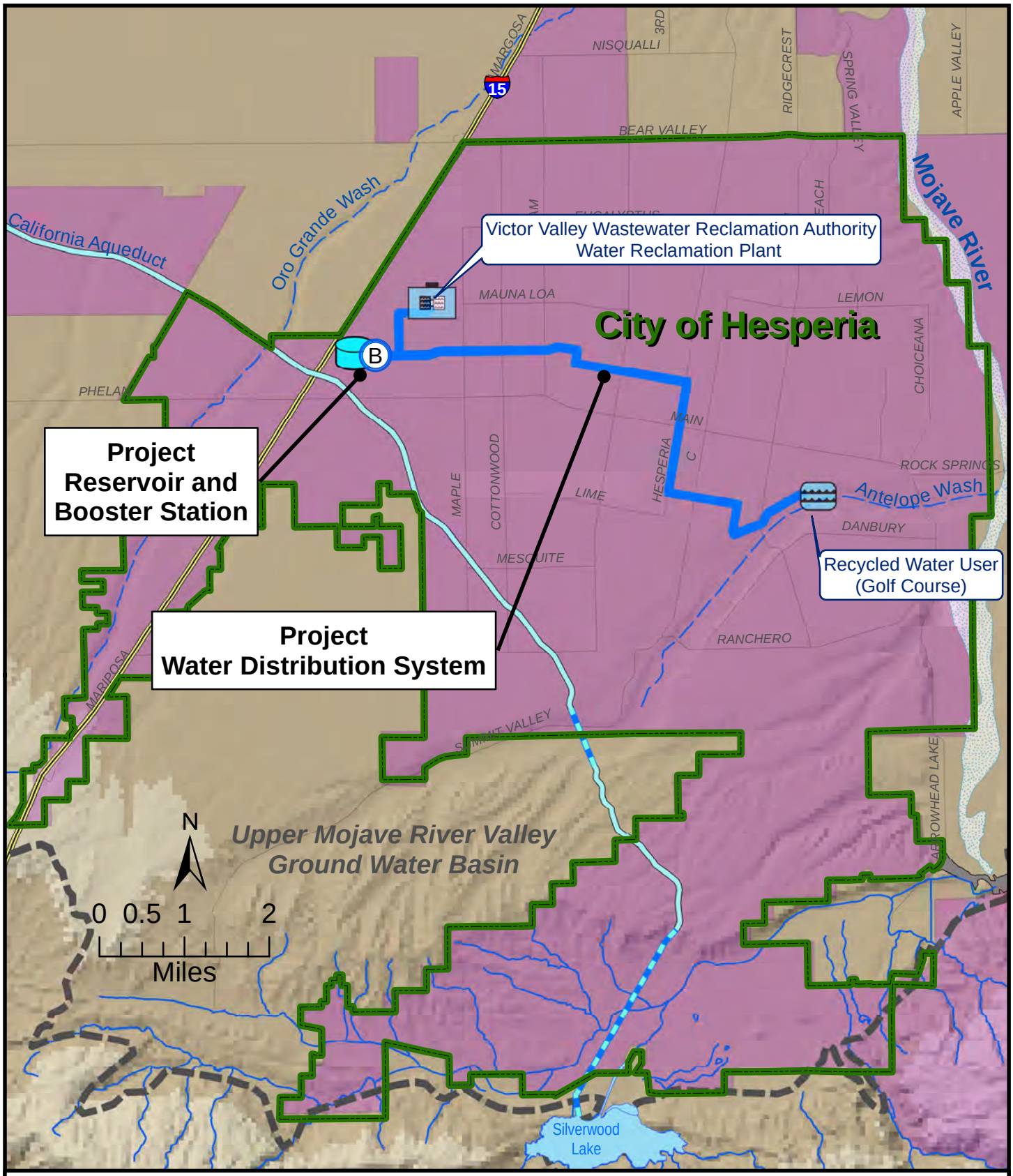
This is a reclaimed water Project. Implementation of this Project provides immediate regional drought preparedness as it provides a new local water supply for irrigation use. Reclaimed water from the VVWRA WRP will be a constant and uniform source of new water for irrigation and will supplant potable water with reclaimed water on a gallon for gallon basis. Every gallon of reclaimed water used for irrigation frees up a gallon of potable water that can be utilized as drinking water for the citizens of Hesperia.

This Project is critical in increasing local water supply reliability and maintaining Hesperia's ability to continue to provide adequate supply of safe drinking water to its residents.

Need for Expedited Funding

Reclaimed water from the VVWRA WRP will become available to Hesperia by the second quarter of 2015. The Hesperia Reclaimed Water Distribution System Project is planned to be constructed and ready for start-up at that time to enable Hesperia to provide this new water supply to its customers. Expedited funding will facilitate immediate implementation of this Project.

[1] The Mojave Basin Judgment assigned Base Annual Production (BAP) rights to each producer using 10 afy or more, based on historical production during the period 1986-1990. Parties to the Judgment are assigned a variable Free Production Allowance (FPA), which is a uniform percentage of BAP set for each subarea each year by the Watermaster. This percentage is reduced or "ramped-down" over time until total FPA comes into balance with available non-SWP supplies. For water year 2014-15, in the Alto Subarea (where Hesperia is located), it is recommended by the Watermaster that the FPA be set to 80 percent of BAP for agriculture and 60 percent of BAP for municipal and industrial.



B Booster Station

Proposed Project Reservoir

Proposed Project Alignment

Disadvantaged Communities

Reclaimed Water Distribution System
City of Hesperia

Figure 4

Project Physical Benefits, Technical Justification, and Cost Effectiveness

Mojave Region CII Turf Removal Program

The following (quantifiable) physical benefits are expected from this Project:

- Water savings of 1,884 af over the ten-year lifetime of this Project.

In addition to the quantitative benefit outline above, this Project will result in the following non-quantified benefits:

- Improved fish and wildlife habitat in the Camp Cady and Upper Mojave Narrows areas.
- Reduced pollution associated with reduced runoff from landscape irrigation

Each benefit is discussed in further detail below.

Project Physical Benefits

Benefit: Water Savings of 1,884 Acre-Feet

CII turf replacement rebates will be dispersed on a first-come-first-served over the two-year Project implementation period. As shown in Table 3-1, once all turf has been converted to Xeriscaping, the Project will result in approximately 61,380,000 gallons or 188 af water savings each year. Over the expected benefits lifetime of ten years, this will total 1,884 af of water savings.

Table 3-1 – Annual Project Physical Benefits
Project Name: Mojave Region CII Turf Removal Program
Type of Benefit Claimed: Water Savings
Units of the Benefit Claimed : Acre-Feet
Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	0	0	0
2015	0	94	94
2016	0	188	188
2017	0	188	188
2018	0	188	188
2019	0	188	188
2020	0	188	188
2021	0	188	188
2022	0	188	188
2023	0	188	188
2024	0	188	188
2025 (Last Year of Project Life)	0	94	94

Comments: Half of the rebates will be dispersed in year one, with the remaining half dispersed in year two of the Project.

Technical Analysis of Physical Benefits Claimed

Benefit: Water Savings of 1,884 Acre-Feet

Each square foot of turf replaced will result in approximately 55.8 gallons of water savings per year. With approximately 1,100,000 square feet of turf expected to be converted to Xeriscape, this initiative will yield water savings benefits of approximately 1,884 af over the ten-year Project lifetime.

Technical Basis of the Project

The MWA's turf replacement program began in 2008, supported by funds from the California Proposition 50 Grant. The second phase of turf replacement was supported independently and the third phase was funded by the California's Proposition 84 Round 1 Implementation Grant (MWA, 2014a).

Turf replacement rebate programs are particularly effective in the dry, hot climate of the Mojave Region, however these efforts are typically cost-prohibitive. Sixty-eight percent of the Mojave Region is comprised of disadvantaged communities (DACs), and even $.50 rebates have been enormously effective in incentivizing households to convert to Xeriscaping. Previous turf replacement rebates have already contributed to the removal of roughly 6.5 million square feet of turf.

The current residential rebate program imposes a limit of 20,000 square feet (or $10,000 eligible for rebates), and therefore does not offer options for larger CII users to participate. This Project will address this need by raising the cap to half of the overall budget and raising the rebate amount in an effort to attract CII customers to replace larger turf areas.

MWA will develop advertising and outreach aimed at informing larger CII customers of the new opportunity. Implementation of the program will be very similar to the residential rebate program, including issuing of rebates, eligibility, documentation and inspections.

Recent and Historical Conditions

MWA manages declining groundwater levels within the Mojave Groundwater Basin and the Morongo Basin Area, covering 4,900 square miles. MWA supplies 25 retail water agencies almost entirely by pumping local groundwater sources (MWA, 2014a, p.5). In order to meet increasing demand due to population growth and increased requirements for groundwater recharge, MWA has an annual contract for up to 82,800 af of State Water Project (SWP) supplies, approximately 30,600 af of which is currently delivered (MWA, 2014a p.5). This figure is projected to increase to 46,200 afy by 2035. The local surface water supply that is available to recharge the Region's underground aquifers is estimated to be 54,000 afy; the Region has been banking groundwater for the past ten years to mitigate stress on local supplies (MWA, 2014a, p.6). According to MWA, the Region would risk running out of water without SWP supplies.

Water production within Agency boundaries in 2012 was 156,181 af, which was slightly higher than the recent ten-year average of 148,963 af. CII use for the same time period accounts for roughly 15% of the total (MWA, 2014a, page 19).

MWA is already funding multiple other water conservation efforts for its 25 retail water agencies along with the Alliance for Water Awareness and Conservation (AWAC), a collaborative group of over twenty agencies whose goal is to promote conservation within the MWA service area and to implement water savings measures, including outreach, education and customer incentives. Programs offered include residential turf replacement rebates, high-efficiency (HE) toilet and HE clothes washer rebates and, as well as the development of new landscape standards. All of these efforts have played a significant part in reducing water consumption. Since 2000 per capita use has decreased 37%, from 271 to 172 gallons per capita-day (GPCD) (MWA, 2014b).

Estimates of Without Project Conditions

Without this Project, CII customers will only be able to apply for $0.50 per square foot turf replacement rebates under the existing turf removal program and be limited to $10,000, or 20,000 square feet. By not implementing this program, CII entities will continue to irrigate approximately 1,100,000 square feet of turf over the next ten years, using approximately 1,884 af water.

In addition, if the drought persists and groundwater supplies go into overdraft, fish and wildlife habitat in the Camp Cady and Upper Mojave Narrows regions will be even more stressed by decreasing groundwater supplies.

Descriptions of Methods Used to Estimate Physical Benefits

The Southern Nevada Water Authority (SNWA) performed an extensive study of water savings achieved by converting natural turf to Xeriscaping. This study found that conversion saves approximately 55.8 gallons per year for every square foot of turf removed, with up to 9.62 gallons saved during the month of July (Sovocool, 2005, pg. 4). During the time period of this study, evapotranspiration (ET) rates in the SNWA service area were very similar to those of the Mojave Region.

Mojave Region CII turf replacement rebates will be dispersed evenly over the two-year project implementation period. In the first year, 94 af of water savings is expected (55.8 gallons per square foot * 550,000 square feet of rebates * 0.00000307 af per gallon = 94 af per year of savings). In the second year, 94 additional af of water savings is expected, making a total of 188 af of water savings by the second year. The lifetime of water savings is expected to be 10 years, and total water savings over that time period for the Project is expected to be 1,884 af.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

There are no new facilities, policies, or actions required to obtain the Project benefits. CII entities must apply for rebates using a process similar to the one being utilized in the residential program.

Description of Any Potential Adverse Physical Effects

No potential adverse physical effects anticipated for this Project.

Non-Quantified Benefits

Improved fish and wildlife habitat in the Camp Cady and Upper Mojave Narrows areas

The geology along the Mojave River at Camp Cady and the Upper Narrows Riparian Area, home to sensitive riparian habitat, causes groundwater to surface and flow year-round, although most of the Mojave River is dry for most of the year. Groundwater overdraft causes surface flows in these areas to be reduced, directly impacting the riparian habitat (Ellsworth, 2014, page 4-7). As a result of the drought, local storm flows have been reduced resulting in less natural groundwater recharge, while SWP reductions have resulted in insufficient imported water available for mitigation of groundwater overdraft. These conditions have caused "Base Flow" (non-storm surface flow) at the Upper Narrows Riparian Area to decrease since 2011 (Mojave Basin Area Watermaster, 2012, 2013, 2014, Table 3-1). Severe drought conditions increase the risk of riparian habitat loss by further depleting groundwater levels. The shrinking riparian areas can only be restored by raising the hydrostatic head in surrounding aquifers to contribute to a healthy riparian base flow (CDFG, 2004, pgs. 8, 15). Prevention of further aquifer declines in drought periods (and increased groundwater levels in wet periods) is critical to the restoration of the Camp Cady and Upper Narrows Riparian areas. Projects that reduce groundwater pumping (such as the Mojave Region CII Turf Replacement Program) will help alleviate these impacts to these sensitive riparian areas.

Reduced pollution associated with reduced runoff from landscape irrigation

Replacing turf with native landscaping directly reduces watershed pollution due to urban runoff. Urban irrigation runoff can include pollutants such as chemicals and bacteria, which can flow from urban landscapes into existing

water bodies. Studies have shown that commercial turf landscapes and other large landscapes have been consistently overwatered – causing runoff. For instance a study in Irvine, California estimated that weather-based irrigation controllers (WBICs) caused irrigation demand to drop by 22% in the commercial landscapes that participated in the retrofit program. And, a large-landscape retrofit study completed in San Diego detected a drop in irrigation of between 24-48% after WBIC retrofits (CUWCC, 2014, pg. 5). This will reduce the resulting dry-weather irrigation runoff, which carries fertilizers, pesticides, and other pollutants into the storm drain system and/or into local creeks and rivers.

Cost Effectiveness Analysis

Answers to the cost effectiveness questions are presented in summary form in Table 3-2 below. One Project alternative that could potentially achieve water savings amounts similar to the Mojave Region CII Turf Replacement Program is to create a rebate program for weather based irrigation controllers (WBIC). However, this program is not considered feasible at this time due to the high cost of irrigation controllers given the disadvantaged community (DAC) designation for the area. Furthermore, WBICs marginally reduce the water demand for turf, which is an inherently inefficient landscape. The Mojave Region CII Turf Replacement Program will reduce water demand 188 afy by completely removing and replacing the most water-wasting landscapes. To achieve the same savings, a WBIC program would require seeking out applicants and administering rebates to approximately 294 participants (based upon CII customer data and an estimated average water savings of 0.64 acre-feet per WBIC installed). The proposed program targets the removal of large acreages of turf (minimum 20,000 square feet), reducing water demand by a minimum of 3.4 afy per participant, but some participants are likely to remove much larger amounts. With only 55 or less participants needed to achieve the maximum water savings of the program, the Mojave Region CII Turf Replacement Program will result in a much more immediate reduction in water demand, more quickly alleviating impacts of the drought on the Region's water supplies. More importantly, turf removal is the cornerstone of climate appropriate landscaping and efficiently irrigating and inefficient landscape does not reflect the direction and identified in the State's "New Normal" for Landscape.

This option is discussed more below.

Table 3-2 – Cost Effectiveness Analysis **Project name:** Mojave Region CII Turf Replacement Program	
Question 1	*Types of benefits provided as shown in Table 5:* Water savings of 1,884 per year due to the Mojave Region CII Turf Replacement Program.
Question 2	*Have alternative methods been considered to achieve the same types and amounts of physical benefits as the proposed project been identified?* Yes
	If no, why?
	If yes, list the methods (including the proposed project) and estimated costs: The proposed Project is a turf rebate program for CII customers. The total present value cost of the Project is $1,074,360. A Mojave Region CII Turf Replacement Program was determined to be the only feasible Project option that can achieve similar water savings. Weather based irrigation controller rebate program was considered, but given that 68% of MWA's service area is designated disadvantaged community, and that the cost per WBIC rebate to customer would be $150 to $200 (multiple WBICs may be necessary for a single site), a WBIC rebate was determined to be not feasible. Furthermore, turf replacement really reflects the priority of promoting climate appropriate landscapes which should precede other irrigation efficiency improvements. Ensuring the efficiency of climate appropriate landscape with improved irrigation techniques including WBICs would reflect the next level of improvement.
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.

The Mojave Region Turf CII Turf Removal Program will save approximately 1,884 af of water over the ten-year project lifetime. As shown in Table 3-3, with a total present value cost of $1,074,360, this Project will yield water savings benefits at a rate of $570/af $1,074,360 /1,884 af).

Table 3-3 – Annual Costs of Project (All costs should be in 2014 Dollars) **Project: Mojave Region CII Turf Replacement Program**										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2014								0	1.000	
2015	$586,121							$586,121	0.943	**$552,712**
2016	$586,121							$586,121	0.890	**$521,648**
2017								0	0.840	
…								0	…	
…								0	…	
2025 (Last Year of Project Life)								0	…	
Total Present Value of Discounted Costs (Sum of column (j))										**$1,074,360**

Of the water conservation efforts that MWA is engaged in, turf replacement is one of the most effective methods of reducing irrigation use. Other water savings initiatives that focus on water efficiency, such as HE toilets, HE clothes washers, and weather-based irrigation (or "smart") controllers (WBICs), all require significantly higher up-front capital costs for customers after rebates have been factored in. and have a significantly lower water savings, both per investment and per participant.

One potential alternative Project to the Mojave Region CII Turf Replacement Program is a weather-based irrigation controller (WBIC) rebate program. However, sixty-eight percent of the Mojave Region consists of DACs. Smart controller rebates would only cover about 50% of the total cost, leaving a large cost for customers that participate, given the average $300-$400 price tag that accompanies a single irrigation controller. MWA expects a much lower level of participation, and therefore lower level of water savings, if customers were required to pay $150-$200 of their own money for each controller.

Additionally, irrigation controllers would have to be installed in such a way that covers a higher amount of irrigated land in order to achieve the same level of water conservation as outright turf replacement. WBICs achieve water savings of anywhere between 22% to 48% depending on how well they are calibrated, maintained, and monitored (CUWCC, 2014, pg. 5), whereas turf replacement has resulted in water savings up to 75% in Southern Nevada, which has a climate and landscape very similar to the Project area (Sovocool, 2005, pg. 60). Turf rebates have provided better incentive to encourage water savings. WBICs are an effective option for irrigating climate appropriate landscapes and can be installed in the future to further improve efficiency.

Summary of Annual Project Physical Benefits

The physical benefits claimed for this Project include water savings of 1,884 af over the ten-year benefits lifetime. Water savings achieved through this Project will also alleviate riparian area stress at the Camp Cady and Upper Mojave Narrows areas. The Project alternatives discussed in the cost-effectiveness analysis were smart controller rebates which would cost customers $150-$200 per controller in a disadvantaged community. The proposed Project was determined the only viable Project for achieving a customer participation level sufficient for this amount of water savings.

References

CDFG (California Department of Fish and Game), 2004, *Habitat Water Supply Management Plan for the Adjudicated Area of the Mojave River Basin San Bernardino County*, California, Prepared by the California Department of Fish and Game, July 2004.

CUWCC, 2014. *Large Landscape Programs: An Update About Costs and Savings*. California Urban Water Conservation Council. Draft. May 12.

Ellsworth, Alisa. 2014. *Declaration of Alisa Ellsworth in support of the Department of Fish and Wildlife's response to Watermaster's motion to adjust free production allowance for the 2014-2015 water year*. Superior Court of the State of California for the County of Riverside. June, 2014.

Mojave Basin Area Watermaster, 2012. *Eighteenth Annual Report of the Mojave Basin Area Watermaster, Water Year 2010-11*. May 2012.

Mojave Basin Area Watermaster, 2013. *Nineteenth Annual Report of the Mojave Basin Area Watermaster, Water Year 2011-12*. May 2013.

Mojave Basin Area Watermaster, 2014. *Twentieth Annual Report of the Mojave Basin Area Watermaster, Water Year 2010-13*. May 2014.

Mojave Water Agency (MWA), 2014a. *Mojave Water Agency CII Turf Removal Program. WaterSMART: Water and Energy Efficiency Grants for FY 2014*. January, 2014.

MWA, 2014b. *GPCD by Subarea 2.25.2014.* Excel spreadsheet provided to Stratus Consulting Inc., Boulder, CO containing municipal water use in GPCD as reported in the MWA water demand forecasting model for 2014 IRWMP. June, 2014.

Sovocool, Kent. 2005. *Xeriscape Conversion Study Final Report.* Southern Nevada Water Authority.

Reference documentation for the Mojave Region CII Turf Replacement Program is provided in Att3_DG_ProJust_2of4.

Hi-Desert Capital Water Main Replacement Program

The following (quantifiable) physical benefits are expected from this Project:

1. 226 afy of reduced water loss to due reduced leaks and main breaks
2. Improved water quality as shown through fewer customer complaints

In addition there are non-quantifiable benefits in terms of:

- Improved reliability of operation
- Improved fire protection
- Improved water quality

Each benefit is discussed in further detail below.

Project Physical Benefits

Benefit 1: Reduced water loss to due reduced leaks and main breaks

The Project would replace old, leaking, steel water distribution pipelines within HDWD's service area. As is shown in Table 3-4, the Project would save approximately 226 afy by reducing water losses.

Table 3-4 – Annual Project Physical Benefits
Project Name: Hi-Desert Capital Water Main Replacement Program
Type of Benefit Claimed: Reduced water loss to due reduced leaks and main breaks
Units of the Benefit Claimed : Acre-feet per year (afy)
Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	403	403	0
2015	403	332	71
2016	403	248	155
2017	403	177	226
2018	403	177	226
2019	403	177	226
2020	403	177	226
2021	403	177	226
2022	403	177	226
2023	403	177	226
2024	403	177	226
2025	403	177	226
2026	358	177	181
2027	313	177	136
2028	267	177	90
2029	222	177	45

Table 3-4 – Annual Project Physical Benefits			
Project Name: Hi-Desert Capital Water Main Replacement Program **Type of Benefit Claimed:** Reduced water loss to due reduced leaks and main breaks **Units of the Benefit Claimed :** Acre-feet per year (afy) **Additional Information About this Benefit:**			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2030	177	177	0
…..	177	177	0
Last Year of Project Life 2066	177	177	0
Comments: Total water loss for the District was estimated to be 403 AFY. The Project is estimated to eliminate water loss for 56% of the service area by replacing old steel water mains. Construction of the main replacement project is assumed to start in March 2015 and be completed in October 2017 (32 months total). Main replacement is assumed to phase-in equally by month during this period. Without the Project, replacement of the steel mains in the Project area is assumed to begin in 2026 and take 5 years to implement.			

Technical Analysis of Physical Benefits Claimed

Benefit 1: Reduced water loss to due reduced leaks and main breaks

The Project would reduce water losses occurring from steel pipes in the Hi-Desert Water District (District) distribution system. These steel pipes are over 50 years old and in extremely poor condition. The Project would save approximately 238 afy by reducing water losses.

Technical Basis of the Project

This Project would replace 124,515 linear feet (LF) of failing steel water main infrastructure. During installation, new isolation valves and fire hydrants would also be installed along with service lines to customer meters. The infrastructure will be installed within the Town of Yucca Valley, CA.

Hi-Desert Water District's water distribution system pipeline materials consist of polyvinyl chloride (PVC), asbestos cement pipe (ACP), and steel constructed materials. In additions to leakage, the District's steel infrastructure does not provide adequate spacing between isolation valves that can allow it to minimize impacts to customers during required shutdowns. The existing pipe does not have enough properly sized fire hydrants and laterals and does not have a large enough capacity to meet emergency demands such as fire flows in many instances.

Experience has shown that the majority of water main breaks, leaks and other water quality issues within the water system are related to the steel mains. These pipes were installed in the 1950's. They are undersized for the current level of demand, and are in very poor condition.

This Project will be conducted in conjunction with a new effort to install 400,000 feet of wastewater collection systems mains known as the Wastewater Collection System Project which is in response to a State mandated septic tank prohibition set forth by the California Regional Water Quality Control Board, Colorado River Basin Region. The Wastewater Collection System Project will include repaving the roads. By doing this proposed

Hi-Desert Capital Water Main Replacement Program before the Wastewater Collection System Project, there will be significant cost savings in having to fully repave the roads only once, after the collection system mains have been installed. In the interim, roads will be temporarily patched following the Hi-Desert Capital Water Main Replacement Program. In addition to the cost savings, this would also significantly reduce the inconvenience to consumers due to the reduced time associated with patching compared to a full repaving.

Recent and Historical Conditions

Hi-Desert Water District owns and maintains over 300 miles of water distribution system pipeline that consists primarily of PVC, asbestos cement pipe (ACP), and steel pipe material. In many cases, the steel pipeline infrastructure is over 50 years old and in extremely poor condition. Due to the age of the material, infrastructure failure is causing a high number of leaks and turbid water events that have an adverse effect on the District's customers, operating budget, conservation efforts, and the ability to provide a reliable source of water to meet both normal and peak water demands within those areas. In 2013, the District conducted 685 main repairs, with 56% occurring on steel mains within the Project area (HDWD, 2104a). Similar percentages were observed in 2011 (59%) and 2012 (55%). To put this in perspective, the AWWA Partnership for Safe Water recommends a performance indicator of less than 15 main breaks (or leaks) per 100 miles (AWWA, 2011, pg. 4). The District's rate is 228 leaks per 100 miles for the entire system, or 1600 leaks per 100 miles within the Project area.

Estimates of Without Project Conditions

Without the Project, this high leakage rate from failing water mains would continue to occur. Leakage for the District as a whole is estimated to be 403 afy, and 59% of that total, or 238 afy, is estimated to come from the Project area. The number of leaks experienced by the District within these areas can release high volumes of water that requires the District to purchase and store additional State Water Project (SWP) water. The ability to replenish these supplies is unattainable during drought conditions when SWP water supplies are unavailable.

Without the Project, the steel mains would eventually be replaced under the District's capital improvement plan. The District has recently been replacing between 25,000 and 30,000 LF of the system every year, when budgeted funds are available. However, the District estimates that without the Project, replacement of the steel mains in this Project area would not occur until 2026, when the current 6-year backlog of capital improvements plus other highly rated improvements from the District's master plan will have been completed. Starting in 2026, the District would then replace 25,000 LF per year of steel main for 5 years until all of the 124,515 LF of steel mains in the Project area are replaced.

Descriptions of Methods Used to Estimate Physical Benefits

A water audit was conducted of the HDWD System for 2013 following the AWWA M36 water loss protocol (AWWA, 2009; HDWD, 2014b). The results indicate that real water losses were approximately 13% or 403 afy. Real losses are defined as those losses due to leaks, breaks, or overflows.

The District estimates that 56% of the real water losses occur within the Project boundaries. This was estimated by counting the number breaks by region within the District. Of the total 685 breaks throughout the District's service area in 2013, 384, or 56%, occurred in steel water mains within the Project area (HDWD, 2014a). It is assumed that the number of leaks/breaks correlate with the provided water loss figures.

The District delivers a total of 3,040 afy of water to its customers, and with 13% real loss rate, the real water losses for the full District service area were calculated to be 403 afy. Assuming that 56% of the real losses are occurring within the Project area, the Project is estimated to save 226 afy. Without the Project, water loss in the Project area will continue to increase as the condition of the mains worsens. However, for this analysis, the rate of leakage is conservatively assumed to stay constant into the future. In total, the Project is estimated to save 2,712 af before the steel mains in the Project area would have been replaced without the Project, under the District's capital improvement plan.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

The Project will not require any new policies, actions, or facilities other than those included in the Project. The Project will replace 111,550 LF of eight-inch water main, 3,270 LF of ten-inch water main and 9,695 LF of twelve-inch water main. The Project will also replace 208 fire hydrants and 498 gate valves, consisting of 446 eight-inch, 13 ten-inch, and 39 twelve-inch valves. Over 4,500 service lines, most comprised of ¾" – 1" steel pipe will also be replaced to ensure leakage does not occur along existing service lines.

Description of Any Potential Adverse Physical Effects

No adverse physical effects are anticipated from the Project, other than short-term inconvenience impacts to customers as the mains are replaced.

Project Physical Benefits

Benefit 2: Improved water quality and reduced customer complaints

As is shown in Table 3-5, the Hi-Desert Capital Water Main Replacement Program is estimated to reduce customer complaints by 64 per year, based on tracking of customer complaints by the District.

Table 3-5 – Annual Project Physical Benefits

Project Name: Hi-Desert Capital Water Main Replacement Program

Type of Benefit Claimed: Improved water quality as shown through reduced customer complaints

Units of the Benefit Claimed : Customer complaints

Additional Information About this Benefit:

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014	109	109	0
2015	109	78	31
2016	109	42	67
2017	109	11	98
2018	109	11	98
2019	109	11	98
2020	109	11	98
2021	109	11	98
2022	109	11	98
2023	109	11	98
2024	109	11	98
2025	109	11	98
2026	89	11	78
2027	70	11	59
2028	50	11	39

Table 3-5 – Annual Project Physical Benefits			
Project Name: Hi-Desert Capital Water Main Replacement Program			
Type of Benefit Claimed: Improved water quality as shown through reduced customer complaints			
Units of the Benefit Claimed : Customer complaints			
Additional Information About this Benefit:			
(a)	**(b)**	**(c)**	**(d)**
	Physical Benefits		
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2029	31	11	20
2030	11	11	0
…..	11	11	0
Last Year of Project Life 2066	11	11	0
Comments: The District received 109 customer complaints in 2013 within the Project area. It is assumed that 90% of the customer complaints will be eliminated through replacing aging leaky steel water mains through the Project. Construction of the main replacement Project is assumed to start in March 2015 and be completed in October 2017 (32 months total). Main replacement is assumed to phase-in equally by month during this period. Without the Project, replacement of the steel mains in the Project area is assumed to begin in 2026 and take 5 years to implement.			

Technical Analysis of Physical Benefits Claimed

Benefit 2: Improved water quality and reduced customer complaints

This Project will address water quality in the distribution system, as expressed as a reduction of customer complaints along with a continued annual audit of the District's water loss using the AWWA M-36 method which will be used to exhibit a reduction in real losses as a result of excess leakage.

Technical Basis of the Project

Each complaint from a customer requires a response from the District, with either a follow-up phone call or on-site investigation. Complaints are usually in response to water being dirty or colored.

Actions following the response include having the customer flush their hot water tank or premise plumbing once the District has flushed the watermain via fire hydrants or blow-offs to expel the dirty water. In each case, water is lost due to the flushing. This water loss would be in addition to the real losses associated a leak or break, but was not quantitated in this analysis.

Recent and Historical Conditions

HDWD received 109 water quality complaints from customers in 2013 (HDWD, 2014c). These complaints are associated with customers served within this Project area due to leaking steel water mains, and complaints are often associated with leaks/breaks.

When leaks/ breaks occur, the velocity of the water in the pipes increases which can cause scouring of the pipes. This scouring can break loose particles which are observed by customers as sediment and/ or color in point of use plumbing/fixtures.

The current inadequate spacing of valves and fire hydrants can also lead to additional problems for consumers. For example, inadequate spacing of valves would mean that more customers will be inconvenienced whenever a repair is made to the lines to address a leak or break. Inadequate flow to hydrants or too much spacing between hydrants can greatly hamper the ability to address water quality issues through flushing exercises.

Estimates of Without Project Conditions

Without this Project, water quality and pressure conditions will continue to deteriorate, and the numbers of customer complaints will most likely increase.

Descriptions of Methods Used to Estimate Physical Benefits

Customer complaints to the District totaled 109 in 2013 within the Project area. Complaints are tracked using work orders under the two categories listed below:

- Check Sediment Work Orders – Following a leak, particles from tubercles that form within the steel mains can break loose causing not only turbid water, but also the presence of small particles of rust accumulation. The District received 66 of these complaints following leaks throughout the 2013 calendar year within the Project area. (HDWD, 2014c).
- Check Color Work Orders – Much like the "Check Sediment" work orders, rust within the pipes that is stirred up during the leak can enter into a customer's plumbing causing turbid water complaints. The District received 43 of these complaints during the 2013 calendar year (HDWD, 2014c) within the Project area.

Without the Project, replacement of the steel mains in the Project area is assumed to begin in 2026 and take 5 years to implement.

It is estimated that customer complaints would be reduced by 90% within the Project area by this Project. This is a conservative estimate that assumes that there will still be a low level of complaints, even with new infrastructure.

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

The Project will not require any new policies, actions, or facilities other than those included in the Project. The Project will replace 111,550 LF of eight-inch water main, 3,270 LF of ten-inch water main and 9,695 LF of twelve-inch water main. The Project will also replace 208 fire hydrants and 498 gate valves, consisting of 446 eight-inch, 13 ten-inch, and 39 twelve-inch valves. Over 4,500 service lines, most comprised of ¾" – 1" steel pipe will also be replaced to ensure leakage does not occur along existing service lines.

Description of Any Potential Adverse Physical Effects

No adverse physical effects are anticipated from the Project, other than short-term inconvenience impacts to customers as the mains are replaced.

Non-Quantified Benefits

This Project will allow the District to improve firefighting capability and public safety, as well as improve water quality in its distribution system. Improved capacity to meet fire demands and improved hydrant spacing is expected to greatly aid firefighting efforts and improve public safety. Improved valve and hydrant spacing will allow greater system control for hydrant flushing thereby allowing the utility to minimize flushing volumes and therefore improve water quality in the distribution system. Many of the existing fire hydrants found within the Project area did not meet the approved size and outlet requirement as listed in the California Fire Code.

Cost Effectiveness Analysis

Answers to the questions in the cost effectiveness table are presented in summary form in Table 3-6, with more complete narrative description for each option provided below. No alternatives were developed or formally considered for this Project because addressing the high leakage rate in the District's water mains is the only way to significantly reduce water losses while improving system reliability. Other options, such as water conservation efforts, can reduce demand but cannot reduce water losses on the delivery/supply side.

Table 3-6 – Cost Effectiveness Analysis **Project name:** Hi-Desert Capital Water Main Replacement Program	
Question 1	*Types of benefits provided as shown in Table 5* 1) Reduced water loss to due reduced leaks and main breaks 2) Improved water quality as shown through reduced customer complaints
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? The pipelines are in poor condition and undersized. Other options, such as water conservation efforts, can reduce water losses from the demand side; this Project reduces water from the delivery/supply side. Other alternatives for leakage control that were considered, but deemed infeasible include: 1) increasing the speed and quality of repairs, 2) conduct active leakage control, and 3) reducing pressure. All are not appropriate because of the condition of the pipe.
	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.*

There are other alternatives for reducing leakage on the delivery/supply side, but none of these options were considered feasible. Alternatives for water main replacement were defined by the International Water Association Water Loss Task Force (Fanner et al., 2007, pg. 119). Those alternatives, and the reasons they were not considered feasible are given below:

- Increase the speed and quality of repairs – This alternative would operate under the principle that a higher break/leak rate is acceptable if the utility can react quicker to leaks and make the subsequent repairs. The high leakage on this section of pipes has been making this option not feasible. Also because of operation challenges such as poor valve spacing, responding to leaks quickly is more difficult.

- Conduct active leakage control – This approach utilizes advanced leak detection technologies to monitor the pipelines for leakage. Again, since the pipe is in such poor condition, leaks are readily apparent in the system, and leak detection would not accelerate identification of leaks in this system.
- Reduce pressure – This alternative would be to reduce leakage by reducing pressure. However, low pressure is already a challenge for this portion of the distribution system, and therefore this is not an option. Also this pressure zone is under direct influence of the wells and installing pressure reducing valves is not possible.

Summary of Annual Project Physical Benefits

The physical benefits include reduced water loss to due reduced leaks and main breaks and improved water quality as measured by reduced customer complaints. In addition there are non-quantifiable benefits such as improved reliability of operation, improved fire protection, and improved water quality. No feasible Project alternatives were identified.

References

American Water Works Association (AWWA), 2009. M36 Water Audits and Loss Control Programs, Third Edition. Available online: http://www.awwa.org/store/productdetail.aspx?productid=6725. Accessed June 2014. [This reference is not being provided with documentation backup because it is an actual software program that has to be purchased.]

American Water Works Association (AWWA), 2011. Partnership for Safe Water Distribution Program: Distribution System Optimization Program (Overview). January 2011. Available online: http://www.awwa.org/Portals/0/files/resources/water%20utility%20management/partnership%20safe%20water/files/DistributionProgramOverview.pdf Accessed June 2014.

Fanner, P.V., et al., 2007. Leakage Management Technologies, Water Research Foundation. Available online: http://www.waterrf.org/PublicReportLibrary/91180.pdf Accessed June 2014.

Hi-Desert Water District (HDWD), 2014a. Water Main Break Database, Excel file.

Hi-Desert Water District (HDWD), 2014b. M36 Water Audit Spreadsheet, Excel File.

Hi-Desert Water District (HDWD), 2014c. Utility Service Request Forms, PDF Files.

Reference documentation for the Hi-Desert Capital Water Main Replacement Program is provided in Att3_DG_ProJust_3of4.

Hesperia Reclaimed Water Distribution System

The following (quantifiable) physical benefits are expected from this Project:

1. *1,220.5 afy of reclaimed water use.* This Project will enable Hesperia's customers to use 1,220 afy of reclaimed water in lieu of potable water for irrigation supplies. This will reduce reliance on water imported into the Mojave Region via the State Water Project (SWP).
2. *19,894 pounds per year of avoided fertilizer use.* The nutrients found in the reclaimed water provided by this Project will reduce fertilizer use.

In addition to the physically quantified benefits listed above, this Project will reduce the potential for adverse ecosystem and groundwater quality impacts by helping to maintain groundwater levels during times of drought.

Each benefit is discussed in further detail below.

Project Physical Benefits

Benefit1: 1,221 AFY of reclaimed water use

As is shown in Table 3-7, at full implementation the proposed Project will result in 1,221 afy of reclaimed water use, which will reduce SWP water use and groundwater use within the Mojave Basin. It is expected that the Hesperia Golf Course, Civic Park, and Civic Complex will connect to the new distribution system before the irrigation season in 2017, and the Project will deliver 1,006 af of reclaimed water in that year. By 2018, the remaining Project participants will be online.

Over the assumed 50-year Project life, the Project will result in a total of 61,025 af of reclaimed water use.

Table 3-7 – Annual Project Physical Benefits
Project Name: Hesperia Reclaimed Water Distribution System
Type of Benefit Claimed: Avoided imported water
Units of the Benefit Claimed : Acre-feet (AF)
Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	0	0
2016	0	0	0
2017	0	1,006.1	1006.1
2018	0	1,220.5	1220.5
2019	0	1,220.5	1220.5
. . . .	0	1,220.5	1220.5
2066	0	1,220.5	1220.5
2067: Last Year of Project Life	0	214.4	214.4
Total	**0**	**61,025**	**61,025**

Technical Analysis of Physical Benefits Claimed

Benefit 1: 1,221 AFY of reclaimed water use

This Project will enable Hesperia customers to use reclaimed water in lieu of potable water for irrigation supplies. This will reduce reliance on water imported into the Mojave Region via the SWP, which will increase local water supply reliability. A reduction in Hesperia's demand for imported water will also make more water available for other districts and municipalities in the Region that rely on SWP water.

Technical Basis of the Project

Hesperia has conducted extensive analyses to determine the irrigation needs of the 14 customers that will connect to the reclaimed water distribution system. This analysis is based on the amount of irrigated acreage at each site (including total turf area, athletic fields, area planted in trees, and on-site landscaping), and established irrigation requirements for representative landscapes. Table 3-8 provides a summary of expected water use for each customer, and the expected connection date for each site (HWD, 2014). The customers that will connect to the distribution system are all municipal entities, and have agreed to the general schedule presented in Table 3-8.

Table 3-8 – Summary of reclaimed water customer irrigation needs

Reclaimed Water User	AFY	Expected Connection Date
Hesperia Golf Course	450.0	March 2017
Sultana High School	97.8	December 2017
Lime Street School	42.0	December 2017
Lime Street Park	62.8	December 2017
Mesa Grande Middle School	21.6	December 2017
Hesperia Township	6.8	December 2017
Hesperia Civic Park	33.2	March 2017
Hesperia Civic Complex	27.9	March 2017
Willow Avenue Paseo	11.5	December 2017
Joshua Circle Schools	20.4	December 2017
Hesperia Jr. High School	98.8	December 2017
Hesperia High School	189.4	December 2017
Topaz Elementary School	28.7	December 2017
Datura Park	129.9	December 2017
Total	**1,220.5**	

Recent and Historical Conditions

The City of Hesperia's wastewater is currently treated by the Victor Valley Wastewater Reclamation Authority (VVWRA), which owns and operates a wastewater reclamation plant in the City of Victorville, approximately 15 miles north of the northern City of Hesperia boundary. The City of Hesperia does not readily have access to reclaimed water from this plant due to the far distance. Therefore the City of Hesperia and VVWRA have proposed to build the Hesperia Sub-Regional WRP (Sub-regional WRP) in the City of Hesperia. One effect of using reclaimed water from this WRP will be to reuse wastewater generated in the basin surrounding the City of Hesperia, keeping water in the upper basin to support groundwater levels before it has a chance to go to VVWRA's WRP in Victorville, which is in the lower groundwater basin. Hesperia provides water to its

customers from 18 active groundwater wells within the Mojave River Groundwater Basin (Alto Subbasin) – an adjudicated groundwater basin managed by the MWA.

The Mojave Basin Area Judgment governs the allocation of water within the Mojave Groundwater Basin. The Judgment assigns Base Annual Production (BAP) rights to each producer in the Basin that uses 10 afy or more, based on historical production. Each year, parties to the Judgment (including the City of Hesperia) are assigned a variable Free Production Allowance (FPA) by MWA, which is a percentage of the BAP set for each Subarea. The allocated FPA represents each producer's share of the water supply available for that subarea. This FPA is reduced or "ramped-down" over time until total FPA comes into balance with available supplies.

When Hesperia exceeds its FPA (which it does every year due to the forced ramp-down of FPA), it is required to purchase "Replacement Water" from MWA. MWA is one of the many state contractors who depend on the SWP as a source of supply to re-charge the area's aquifer.

Hesperia has been assigned BAP rights of 13,688 afy and has a projected FPA of 60 percent (8,213 afy) from 2010 to 2035 (Kennedy/Jenks Consultants, 2011, p. 3-8). In 2015, water demands within the Hesperia service area are expected to amount to 17,660 afy (Kennedy/Jenks Consultants, 2011, p. 2-7).

This Project will reduce the amount of replacement water that Hesperia will have to purchase from MWA, which will in turn reduce the amount of that MWA will need to import via the SWP. Within the Mojave Basin Area Adjudication, SWP supplies are used to recharge groundwater basins in areas where groundwater production exceeds the production safe yield of the basin. Any reclaimed water delivered directly offsets groundwater production. The consumptive use portion of groundwater production results in a Replacement Water obligation for groundwater to be recharged with SWP water. According to Exhibit F in the Judgment, 50% of municipal demand and 50% of landscape irrigation demand is consumptively used; therefore half of any reduction in groundwater production from those uses contributes to reduced SWP demand (Kaiser, 1996, p. F-1).

As an important note, MWA's allocation of SWP water is currently at 5% because there are little to no available supplies due to the drought. Thus, Hesperia is not able to purchase its replacement water from MWA. MWA had the foresight to pre-purchase and bank water in the aquifer, so supplies are available for this water year. Should the drought continue into 2015 (and beyond), there is a real possibility Hesperia would have to take drastic measures (such as water rationing) to stay within its FPA. It could also mean a moratorium on new building in the area, which is just now resuming at a slow pace after several years of no growth. In the future, Hesperia's reclaimed water supply will help to offset these impacts.

Estimates of Without Project Conditions

Without the Hesperia Reclaimed Water Distribution System, 1,220 afy of potable water will continue to be used for non-potable purposes (e.g., landscape irrigation). Reliance on imported water to recharge the aquifer will continue, which will decrease water supply reliability within the Mojave Region.

Descriptions of Methods Used to Estimate Physical Benefits

By the end of 2017, the Hesperia Reclaimed Water Distribution System will supply 1,220 afy of reclaimed water, and will continue to do so over the 50-year project life. This will result in an offset of water imported from the SWP via MWA for half of the 1,220 af of reclaimed water used, or 610 af (Kaiser, 1996, p. F-1). Hesperia has conducted extensive analyses to determine the irrigation needs of the 14 customers that will connect to the reclaimed water distribution system (HDWD, 2014).

Identification of All New Facilities, Policies, and Actions Required to Obtain the Physical Benefits

To achieve this benefit, facilities and actions planned under the proposed Hesperia Reclaimed Water Distribution System (as described in this grant application) must be completed. The customers served by the Project will also need to connect to the new distribution system, and the VVWRA Sub-regional WRP will need to be constructed.

Description of Any Potential Adverse Physical Effects

Reduced reliance on imported water is not expected to result in any potential adverse physical effects. However, based on the "Waste Discharge Requirements and Water Recycling Requirements for the City of Hesperia and VVWRA Hesperia Sub-regional Reclamation Plant," issued by the Lahontan Regional Water Quality Control Board (RWQCB, Board Order No. R6V-2013-0005), the application of reclaimed water may result in slight degradation of existing groundwater quality in terms of TDS and nitrate-nitrogen. Per the Board Order, modeling efforts were undertaken to assess the impact of discharging the effluent from the VVWRA Sub-regional WRP to percolation ponds (i.e., assuming no reclaimed water use). Based on the results of this effort, the RWQCB deemed the groundwater degradation resulting from this discharge to be acceptable and justified according to State Water Board Resolution No. 68 – 16 (Lahontan RWQCB, 2013, p.8).[2]

No analysis has been conducted to determine the impacts to groundwater quality if 1,220 afy of the tertiary-treated effluent is used as reclaimed water rather than discharged to the WRP's percolation ponds. However, impacts are expected to be lower with the proposed Project. This is because not as much effluent from the WRP would be discharged to the percolation ponds, and the reclaimed water would be distributed throughout the Project area, resulting in less localized (more disbursed) effects.

Project Physical Benefits

Benefit 2: 19,894 pounds of reduced fertilizer use per year

For the 1,220 af of reclaimed water applied each year in lieu of imported water, reclaimed water customers serviced by the Project will avoid the use of 19,894 pounds of fertilizer per year. As shown in Table 3-9, over the lifetime of the Project, total avoided fertilizer use will amount to 994,700 pounds. Additional benefits would be expected through avoided fertilizer costs because of the increased levels of phosphorus in reclaimed water compared to potable supplies.

Table 3-9 – Annual Project Physical Benefits
Project Name: Hesperia Reclaimed Water Distribution System
Type of Benefit Claimed: Avoided imported water
Units of the Benefit Claimed : Acre-feet (AF)
Additional Information About this Benefit: N/A

(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Change Resulting from Project (b) – (c)
2014			
2015	0	0	0
2016	0	0	0
2017	0	16,399	16,399
2018	0	19,894	19,894
2019	0	19,894	19,894
. . . .	0	19,894	19,894
2066	0	19,894	19,894

[2] The waste discharge requirements contain nitrogen effluent limitations to prevent significant increase in nitrogen concentration in the receiving groundwater. The nitrogen effluent limitations are set in a manner that achieves a long-term average of 6 mg/L.

Table 3-9 – Annual Project Physical Benefits **Project Name:** Hesperia Reclaimed Water Distribution System **Type of Benefit Claimed:** Avoided imported water **Units of the Benefit Claimed :** Acre-feet (AF) **Additional Information About this Benefit:** N/A			
2067: Last Year of Project Life	0	3,495.4	3,495
Total	0	**994,700**	

Technical Analysis of Physical Benefits Claimed

Benefit 2: 19,894 pounds of reduced fertilizer use per year

The use of 1,220.5 afy of reclaimed water for landscape irrigation will reduce fertilizer use by 19,894 pounds per year. Reclaimed water customers are already in the process of being educated about reclaimed water use, including the nutrient value, and thus are expected to adjust their fertilizer use accordingly.

Technical Basis of the Project

Fertilizing compounds commonly present in reclaimed water are typically not found in potable water (e.g., nitrogen, phosphorus, potassium). Thus the use of reclaimed water for landscape irrigation will reduce fertilizer use for properties that will be serviced by the Project. The expected level of Total Nitrogen for the reclaimed water produced at the VVWRA Sub-regional WRP is 6.0 mg/L (Lahontan RWQCB, 2013, p. 12).

Recent and Historical Conditions

The exact offset of fertilizer use from using reclaimed water is difficult to predict due to daily and seasonal nutrient variations in the reclaimed water. In addition, avoided fertilizer use also depends on the knowledge and behavior of the landscape manager at each site. However, pursuant to the Lahontan RWQCB requirements for waste discharge and water recycling at the VVWRA Sub-regional WRP (Board Order No. R6V-2013-0005), Hesperia must educate reclaimed water users on how to appropriately manage fertilizer application. To meet this requirement, Hesperia will provide a "user manual", developed by VVWRA, to each reclaimed water customer. In addition, Hesperia will conduct one-on-one training sessions with the reclaimed water users, providing further information on appropriate fertilizer use.

Estimates of Without Project Conditions

The reclaimed water provided by the Project will be used by parks, schools, a large golf course, and other municipal properties, for irrigation purposes. Without the Hesperia Reclaimed Water Distribution System, these customers will continue to use 1,220.5 afy of potable water for this purpose, which will not provide fertilizer benefits. Customers will therefore continue to apply more fertilizer than if the Project is implemented.

Descriptions of Methods Used to Estimate Physical Benefits

The amount of nutrients (i.e., pounds of fertilizer) per acre-foot of reclaimed water can be calculated from average (tertiary-treated) effluent values for the VVWRA Sub-regional WRP. The reclaimed water from the WRP is expected to contain 16.3 pounds of nitrogen per acre-foot (average of 6.0 mg/L per Lahontan RWQCB, 2013, p. 12). Thus for every acre-foot of reclaimed water used in lieu of potable water, the reclaimed water customers will avoid the use of a total of 16.3 pounds of fertilizer. To calculate total fertilizer savings associated with nitrogen, the 1,220.5 afy of reclaimed water provided by the Project in each year of the Project life is multiplied by 16.3 pounds to get 19,894 pounds per year total. This amounts to 994,700 pounds of fertilizer over the assumed

50-year life of the Project, or 451 metric tons. This represents a lower bound estimate, as the likely presence of potassium and phosphorous in the reclaimed water will also provide some benefit.

Identification of all new facilities, policies, and actions required to obtain the physical benefits

To achieve this benefit, facilities planned under the Hesperia Reclaimed Water Distribution System must be completed. The customers served by the Project will also need to connect to the new distribution system. These customers will need to use less fertilizer to take advantage of the nutrients in the reclaimed water delivered to them. VVWRA has been conducting a comprehensive public outreach and education campaign to provide information on the WRP since 2009. This has included meeting with residents near the Project locations, conducting focus groups and open house events, and publishing newspaper articles and newsletters (VVWRA, 2014). Building on this framework, Hesperia and VVWRA will extend the education campaign to reclaimed water users. Specifically, the agencies will provide a "user manual" to each reclaimed water customer and will conduct one-on-one training sessions with those customers. These efforts will help to ensure that the benefits of reduced fertilizer use are realized.

Description of Any Potential Adverse Physical Effects

Reduced fertilizer use is not expected to result in any potential adverse physical effects.

Non-Quantified Benefits

As described above, MWA's allocation of SWP water is currently at 5% because there are limited to no available supplies due to the drought. Thus, MWA will not be able to replace the water that is pumped from the aquifer this year with SWP. MWA had the foresight to pre-purchase and "bank" SWP water in the aquifer, so supplies are available for this water year. In future drought years, the reclaimed water made available by this Project will help to reduce these impacts by maintaining groundwater levels at more sustainable levels.

Environmental impacts to the Upper Mojave River Narrows Ecosystem

The Victorville to Silver Lakes Riparian Corridor of the Mojave River was legally defined and established in the 1996 Mojave River Watershed Adjudication. The delineation of this sensitive environment is based on the geographic extent of healthy riparian vegetation in 1986. This stretch of the River consists of just over 5,000 acres of mostly mature cottonwood forest riparian habitat. The southern limit of this riparian area extended approximately 3.2 miles upstream of the Mojave River Upper Narrows. However, it has since declined to approximately 2 miles (CDFG, 2004).

Geologically the Riparian Area south (upstream) of the Upper Narrows consists of a system of vertically stacked aquifer systems separated from one another by partially to nearly completely impermeable clay layers. This stacked groundwater system creates an environment for groundwater to be under pressure in deeper layers and cause artesian flow in wells. Artesian flow in wells in this area has largely ceased due to depletion of groundwater. In addition, declines in groundwater levels have reduced riverbank flow from the surrounding aquifer into the River (CDFG, 2004, p.7).

Annual base flow out of the Narrows has declined from an average of about 20,000-25,000 af to only about 5,000-10,000 af in recent years (see Figure 3-1). The Narrows is one of the few remaining perennial-flow stretches of the Mojave River. Several sites along the River that historically experienced perennial have dried up (Lines, 1996, p. 2). The decline of the riparian area south of the Narrows is of critical concern because of species such as the Least Bell's Vireo and the Southwest Willow Flycatcher (CDFG, 2004, pg. 10), which are listed as endangered species.

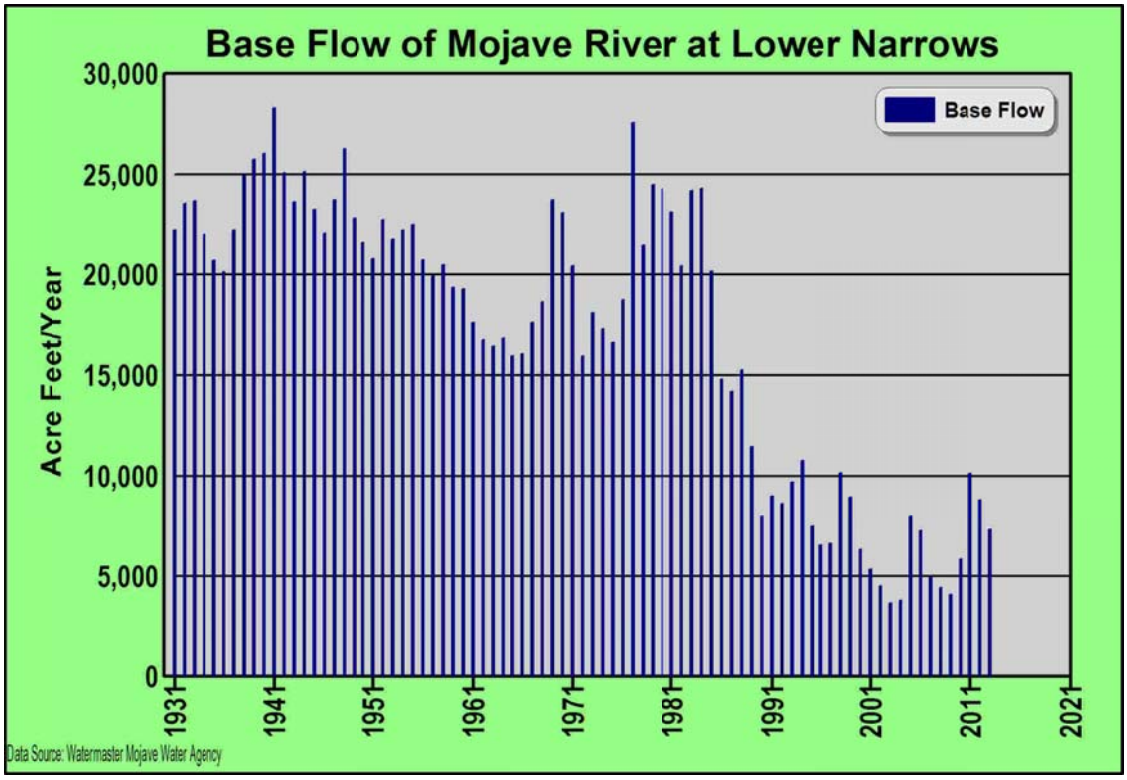


Figure 3-1. Baseflow of Mojave River at Lower Narrows

Storm flow and imported SWP water in the River rapidly boost groundwater levels in the River but, "To be of value to the habitat corridor, water must be constantly available – not just available on an interruptible basis. Imported water is most beneficial therefore, if it is placed where it will recharge aquifers…[and] increase the hydrostatic head rather than flowing on the surface on an intermittent deliver schedule" (CDFG, 2004, p. 8). Erratic flows supported by stormwater and SWP imports do not maintain riparian habitat, higher groundwater levels do (CDFG, 2004, p. 11).

Water quality impacts associated with arsenic located in the lower aquifer

Naturally occurring arsenic in groundwater is common in Victor Valley Area Groundwater. Arsenic is regularly observed in the MWA Groundwater Quality Monitoring Program. This arsenic comes from chemical weathering of igneous and metamorphic rock formations such as those found in the San Gabriel Mountains (Garcia, 2008, pg. 12). Generally, natural arsenic is found in deeper less-productive aquifer zones.

Most production wells in the Victor Valley Area (which includes the cities of Adelanto, Apple Valley, Hesperia, Victorville and surrounding communities and overlies the Mojave Groundwater Basin) draw water from the aquifer above the zones of high arsenic concentration. This contributes to a groundwater gradient in the aquifer system from deep aquifer zones upward toward the production zone. As groundwater levels decline to historically low levels under severe drought conditions, the potential for arsenic mobilization from deep un-produced aquifer zones upward into developed-aquifer production zones increases.

Severe drought conditions, such as those experienced in 2014, lead to lower groundwater levels in the Region's aquifers as there is little to no natural recharge occurring. In addition, the low SWP allocations in such years exacerbate the situation as very little artificial recharge supply is available to boost groundwater levels. Under these circumstances the groundwater gradient from the deep arsenic-containing zones toward shallower production zones grows and increases the potential for migration of arsenic water into these zones.

If current drought-related groundwater declines continue arsenic mobilization will occur and treatment for arsenic of a previously potable water supply will become necessary.

Cost Effectiveness Analysis

Answers to the questions in the cost effectiveness table are presented in summary form in Table 3-10, with more complete narrative description for each option provided below. Hesperia has concluded that there are no viable alternatives to the proposed Project. Given that the VVWRA Sub-regional WRP will be constructed, providing reclaimed water from this new plant is the only option for offsetting imported water use and/or further drawdown of the local aquifer. Using reclaimed water produced at the Sub-regional WRP is the only option that keeps water in this upper basin rather than letting it flow to the VVWRP in Victorville, which is located in the lower basin. Also, this is the only option that replaces potable water used for non-potable purposes with non-potable supplies, thus matching water quality to type of use. These are reasons why no other Project can achieve the benefits this one can and therefore no other Project alternatives are comparable.

Table 3-10 – Cost Effectiveness Analysis **Project name: Hesperia Reclaimed Water Distribution System**	
Question 1	*Types of benefits provided as shown in Table 5:* 1,200 afy of reclaimed water supply 19,894 pounds of fertilizer use avoided per year
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? Hesperia has concluded that there are no viable alternatives to the proposed Project. Given that the VVWRA Sub-regional WRP will be constructed, providing reclaimed water from this new plant is the only option for offsetting imported water use and/or further drawdown of the local aquifer.
	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.* Not applicable.

When evaluating the feasibility of the new Sub-regional WRP, VVWRA compared the costs of the new facility to an alternative regional system that included expanding the existing regional WRP and installing outfall pipes to deliver reclaimed water to Hesperia. VVWRA found that the Sub-regional WRP system would cost 20% less than the Regional WRP system. Both capital costs and operation/maintenance costs were included in the cost comparison (Lahontan RWQCB, 2013, p. 9).

To calculate the total present value costs, the following assumptions were made to simplify calculations (please note the activity dates below do not exactly match the schedule provided in Attachment 6 with some activities completed already and some not starting for another month, but in general the simplification below is reasonable):

1. The land acquisition, design, permitting, and environmental documentation aspects of the Project will begin in July 2014 and will be completed by the end of December 2014.
2. Construction of the Project is expected to start in March of 2015, and will be completed by the end of February in 2017.

3. Operations, maintenance, and replacement costs of the Project are expected to amount to $700,000 per year.

Based on the above assumptions, Table 3-11 presents the present value costs of the Project over its expected 50-year Project life. As shown, total present value costs amount to $21.79 million.

Table 3-11 – Annual Costs of Project (All costs shown in 2014 Dollars) **Project:** Hesperia Reclaimed Water Distribution System										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs (1)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2014	$667,354.75								1.000	
2015	$5,868,149.50							$5,868,150	0.943	**$5,533,665**
2016	$6,784,837.50							$6,784,838	0.890	**$6,038,505**
2017	$1,130,806.25							$1,130,806	0.840	**$949,877**
2018				$350,000	$350,000			$700,000	0.792	**$554,400**
2019				$350,000	$350,000			$700,000	0.747	**$522,900**
2020				$350,000	$350,000			$700,000	0.705	**$493,500**
2021				$350,000	$350,000			$700,000	0.665	**$465,500**
2022				$350,000	$350,000			$700,000	0.627	**$438,900**
2023				$350,000	$350,000			$700,000	0.592	**$414,400**
2024				$350,000	$350,000			$700,000	0.558	**$390,600**
2025				$350,000	$350,000			$700,000	0.527	**$368,900**
2026				$350,000	$350,000			$700,000	0.497	**$347,900**
2027				$350,000	$350,000			$700,000	0.469	**$328,300**
2028				$350,000	$350,000			$700,000	0.442	**$309,400**
2029				$350,000	$350,000			$700,000	0.417	**$291,900**
2030				$350,000	$350,000			$700,000	0.394	**$275,800**
2031				$350,000	$350,000			$700,000	0.371	**$259,700**
2032				$350,000	$350,000			$700,000	0.350	**$245,000**
2033				$350,000	$350,000			$700,000	0.331	**$231,700**
2034				$350,000	$350,000			$700,000	0.312	**$218,400**
2035				$350,000	$350,000			$700,000	0.294	**$205,800**

Table 3-11 – Annual Costs of Project (All costs shown in 2014 Dollars) **Project:** Hesperia Reclaimed Water Distribution System										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs (1)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2036				$350,000	$350,000			$700,000	0.278	**$194,600**
2037				$350,000	$350,000			$700,000	0.262	**$183,400**
2038				$350,000	$350,000			$700,000	0.247	**$172,900**
2039				$350,000	$350,000			$700,000	0.233	**$163,100**
2040				$350,000	$350,000			$700,000	0.220	**$154,000**
2041				$350,000	$350,000			$700,000	0.207	**$144,900**
2042				$350,000	$350,000			$700,000	0.196	**$137,200**
2043				$350,000	$350,000			$700,000	0.185	**$129,500**
2044				$350,000	$350,000			$700,000	0.174	**$121,800**
2045				$350,000	$350,000			$700,000	0.164	**$114,800**
2046				$350,000	$350,000			$700,000	0.155	**$108,500**
2047				$350,000	$350,000			$700,000	0.146	**$102,200**
2048				$350,000	$350,000			$700,000	0.138	**$96,600**
2049				$350,000	$350,000			$700,000	0.130	**$91,000**
2050				$350,000	$350,000			$700,000	0.123	**$86,100**
2051				$350,000	$350,000			$700,000	0.116	**$81,200**
2052				$350,000	$350,000			$700,000	0.109	**$76,300**
2053				$350,000	$350,000			$700,000	0.103	**$72,100**
2054				$350,000	$350,000			$700,000	0.097	**$67,900**
2055				$350,000	$350,000			$700,000	0.092	**$64,400**
2056				$350,000	$350,000			$700,000	0.087	**$60,900**
2057				$350,000	$350,000			$700,000	0.082	**$57,400**

Table 3-11 – Annual Costs of Project (All costs shown in 2014 Dollars) **Project: Hesperia Reclaimed Water Distribution System**										
	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost	Annual Costs (1)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**
2058				$350,000	$350,000			$700,000	0.077	**$53,900**
2059				$350,000	$350,000			$700,000	0.073	**$51,100**
2060				$350,000	$350,000			$700,000	0.069	**$48,300**
2061				$350,000	$350,000			$700,000	0.065	**$45,500**
2062				$350,000	$350,000			$700,000	0.061	**$42,700**
2063				$350,000	$350,000			$700,000	0.058	**$40,600**
2064				$350,000	$350,000			$700,000	0.054	**$38,002**
2065				$350,000	$350,000			$700,000	0.051	**$35,851**
2066				$350,000	$350,000			$700,000	0.048	**$33,822**
2067: Last Year of Project Life				$350,000	$350,000			$700,000	0.046	**$31,907**
Total Present Value of Discounted Costs (Sum of column (j))										**$21,787,529**
(1) The incremental change in O&M costs attributable to the Project.										

Summary of Annual Project Physical Benefits

The physical benefits claimed for this Project include distribution of reclaimed water, which avoids imported water and groundwater use, and reduced fertilizer use. The Project proponents have concluded that the production of reclaimed water (through the construction of Sub-regional WRPs) is the only viable option for reducing reliance on imported water within the Mojave Groundwater Basin.

References

California Department of Fish and Game (CDFG). 2004. Habitat Water Supply Management Plan for the Adjudicated Area of the Mojave River Basin San Bernardino County, California, Prepared by the California Department of Fish and Game, July 2004.

Garcia, Anna L., 2008, White Paper – Oro Grande Wash, To: Lance Eckhart, Principal Hydrogeologist, Water Resources Department Manager, From: Anna L. Garcia, Senior Hydrogeologist Mojave Water Agency, June 19, 2008.

Hesperia Water District (HWD). 2014. Recycled Water User Program – Phase I. Spreadsheet – Phase I User List tab. City of Hesperia/ Hesperia Water District (HWD).

Kaiser, M., Judge. 1996. Judgment After Trial, Mojave Basin Area Adjudication, City of Barstow, et al v. City of Adelanto, et al, Riverside County Superior Court Case No. 208568.

Kennedy/Jenks Consultants. 2011. 2010 Urban Water Management Plan. Prepared for Hesperia Water District/ City of Hesperia. August.

Lahontan Regional Water Quality Control Board (RWQCB), 2013. Waste Discharge Requirements and Water Recycling Requirements for the City of Hesperia and Victor Valley Wastewater Reclamation Authority Hesperia Sub-Regional Reclamation Plant. Board Order No. R6V-2013-0005, WDID 6B360907005.

Lines, Gregory C. 1996. Ground-Water and Surface-Water Relations along the Mojave River, Southern California, U.S. Geological Survey, Water-Resources Investigations Report 95-4189, Prepared in cooperation with the Mojave Water Agency, Sacramento, California 1996.

Victor Valley Wastewater Reclamation Authority (VVWRA), 2014. Subregional Outreach Synopsis for the Hesperia Subregional Water Recycling Facility. Victor Valley Wastewater Reclamation Authority.

Reference documentation for the Hesperia Reclaimed Water Distribution System is provided in Att3_DG_ProJust_4of4.