Lake Wildwood Water Treatment Plant Capacity Study and Options Analysis Report Final

Nevada Irrigation District

Grass Valley, CA

Lake Wildwood WTP Options Analysis and Master Plan Project

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Table of Contents

List of Tables

List of Figures

ES-1 Executive Summary

The Nevada Irrigation District (NID) has retained HDR to complete a study of the drinking water supply system for the Lake Wildwood (LWW) water system and meet expected future demands for water. Lake Wildwood is currently served by an existing water treatment plant (WTP) that is the sole supply of drinking water to the community. The WTP while close to 40 years old, has historically met the water demands in the system; however, during peak demand periods the plant has been required to operate close to the maximum capacity, leaving little spare capacity for any future system growth or operational redundancy.

This analysis examines the potential future water needs in the Lake Wildwood system and alternatives to increase the water supply capacity, reliability; and create redundancy. Alternatives to upgrade the WTP were analyzed and compared with alternatives to extend a pipeline from the existing E. George WTP to provide a second source of treated water supply to LWW. This would increase supply because the limited raw water storage in LWW is not capable of supplying the WTP for a considerable length of time. In comparison, the Elizabeth George Water Treatment Plant (E. George WTP) source has raw water system redundancy as the raw water supply can be routed through one or two separate canals with some raw water storage available.

ES-1.1 Demand Analysis

In October 2016 HDR performed a capacity study for the Lake Wildwood Water Treatment Plant (Appendix A). From 2006 to 2014 the historic average day demand (ADD) and maximum day demand (MDD) were 1.19 and 2.97 MGD respectively. Four scenarios of future demand were analyzed; however, it should be noted that due to recent drought conditions, the demand since 2004 has not increased (0% growth). Therefore, projecting historic growth into the future results in no increase in demand. Descriptions of these scenarios and the future ADD and MDD associated with each are shown in Table ES-1.

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Table ES-1: Summary of Future Demands

Description		2017	2027	2037
Scenario 1: Historic Population will continue to grow at the same rate as observed between 2006 and 2014, 0%.	ADD (MGD) MDD (MGD)	1.19 2.97	1.19 2.97	1.19 2.97
Scenario 2: Low Demand Population will grow at the estimated low average annual rate.1.	ADD (MGD) MDD (MGD)	1.20 3.00	1.37 3.42	1.56 3.89
Scenario 3: High Demand Population will grow at the estimated high average annual rate.1	ADD (MGD) MDD (MGD)	1.21 3.04	1.54 3.85	1.95 4.88
Scenario 4: Full Build-out Implementation of all proposed developments in the LWW service area within the next 20 years.	ADD (MGD) MDD (MGD)	1.21 3.02	1.44 3.59	1.66 4.16

[1]Low and high estimated annual growth rates based on the 2015 NID Urban Water Management Plan (2016)

Assuming a net capacity of the existing LWW WTP of 3.6 MGD (4.0 MGD total capacity), Table ES-2 summarizes the year that the MDD for each scenario would exceed the current capacity.

Table ES-2: Future Demand Timeframe to Exceed LWW WTP Capacity

Scenario	Year MDD Exceeds LWW WTP Capacity
Scenario 1: Historic	Not Exceeded by 2037
Scenario 2: Low	2031
Scenario 3: High	2024
Scenario 4: Build-Out	2027

ES-1.2 Project Need and Key Criteria

As determined from the demand analysis, the existing LWW WTP is expected to reach the maximum capacity within the next 10 years. Typically supply facilities are operated with some spare capacity to account for maintenance and equipment failure, so the realistic timeframe for an increase in water supply is likely less than 10 years. A planning level decision to select the best alternative is needed now to provide sufficient time to fund, plan, design, and construct the improvements, which takes years to complete.

Water supply reliability is a key concern of the District and efforts have been made throughout NID's water system to intertie supply facilities, which greatly increases supply reliability and operational flexibility. These both provide a higher level of service to the District's customers.

This is one of the main considerations for including E. George WTP intertie pipeline alternatives in the study. The pipeline would provide a second source of supply which could be used to provide drinking water and fire supply in the event of a WTP failure or raw water source interruption. Likewise, the WTP would continue to provide a supply to customers in the existing LWW development in the event the pipeline is taken out of service. However, customers along the new pipeline alignment outside the LWW development would be dependent on the pipeline only for supply because the WTP cannot supply the higher elevations along the pipeline alignment.

A new pipeline would also provide another benefit, connection of customers to the public water system who are not currently connected. Because the pipeline would be routed through the District's existing service area, properties along the alignment could be connected to the water system, increasing water supply reliability (and potentially quality) to those new customers.

ES-1.3 Elizabeth George Intertie Pipeline

Four preliminary alignment alternatives were presented to HDR by NID in the initial stages of the project. These alignments run from the corner of Rough and Ready Highway and Bitney Springs Road to connect to LWW at various locations within the system. HDR has refined these alignments through looking closely at parcel maps, property lines, existing road routes, and site visits, so that the alignments described below represent four optimal options to join LWW to the E. Elizabeth George WTP. All four alignments are shown in Figure ES-1.

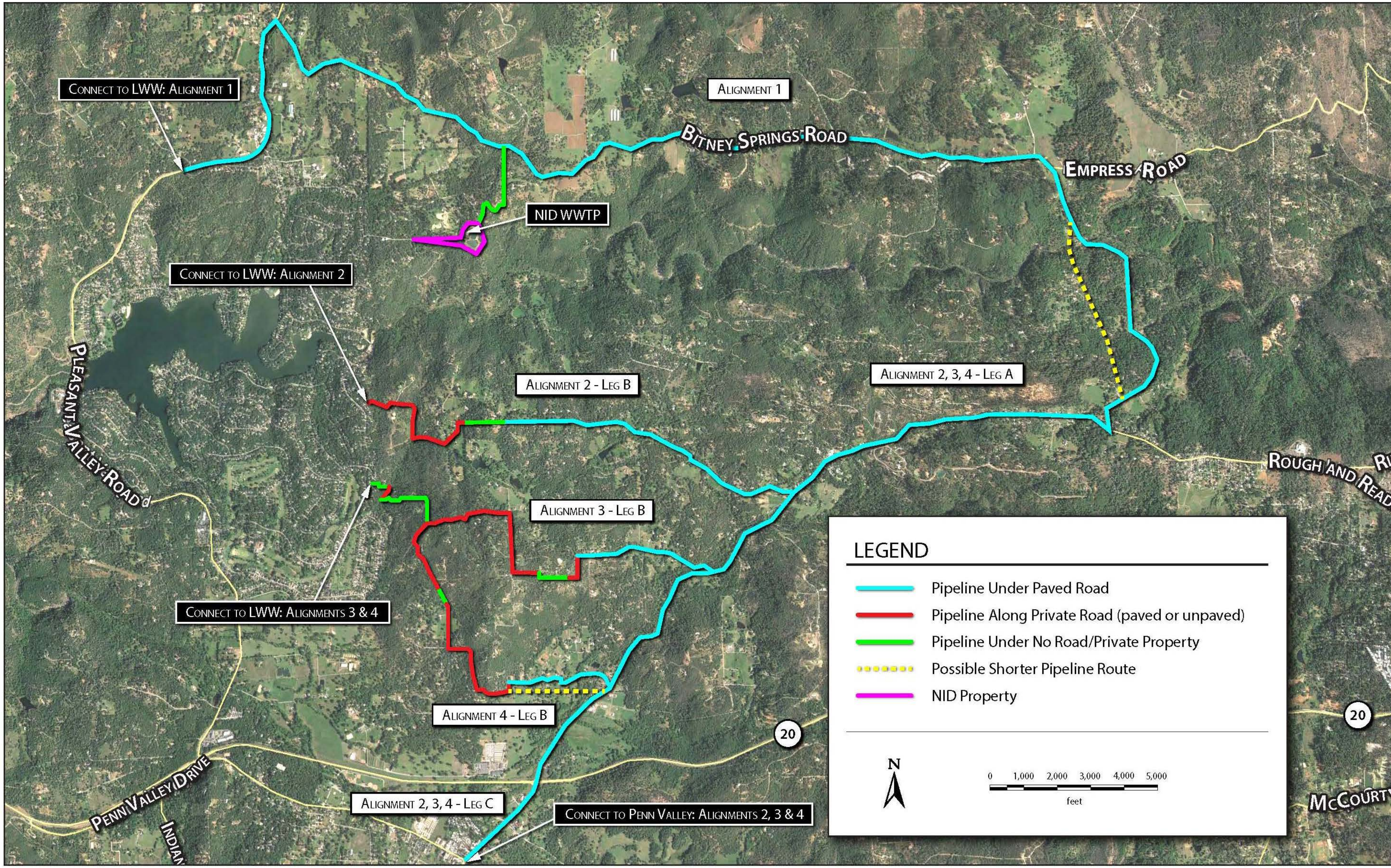

Figure ES-1: Proposed Alignment Alternative Routes

ES-1.3.1 In-Conduit Hydroelectric

HDR performed a reconnaissance level investigation of the hydropower potential of the various pipeline alternatives being evaluated. It is assumed that any new hydropower generation would be located at the same location and in parallel with any required pressure reducing valves (PRV).

A cost analysis was completed for a 20+ year life cycle. Each pipeline alignment was analyzed for energy production based on the available pressure head. While the alignments varied somewhat, in general approximately one-half to two-thirds of the cost for hydropower facilities can be recovered in 20 years.

ES-1.3.2 Service Connections

Along each alignment alternative there are opportunities for new services at parcels which are currently classified as construction conveyances, and other developed or undeveloped parcels. Construction conveyances are possible service connections to existing in home raw water users that have an alternative approved potable water source such as bottled water. These users could benefit from connection to the public water system by improving health and safety.

The total number of service connections along the pipeline route is estimated to range from 108-162. This estimate includes parcels that have frontage along the pipeline. No variance parcels were analyzed as part of this report. There are also 41-50 estimated possible future service connections based upon frontage along the pipeline routes that is yet to be developed. The total number of construction conveyances and service connections are reflected in Table ES-3.

Table ES-3: Number of Construction Conveyances for Each Alignment

Alignment	# Constructed Conveyances	Total # Service Connections	
		Developed	Undeveloped
1	3	108	41
2	19	162	50
3	5	150	49
4	5	150	46

ES-1.3.3 System Modeling

Models of the LWW and E. George systems were provided by NID for this analysis. The updated LWW model and E. George model were combined with the new pipeline alignments for the purpose of determining impacts resulting from supplying LWW through the pipeline, and determining improvements needed to mitigate the impacts.

The pressures in each zone were maintained at the current level, and the new pipeline supply pressure was reduced to match those currently observed in each zone where the connection is located. Therefore, no significant differences in system pressure or operation were required to provide supply via the new pipeline.

Water age was also considered for each alignment to determine if a significant difference in age exists between alignments. Overall, the difference in the connection locations to the LWW system has minimal impact when comparing water age for each alignment alternative.

The water age in the existing system was modeled, along with water age for the system including supply from the E. George pipeline. The water age between the two supply scenarios does not vary significantly and there is actually some reduction in age with the pipeline due to the more central supply point in the distribution system.

ES-1.4 Alignment Evaluation Criteria

The analysis criteria below were selected and given percentages based on level of importance by NID staff. These criteria are shown in Table ES-4.

Table ES-4: Alignment Analysis Criteria Weighting

Criteria	Weight
Construction Cost	20%
Design Impacts/Considerations	15%
Operations & Maintenance	10%
Customer Availability	30%
Water Quality	25%

For each criterion, there were sub-criteria that were used for the final analysis. The ranking system used scores from 1 to 4 with 1 being the most favorable and 4 the least favorable. The other two scores were interpolated between 1 and 4 based upon comparison to the alignments that received the 1 or 4.

ES-1.5 Evaluation Results

The results of the alignment analysis can be seen in Table ES-5. Alignment 2 received the lowest ranking total, making it the most favorable alternative, with Alignment 1 receiving the second best ranking total.

Table ES-5: Alignment Analysis Results

	Weight (%)	Alignment 1		Alignment 2		Alignment 3		Alignment 4	
		Rank2	Weighted	Rank2	Weighted	Rank2	Weighted	Rank2	Weighted
Construction Cost[1]	**20%**	4.0	0.8	1.0	0.2	1.9	0.4	1.8	0.4
		46,530 ft. total length, large bridge crossing		40,690 ft. total length, 1 bridge crossings		39,680 ft. total length, 2 bridge crossings		39,420 ft. total length, 1 bridge crossing	
Design Impacts/ Considerations	**15%**	1.9	0.3	1.0	0.2	4.0	0.6	3.8	0.6
		Largest length of construction with lowest CF[3], small easement purchase, and the lowest B/C ratio for a hydro facility.		Second largest length of pipe, second smallest easement purchase, highest B/C[3] ratio for a hydro facility.		Second shortest pipe length, second largest easement purchase, and highest B/C ratio for a hydro facility.		Shortest pipe length, largest easement purchase, highest B/C ratio for a hydro facility.	
Operations & Maintenance	**10%**	1.0	0.1	2.3	0.2	3.4	0.3	4.0	0.4
		Lowest number of required ARVs/BOs[3] and easiest access to pipeline route		Second smallest number of ARVs/BOs[3] and some easements making access somewhat difficult.		Largest number of ARVs/BOs[3] and largest easement purchase making access difficult.		Largest number of ARVs/BOs[3] and some easements making access somewhat difficult.	
Customer Availability	**30%**	4.0	1.2	1.0	0.3	2.6	0.8	2.7	0.8
		Lowest constructed conveyances, no Penn Valley connection, possible other extensions.		Large number of constructive conveyances, highest density population.		Small number of constructive conveyances and lower density population.		Small number of constructive conveyances and least dense population.	
Water Quality	**25%**	4.0	0.5	1.0	0.3	3.5	0.9	3.0	1.0
		Longest pipe length = maximum water age, Poor water quality to Penn Valley		Shortest pipe length = minimum water age, connects to the middle of the system		Longer pipe length with more improvements needed to connect to system		Second longest pipe length, most improvement needed to connect to the system	
Total	**100%**		**3.4**		**1.1**		**3.0**		**2.9**

Notes:
1. Length will be the primary driver of construction cost, and bridge crossings. Cost at $15/in-dia/ft.;
2. Relative ranking of alternatives will assign a 1 for the best alternative, and 4 for the worst alternative. Quantifiable rankings are interpolated between best score (1) and worst score (4).
3. CF = constructability factor; B/C = benefit/cost (20 year net present value); ARV = air release valve; BO = Blowoff valve.

ES-1.6 Water Treatment Plant Upgrades

ES-1.6.1 Background

The Lake Wildwood WTP has a permitted treatment capacity of 4 mgd. The Lake Wildwood WTP was built in stages. The first stage was completed in 1972 and a second stage was completed in in 1986. The existing plant includes the following components:

- NID canal turnout and raw water pipeline to plant site
- Raw water reservoirs
- Upflow sludge blanket steel clarifiers
- Dual media circular steel filters
- Washwater ponds
- Clearwell
- Filter backwash pumps and air scour blower
- Chemical storage and feed facilities for: alum, polymer, lime, and sodium hypochlorite
- Control Building

The existing plant has generally operated well, however repairs and upgrades will be needed for continued successful operation into future years.

ES-1.7 Source Water Quality

The source water used by Lake Wildwood WTP originates in Deer Creek and flows through the Scott's Flat and Lower Scott's Flat Reservoirs, then through the Newtown Canal to the Lake Wildwood Water Treatment Plant (WTP). Raw water diverted from the Newtown canal is conveyed through a pipeline to the raw water ponds at the WTP site, located one half mile west of Lake Wildwood. The raw water is generally of good quality with turbidity that varies from 2 to 15 NTU with occasional turbidity spikes of 30 to 50 NTU that last for 3 or 4 days during the rainy season. The Ph of the water ranges from 7.1 to 8.1 with average of about 7.6. Total organic carbon (TOC) is typically less than 2 mg/L with disinfection byproduct formation potential that meets state and EPA requirements. Because Cryptosporidium has been detected in the raw water supply, the plant has been classified as Bin 2 under the LT2ESWTR.

ES-1.8 WTP Preliminary Capacity Analysis

A maximum day plant capacity of 3.9-4.9 mgd is expected by the end of the 20-year planning period. The existing WTP has a permitted treatment capacity of 4.0 mgd with net capacity of 3.6 mgd after allowing for up to 10 percent for recycle streams.

Based on the capacity and the projected increase in demands, the existing WTP can meet system demands until approximately 2027 provided the following interim improvements are made:

- Improvements to the canal turnout screen
- Addition of new drying beds to relieve the overloaded wash water ponds
- Potentially replacement of backwash pumps and blower that may fail prior to 2027

ES-1.9 WTP Alternatives

Providing a reliable water supply for the Lake Wildwood service area can be accomplished by several different approaches that either retain the existing treatment plant or involve construction of new treatment units. The water supply to the Lake Wildwood service area could be entirely from the Newtown canal or a portion of the supply could be provided as treated water by a new pipeline from the E. George WTP.

For the treatment plant only scenario, the capacity of each alternative is up to 5.0 mgd net capacity to meet the high range of projected future demand. For the options that include water supply from a new pipeline from the E. George WTP, the treatment plant upgrades could be sized for 2.0-2.5 mgd and provide redundancy.

An alternatives evaluation was conducted for each alternative including advantages and disadvantages. A summary of the alternatives is presented in Table ES-6.

Table ES-6: WTP Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages
1. Future Water Supply from LWW WTP only (5.5 MGD)		
A. Upgrade and Expand Existing Treatment System	• Minimize disruption to the plant site. • Flocculation and plate settlers provide better performance than existing clarifiers. • UV disinfection will provide greater flexibility in filter operation and reduce the required chlorine dose and DBP formation	• Depth of the filters and media not ideal requiring a lower design filtration rate. Two new filters are required to increase the plant capacity to 5.5 MGD. • Risk that refurbishing of old equipment may be more costly than currently estimated.
B. Construct New Modular Treatment Plant	• Small foot print • Treatment equipment would be covered by canopy • Proven process performance • See UV comment above.	• Operators will need to be trained for operating a new system.
2. Water supply from combination of LWW WTP (4.0 MGD total) and new pipeline (2.0-2.5 MGD)		
A. Upgrade Existing Treatment System	• Having pipeline allows for the plant to shut down during the winter and run at lower capacity during the summer. • Having pipeline greatly reduces operation of the plant resulting in much lower annual sludge quantity. • Refurbishing the existing Plant 2 clarifier and all the filters reduces impacts and the need for re-training. • See UV comment above	• Depth of the filters not ideal reducing available head for operation. • Risk that refurbishing of old equipment may be more costly than currently estimated. • Additional treatment for TOC removal at the E. George WTP may be required to meet DBP limits.

Alternative	Advantages	Disadvantages
B. Construct New Modular Treatment Plant - With Design Capacity of 4.0 mgd	• The modular design and small footprint simplifies construction. Project could be built in 2 phases as demand increases. • Proven process performance of modular systems. • Having pipeline greatly reduces operation of the plant resulting in much lower annual sludge quantity. • See UV comment above	• Operators will need to be trained for operating a new system. • Additional treatment for TOC removal at the E. George WTP may be required to meet DBP limits.

ES-1.10 Evaluation Results

A new coanda screen is recommended at the canal turnout to reduce maintenance and prevent possible overtopping of the canal.

For the WTP supply only options, Alternative 1-A, Upgrade and Expand Existing Treatment System has the lowest initial cost, but relies on continued use of the existing filters that would be refurbished plus two new similar filters. Alternative 1-B is 11 percent higher in cost, but includes all new modular treatment units including deeper bed filters. Given the advantages of new treatment equipment, Alternative 1-B is recommended for the treatment plant only scenario.

For the WTP and Pipeline Supply options, Alternative 2-A, Upgrade Existing Treatment System with New Pipeline has the lowest estimated construction cost for the WTP options, but relies on continued use of the existing filters that would be refurbished. Alternative 2-B is 15 percent higher in cost, but includes all new modular treatment units including deeper bed filters. Given the advantages of new treatment equipment, Alternative 2-B is recommended for the combined smaller treatment plant and pipeline scenario.

Using O&M costs from 2015 provided by NID, the cost of treated water was determined for the E. George WTP to be $0.70 per 1,000 gallons and $0.94 per 1,000 gallons treated at LWW. It is not anticipated that upgrades to the LWW WTP will significantly affect this unit cost.

The difference in treated water costs results in a reduction in O&M when LWW is partially supplied by E. George. The difference in net present value of the O&M costs over 20 years between Alternatives 1 (LWW only) and Alternative 2 (LWW + E. George) is $1.24M, with Alternative 2 being less due to this reduction in O&M.

ES-1.11 Comparison of Pipeline and Water Treatment Plant Alternatives

ES-1.11.1 Summary of Alternatives Compared

Two options were considered: upgrading the treatment plant to support the full future capacity and upgrade the treatment plant to operate in conjunction with the intertie pipeline. The details of these two options are summarized in Table ES-7.

Table ES-7: Pipeline and Water Treatment Plant Alternative Summary

WTP Upgrade Only	Pipeline & WTP Upgrade
Alternative 1-B	**Alternative 2-B, Alignment 2**
• Install new self-cleaning raw water screen either at WTP site or at canal. • Install floating decanters in Raw Water Reservoirs. • Construct one new sludge lagoon to help reduce loading to existing ponds • Replace existing clarifiers and filters with three 2.0 mgd modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters. • Install new UV disinfection system for Cryptosporidium inactivation	• Install new raw water screen either at WTP site or at canal. • Install floating decanters in Raw Water Reservoirs. • Construct one new sludge lagoon to help reduce loading to existing ponds • Install three 1.0 mgd new modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters. • Demolish existing Plant #2 clarifier and Plant #2 filters. • Install new UV disinfection system for Cryptosporidium inactivation • Pipeline Alignment 2 with connection points at Penn Valley and at Minnow Way in LWW. Supplying full demand for 6 months of the year. • *Optional* – One hydroelectric power generating unit on pipeline.

ES-1.12 Evaluation of Combined Alternatives

ES-1.12.1 Preliminary Cost Estimate

The summary of the preliminary cost estimates and 20 year net present values comparing the two options are shown in Table ES-8.

Table ES-8: Preliminary Cost Estimates and 20 Year NPV

Cost	WTP Upgrade Only (Alternative 1-B)	Intertie Pipeline Only	WTP Upgrade & Pipeline (WTP Alt 2-B + Pipeline Alignment 2)
Construction Estimate	$8,561,000	$14,523,000	$19,636,000
LWW WTP O&M Per 1,000 Gallons Treated	$0.94	n/a	$0.94
E. George WTP O&M Per 1,000 Gallons Treated	n/a	n/a	$0.70
Total O&M 20 year NPV	**$6,870,000**	**n/a**	**$5,630,000**
Pipeline Reimbursement Policy	n/a	$3,631,000	$3,631,000
Total 20 year NPV Cost	**$15,431,000**	**$10,892,000**	**$21,635,000**
Optional			
Hydroelectric Cost Estimate	n/a	$1,050,000	$1,050,000
Hydroelectric 20 year NPV Revenue	n/a	$670,000	$670,000

ES-1.12.2 Advantages and Disadvantages

The advantages and disadvantages of both options are provided in Table ES-9.

Table ES-9: Advantages and Disadvantages of WTP Upgrade Only and WTP Upgrade with Intertie Pipeline

Option	Advantages	Disadvantages
WTP Upgrade Only	• Construction limited to WTP Site • Lower water age due to proximity of supply • Lower capital cost	• No redundancy for WTP. If WTP fails, LWW tanks are only emergency water storage. • Reduced operational flexibility with single source of supply • No ability to add additional customers to the system along pipeline alignment
WTP Upgrade & Intertie Pipeline	• Redundancy for LWW development supplied by WTP and E. George supply • WTP can be offline for about 6 months of the year • WTP upgrade much easier because plant doesn't need to be online constantly • Ability to add additional customers to the system along pipeline alignment • Pipeline reimbursement fees allows for some repayment over the facilities lifetime	• Higher capital investment for pipeline and WTP upgrades.

ES-1.13 Recommendation

The recommended alternative is to construct the intertie pipeline along Alignment 2 to connect E. George to LWW. Once the LWW WTP can be shutdown as the LWW system is supplied by the pipeline, then upgrade the WTP according to Alternative 2-B.

1 Introduction

The Nevada Irrigation District (NID) has retained HDR to complete a study of the drinking water supply system for the Lake Wildwood (LWW) water system and meet expected future demands for water. Lake Wildwood is currently served by an existing water treatment plant (WTP) that is the sole supply of drinking water to the community. The WTP while close to 40 years old, has historically met the water demands in the system; however, during peak demand periods the plant has been required to operate close to the maximum capacity, leaving little spare capacity for any future system growth or redundancy.

This analysis examines the potential future water needs in the Lake Wildwood system and alternatives to increase the water supply capacity, along with increasing reliability. Alternatives to upgrade the WTP are analyzed which could increase capacity and plant reliability, but still relies on a single source of supply to meet water demands. Therefore, a second set of alternatives are analyzed which include extending a pipeline from the existing Elizabeth George Water Treatment Plant (E. George WTP) to provide a second source of water supply, significantly increasing the reliability of the system. Finally, these two sets of alternatives are compared to recommend a final project which best meets the existing and future water demands and provides the most benefit to the District and its customers.

This report describes the analyses HDR performed, including a demand analysis, intertie pipeline alternatives comparison, WTP improvement alternatives, and final comparison of all alternatives. The following sections describe in detail how these analyses were performed and the criteria used to compare alternatives.

2 Demand Analysis Summary

In October 2016 HDR performed a capacity study for the Lake Wildwood Water Treatment Plant (Appendix A). From 2006 to 2014 the historic average day demand (ADD) and maximum day demand (MDD) were 1.19 and 2.97 MGD respectively. Since 2015 was a severe drought year following several previous years of drought, water demands were uncharacteristically low so where not used in the demand analysis. A conservative peaking factor of 2.5 was used for future planning purposes, as lower demands impacted by economic recession and drought between 2006 and 2014 may rebound in the future. Four scenarios of future demand were analyzed; however, it should be noted that due to recent drought conditions, the demand since 2004 has not increased (0% growth). Therefore, projecting historic growth into the future results in no increase in demand. Descriptions of these scenarios and the future ADD and MDD associated with each are shown in Table 2-1. Population growth was used at the primary driver of future water use patterns.

Table 2-1: Summary of Future Demands

Description		2017	2027	2037
Scenario 1: Historic Population will continue to grow at the same rate as observed between 2006 and 2014, 0%	ADD (MGD) MDD (MGD)	1.19 2.97	1.19 2.97	1.19 2.97
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Scenario 3: High Demand Population will grow at the estimated high average annual rate.[1]	ADD (MGD) MDD (MGD)	1.21 3.04	1.54 3.85	1.95 4.88
Scenario 4: Full Build-out Implementation of all proposed developments in the LWW service area within the next 20 years.	ADD (MGD) MDD (MGD)	1.21 3.02	1.44 3.59	1.66 4.16

[1]Low and high estimated annual growth rates based on the 2015 NID Urban Water Management Plan (2016)

Assuming a net capacity of the existing LWW WTP of 3.6 MGD (4.0 MGD total capacity), Table 2-2 summarizes the year that the MDD for each scenario would exceed the current capacity.

Table 2-2: Future Demand Timeframe to Exceed LWW WTP Capacity

Scenario	Year MDD Exceeds LWW WTP Capacity
Scenario 1: Historic	Not Exceeded by 2037
Scenario 2: Low	2031
Scenario 3: High	2024
Scenario 4: Build-Out	2027

This demand analysis suggested that improvements to LWW WTP focused on increasing capacity were needed to plan for future demands. Even the addition of a new development with approximately 0.25 MGD of ADD (about 820 new residential dwelling unit connections) would reach the net LWW WTP capacity of 3.6 MGD.

3 Project Need and Key Criteria

As determined from the demand analysis, the existing LWW WTP is expected to reach the maximum capacity within the next 10 years. Typically supply facilities are operated with some spare capacity to account for maintenance and equipment failure, so the realistic timeframe for an increase in water supply is likely less than 10 years. A planning level decision to select the best alternative is needed now to provide sufficient time to fund, plan, design, and construct the improvements, which takes years to complete.

The existing LWW WTP was built in stages with the oldest portion over 40 years old. The WTP is reaching the end of its useful life and many components will require upgrade or replacement in the near future.

One component of concern for the existing WTP supply is the 14-mile long Newtown Canal that conveys raw water supply to the WTP. This canal is routed along steep hillsides which are subject to landslides, tree damage and excess storm run-off. During storms the storm water is released at several spills to minimize potential damage to the canal berm. The plant will have no water during this time. The quality of the water during storm events may be too high in turbidity to treat due to the storm water run off in the canal system. If the canal is damaged and cannot convey water, the entire LWW system would be without a water supply until the canal is repaired.

Water supply reliability is a key concern of the District and efforts have been made throughout NID's water system to intertie supply facilities, which greatly increases reliability and operational flexibility. These both provide for the ability to maintain a consistent service to the District's customers. This is one of the main considerations for including E. George WTP intertie pipeline alternatives in the study. The pipeline would provide a second and/or alternate source of treated supply which could be used to replace or supplement treated water in the event of a WTP failure or raw water interruption. This treated water service includes drinking, fire protection and emergency supplies. Likewise, the WTP would also provide a redundant supply to the LWW development in the event the pipeline is taken out of service, but could not provide supply to customers along the E. George supply pipeline.

A new pipeline would also provide another benefit, connection of customers to the public water system who are not currently connected. Because the pipeline would be routed through the District's existing service area, properties along the alignment could be connected to the water system, increasing water supply reliability (and potentially quality) to those new customers.

4 Elizabeth George Intertie Pipeline

4.1 Background

Four preliminary alignment alternatives were presented to HDR by NID in the initial stages of the project. These alignments run from the corner of Rough and Ready Highway and Bitney Springs Road to connect to LWW at various locations within the system. HDR has refined these alignments through looking closely at parcel maps, property lines, existing road routes, and site visits, so that the alignments described below represent four optimal options to join LWW to the E. George WTP. All four alignments with along the proposed alignments are shown in Figure 4-1. The general features for this project along with a description of each alignment are described below.

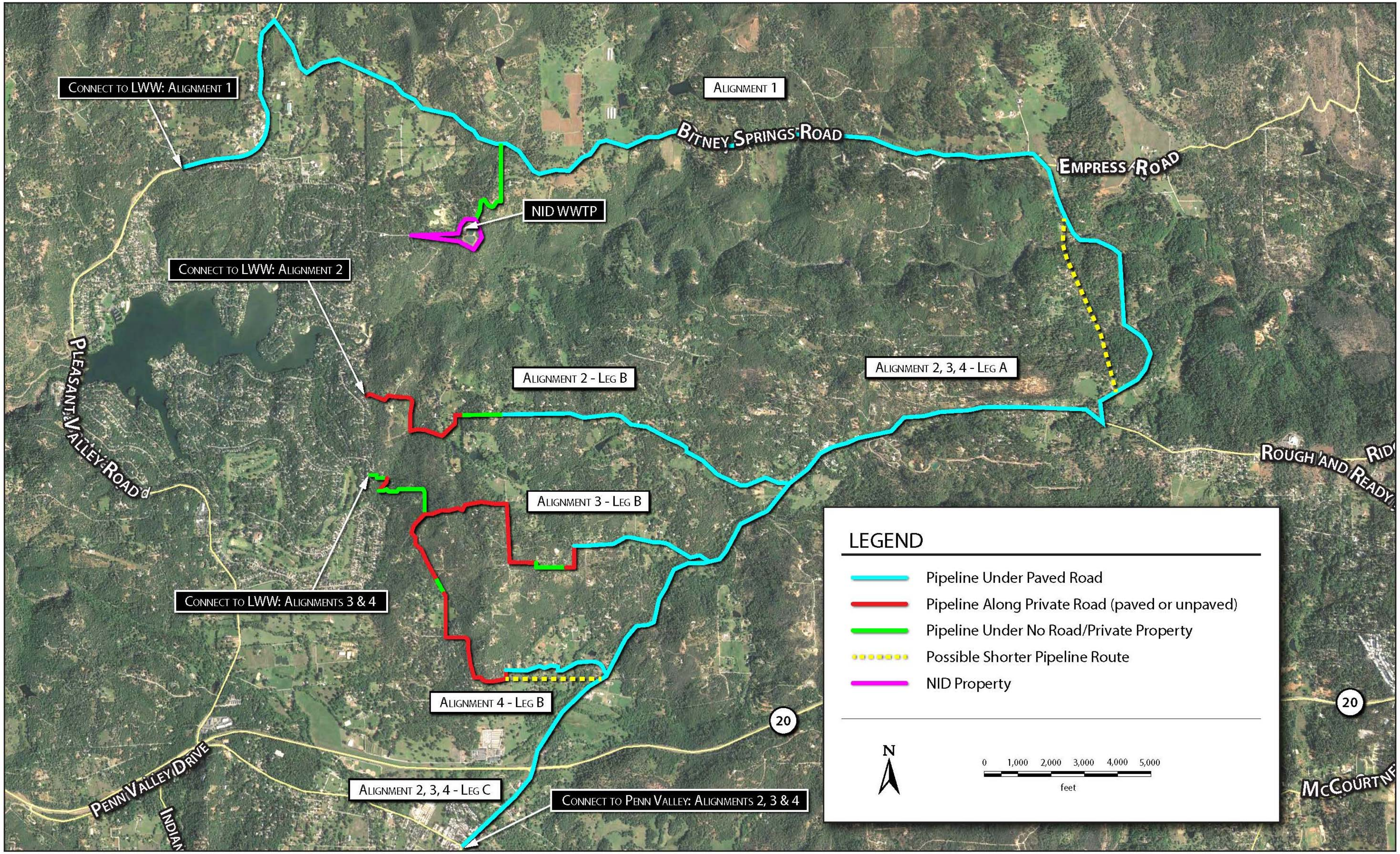

Figure 4-1: Proposed Alignment Alternative Routes

4.1.1 Proposed Alignment Alternatives

The proposed alignment alternatives are presented in further detail in the proceeding sections. Each alignment is assumed to use available standard 16" pipe with a maximum pressure of 230 psi (+/- 8%). Because of the high head at the beginning of the pipeline, each pipe reaches 230 psi before the connection points so pressure reduction is required to maintain the pipeline pressure within NID service pressure limits. The connection locations and potential pressure relief locations are shown on the approximate alignment profiles in Figure 4-2 through Figure 4-5.

On all alignment profiles the estimated hydraulic grade line (4 feet of loss for every 1,000 LF) represents the total HGL for the pipeline (black line at top) with no pressure reduction. This line shows the amount of available pressure within the pipeline alignments. The figures also show the point where the pressure reaches 230 psi and pressure reduction is required. The circles at the connection points represent the pressure in the existing systems that need to be matched in the new pipeline. Locations for In-Conduit Hydroelectric facilities are also shown in the figures and are discussed further in that section below.

ALIGNMENT 1

Alignment 1 would run the entire length of Bitney Springs Road between Rough and Ready Highway and Pleasant Valley Road. The proposed pipeline runs along Pleasant Valley Road to meet up with the Tank No. 2 site. In order to provide a backup of treated water to the LWW WTP there would also be a branch from the alignment along Bitney Springs Road that runs along the edge of a property line south to the WTP to connect downstream of the treated water pumps. This alignment would require support along the bottom or side of the bridge located on Bitney Springs Road above Deer Creek. More information on the proposed bridge crossing is given in the Bridge Crossings section. The approximate alignment profile is shown in Figure 4-2.

ALIGNMENT 2

Alignment 2 through Alignment 4 have a Leg A and Leg C that would navigate Rough and Ready Highway between Bitney Springs Road and Penn Valley Drive to connect to the Penn Valley water system to supply demand in that area. This section of the alignments include a small bridge crossing at the southern end of Rough and Ready Highway described in the Bridge Crossings section. Leg B of Alignment 2 would run along Rough and Ready Road until Riffle Box Road, where it cuts across private property to eventually run south onto Empty Diggins Lane. The alignment would run north onto Bosa Drive which connects to Minnow Way in LWW. The approximate alignment profile is shown in Figure 4-3.

ALIGNMENT 3

Leg B of Alignment 3 cuts through Cook Road to its end, runs south on Dolomite Court, and then cuts across the private property to meet up with Lively Wood Lane. The pipeline would then head north along Miners Way, turn west onto Diersak Way to continue onto Black Forest Road. From Black Forest Road the alignment would run along the edge of property lines until meeting up with Empty Digging Lane. Running across the edge of a property line, the alignment would connect to LWW through the Tank No. 5 site. Leg B of Alignment 3 includes a small bridge crossing at the eastern edge of Cook Road where a support structure would have to be constructed. This crossing is described in the Bridge Crossings section. The approximate alignment profile is shown in Figure 4-4.

ALIGNMENT 4

Leg B of Alignment 4 turns off Rough and Ready Highway onto Valley Drive. Valley Drive leads to Pioneer Way which, after a couple bends, leads to Cavitt Lane where the pipeline would head north under a private driveway to Raintree Lane. Raintree Lane leads to Black Forest Road where the alignment would then follow the same route of Alignment 3 for access into the LWW system at Tank No. 5. The approximate alignment profile is shown in Figure 4-5.

4.1.2 Pipeline Flow

Based on the Demand Analysis the estimated flow through the pipeline for each month of the year was determined. The values are based upon only using the LWW WTP for approximately six months of the year during the summer, with the pipeline supplying the full demand during the winter. The assumed percentage of total flow being supplied by the pipeline for each month is summarized in Table 4-1.

Table 4-1: Water Demand Supplied by Pipeline during the Year

Month	% Demand Supplied by Pipeline
January – April	100%
May	75%
June – August	50%
September	65%
October	75%
November – December	100%

Based on these percentages, the annual average of flow supplied by the pipeline is 70%. This annual percentage along with the flow projections were used to determine future pipeline flows for hydroelectric power generation estimates in the section below.

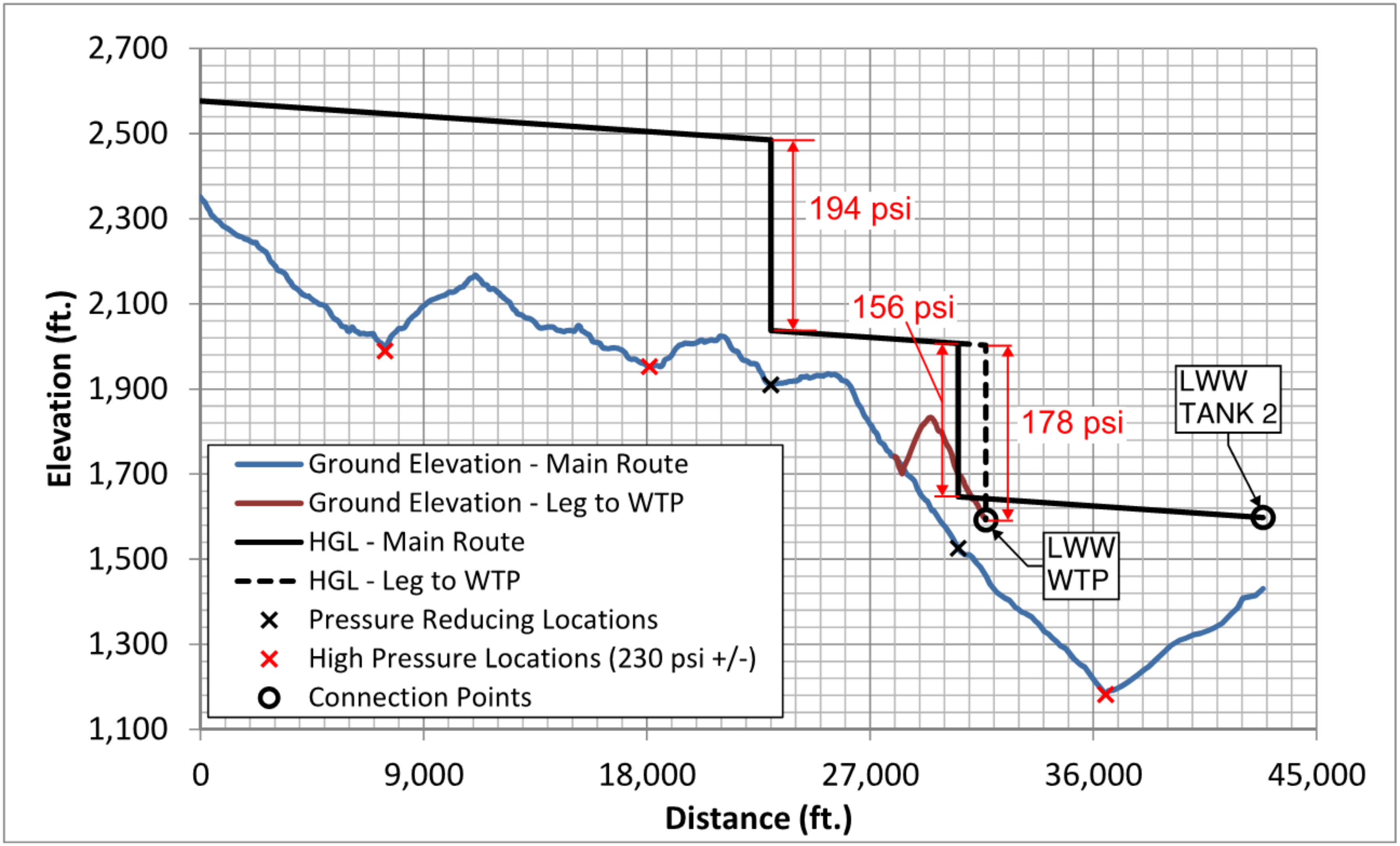

Figure 4-2: Approximate Alignment 1 Profile and Pressure Reducing Locations

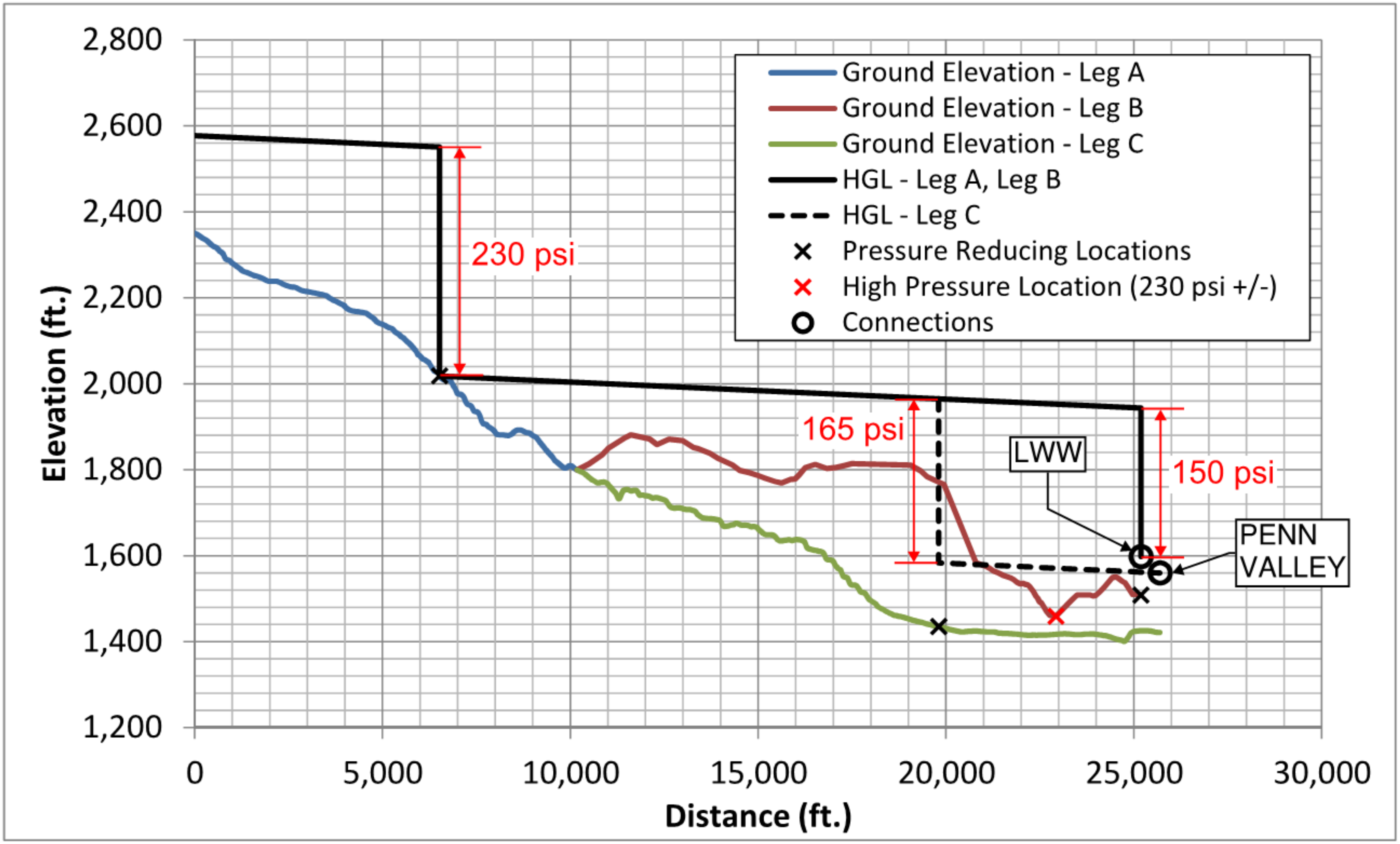

Figure 4-3: Approximate Alignment 2 Profile and Pressure Reducing Locations

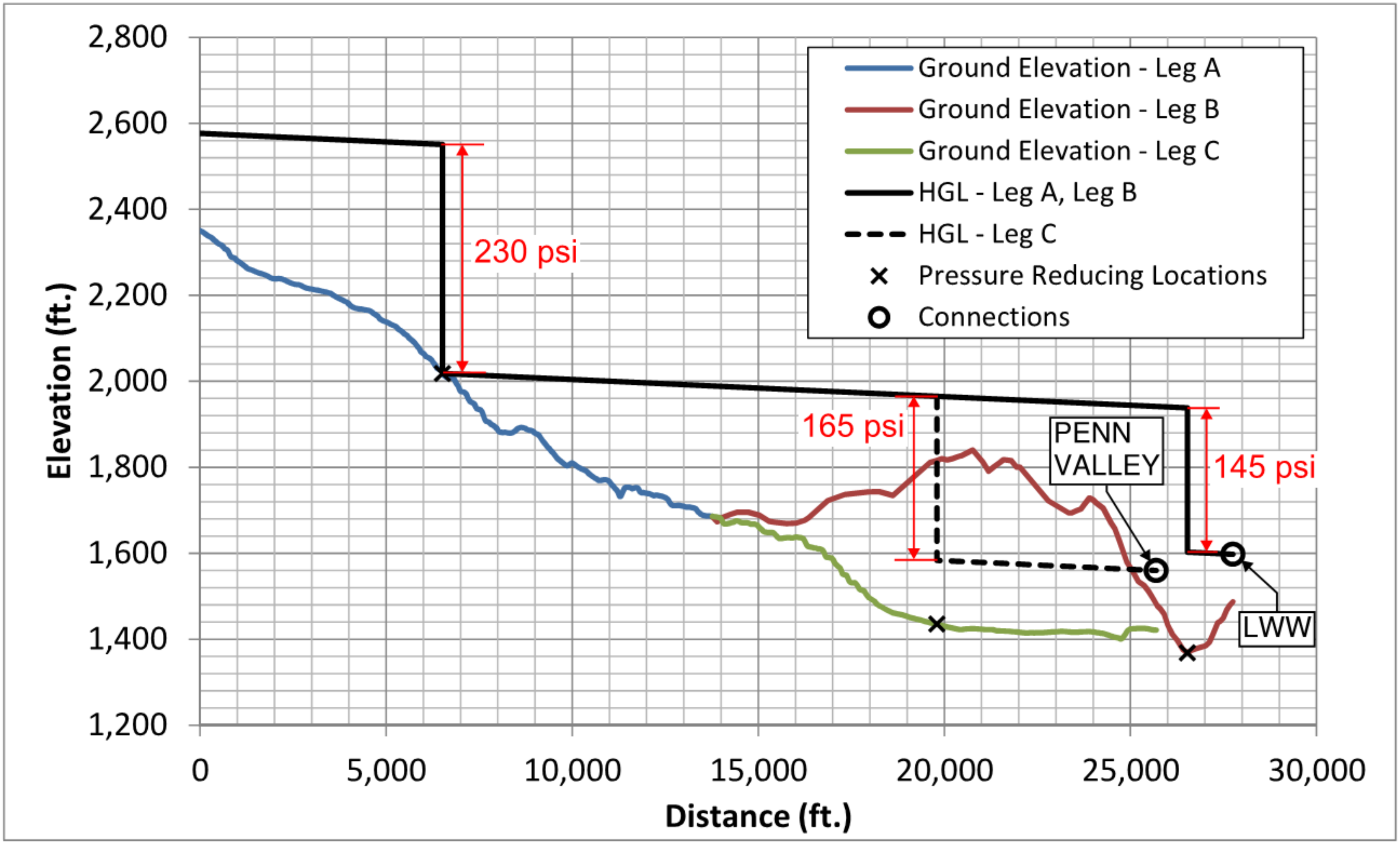

Figure 4-4: Approximate Alignment 3 Profile and Pressure Reducing Locations

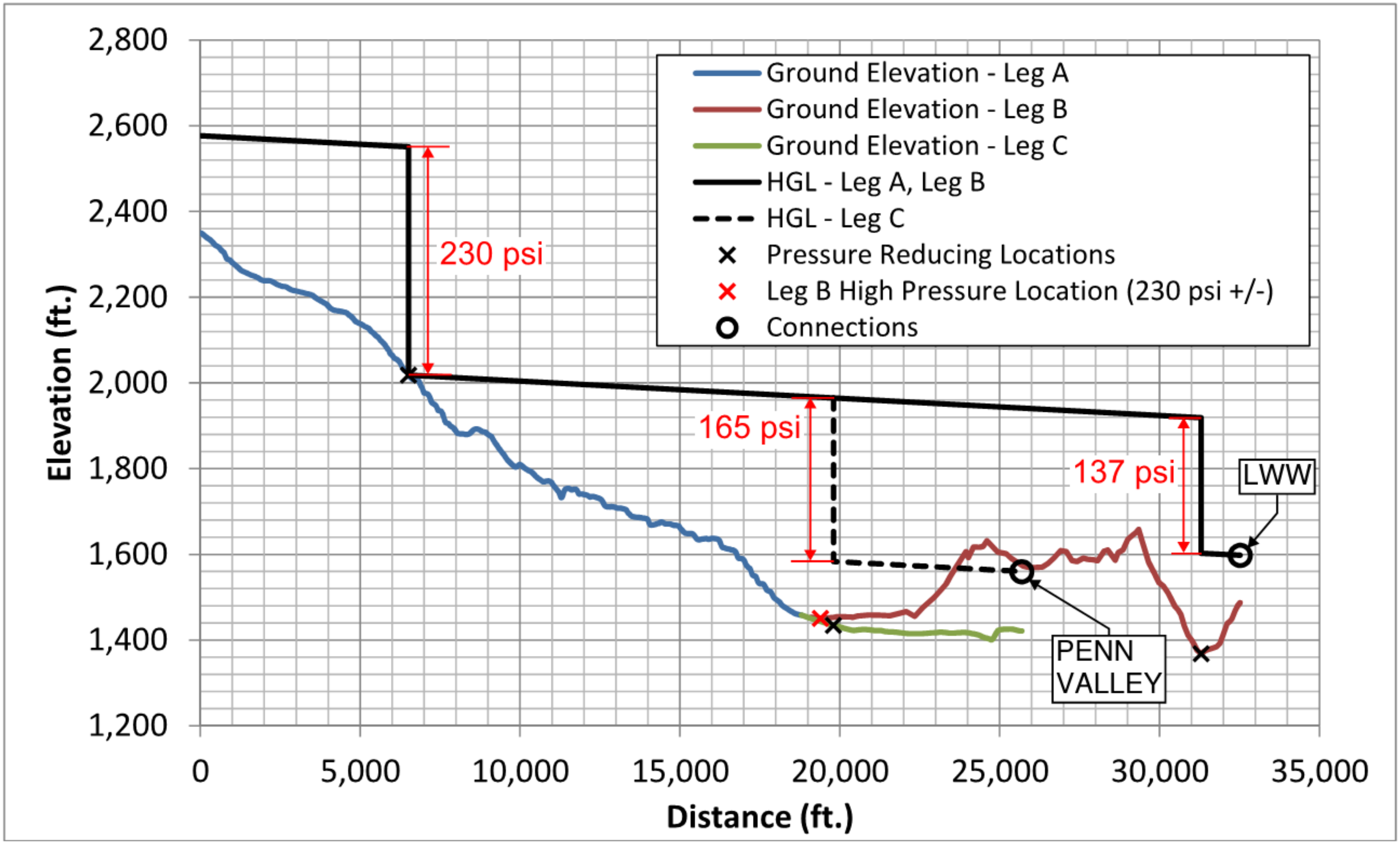

Figure 4-5: Approximate Alignment 4 Profile and Pressure Reducing Locations

4.1.3 In-Conduit Hydroelectric

HDR performed a reconnaissance level investigation of the hydropower potential of the various pipeline alternatives being evaluated. The work has been performed at a reconnaissance level with the intent of making an initial cost/benefit analysis.

It is assumed that any new hydropower generation would be located at the same location and in parallel with any required pressure reducing valves (PRV). In reviewing the various pipeline route options, two basic opportunities for hydroelectric generation were identified. Option 1 would be a single-unit powerhouse located on the main line before branching and would use all available flow and pressure head. The remaining locations where pressure needs to be reduced would have pressure reducing valves. Option 2 would have multiple powerhouses; one at each location where pressure reduction needs to occur. Having multiple powerhouses would increase the capital cost, but also increase the annual payback.

The powerhouse would be a structure with a concrete foundation, concrete masonry unit walls and a metal clad wood truss roof. The powerhouse would contain a turbine, synchronous generator and associated switchgear and controls. It is assumed that no new access would be required and that transmission would be via a short overhead pole line to local utility distribution line. Water would be discharged at atmospheric pressure and would re-enter the pipeline route immediately downstream of the powerhouse. If services are located close to the downstream end of the hydro unit, sufficient pressure may not be available, so a short parallel service line or pressure turbine may be needed. This should be addressed in the preliminary design of the pipeline and hydro unit.

Turbine sizing was based upon the maximum flow rate the project would see over the life of the analysis. Due to the relatively constant efficiency curve of a typical turbine over a broad range of flows, the energy generation is somewhat independent of the installed capacity. The water assumed to be available for hydroelectric generation is based on the demand analysis and pipe flow assumptions as discussed above. The total average annual flows ranged from 0.83 MGD to 1.17 MGD over the evaluation period with a peak flow used for turbine sizing of 2.91 MGD in the pipeline.

Annual energy was estimated by multiplying the average annual flow by the working pressure for each of the options. A water to wire efficiency of 85% was used for all cases. For each option a cost estimate was developed. The estimate assumes that the powerhouses will be located adjacent to and made integral with the any facilities required for the PRV's. As such, no new access would be required. It is also assumed that a low voltage electrical distribution line suitable for interconnection would be located nearby and only a minimal transmission line would be required. This assumption could have significant cost implications and would need to be verified in the field during subsequent evaluations.

A cost analysis for each option was conducted which includes capital, O&M, and energy revenue. The financial assumptions used for this analysis are summarized in Table 4-2.

Table 4-2: Hydroelectric Economic Evaluation Assumptions

Assumption	Value
Term	20 years (2017-2037)
Energy Base Rate	$0.0892 / kWh
Rate escalation	4.0%
Annual O&M	$18,000
Inflation Rate	2.0%
Discount Rate	4.0%

To the subtotal of direct construction costs, engineering of 15% and a 30% contingency were added to arrive at an overall project cost estimate. The results of the evaluation indicate that a single powerhouse would be more cost effective than multiple units for all alignments. The values vary slightly for each alignment alternative, but produce the same conclusion. An example for Alignment 2 is summarized in Table 4-3. Cost estimates and power generation estimates for each alignment are included in Appendix B-2.

Table 4-3: Alignment 1 Hydroelectric Benefit and Cost for Option 1 and Option 2

Option	Capital Cost	Power Generation NPV	Benefit/Cost
1	$1,050,000	$670,000	0.64
2	$2,730,000	$1,340,000	0.49

Based on this assessment, the alignment alternatives analysis in the following sections assumes a single hydro unit for each alignment in the evaluation criteria. However, the actual power generated is based on the available head and has been calculated for each alignment as part of the evaluation.

4.1.4 Bridge Crossings

Three different bridge crossings are encountered through the alternative alignments. The large bridge crossing on Bitney Springs Road along Alignment 1 seems most suited for supporting the pipe on the bridge. The bridge is shown in Figure 4-6 below. The bridge span is too long for a separate free standing pipe support structure without additional footings/columns, and trenchless installation under the creek is likely cost prohibitive.

Figure 4-6: Bridge Crossing for Alignment 1 on Bitney Springs Road

For the smaller bridge crossings on Rough and Ready Highway and Cook Road, the most cost effective approach is to support the pipeline on a separate pipe support structure away from the bridge. Both bridges (shown in Figure 4-7) are on the older side and likely not suitable to support the pipe fully, or require extensive changes to their substructure that would be required to construct a pipe support directly under the bridges.

Figure 4-7: Bridge Crossing on Rough and Ready Highway (Left), and Bridge Crossing on Cook Road (Right)

4.1.5 Access into Lake Wildwood

Following receipt of the initial alternative alignments, the largest changes in the pipeline routes are where there is access into the LWW system. Alignments 1 and 2 provide the easiest access as they connect to LWW through existing roads (besides the addition of a connection point for Alignment 1 near the WTP).

Alignment 3 and 4 are more difficult to connect because the development is built out on the south/east border and the houses are quite close together, making access for a pipeline very difficult. Therefore, Alignments 3 and 4 are routed along property boundaries and connect at the Tank No. 5 site. This increases the easement purchases for those alignments, but is the most feasible option due to narrow access corridors in the development between houses.

4.1.6 Service Connections

The location of the connection points into LWW were selected because they are located in the higher system pressure zones. They were selected as such, because the pipeline pressure will be above the Zone 1 pressure and would need to be reduced to match Zone 1. The supply would then be re-pumped back up to the higher zones in the LWW system, resulting in wasted pumping energy. Using the pressure zone map for LWW as well as the hydraulic model, the previously described connection locations connect to LWW at Zone 2 for Alignment 1, and Zone 3 for Alignments 2 through 4.

Alignments 2 through 4 allow for a connection to LWW as well as to the Penn Valley system. Connecting to this system allows for the Penn Valley area to increase general capacity and to provide an additional "feed" in the PV system, as there is only 1 point of connection between LWW & PV.

Along each alignment alternative there are opportunities for new service connections at current construction conveyances, in home raw water users, to connect to the treated water line. These users could benefit from connection to the public water system by improving health and safety as they must maintain an alternate source of potable water, such as bottled water. The number of possible construction conveyances for each alignment was counted based mapping data provided by NID (Appendix D). Where a property line or road separates the area identified as a construction conveyance, the areas were counted as separate new services. No variance parcels were analyzed as part of this report. The numbers of construction conveyances with frontage within 1,000 feet of each pipeline alignment are presented in the Customer Availability section.

Additionally all parcels fronting the pipeline will have an opportunity to connect. The total number of service connections along the pipeline route is estimated for each alignment. This estimate only includes parcels that have frontage along the pipeline.

The Pipeline Reimbursement Policy covers reimbursement of the distribution portion (8" pipe size) of the pipeline including appurtenances. However, fire hydrants, pumps and PRVs that have a regional benefit are not included. The cost to the property owner is based on the ratio of distribution to transmission main as indicated in the 2014 Bartle Wells Capacity Charge Update page 17. For a 16 inch pipe is 75% transmission and 25% distribution.

4.1.7 System Modeling

Models of the LWW and E. George systems were provided by NID for this analysis. The LWW model was recently updated by ID Modeling to include operational set points for pump stations, control valves, etc. It was also compared to operations data from the District to closely approximate the actual operation of the system.

The updated LWW model and E. George model were combined with the new pipeline alignments for the purpose of determining impacts resulting from supplying LWW through the pipeline, and determining improvements needed to mitigate the impacts.

Each alignment alternative was modeled and the LWW system supplied from the combined WTP/new pipeline, and the new pipeline alone. When supplied by only the pipeline, the system demands were limited to 2.5 mgd since this is considered the nominal capacity for the pipeline. The LWW system currently supplies all water to Tank 1, in Zone 1, and the water is pumped to the higher zones from there. Since all alternatives connect to the LWW water system above Zone 1, improvements to connect the higher zones to supply Zone 1 were needed.

The pressures in each zone were maintained at the current level, and the new pipeline supply pressure was reduced to match those currently observed in each zone where the connection is located. Therefore, no significant differences in system pressure or operation were required to provide supply via the new pipeline to the current LWW service area. Some changes in tank and pump station operation may be needed to achieve optimal performance, but the modeling indicates that no major changes should be required.

Table 4-4 provides a summary of the improvements needed for each alignment and modeling details are included in Appendix C.

Table 4-4: Required System Improvements for Each Alignment

Alignment	Required Improvements
1	300 feet new 12-inch piping in Via Villago Rd and new PRV station to connect Zone 2 supply to Zone 1
2	900 feet new 12-inch piping in Chaparral Dr and new PRV station to connect Zone 3 to Zone 1, and 4200 feet new 16-inch piping to connect new supply to Zone 2
3	1200 feet new 16-inch piping in Chaparral Dr and new PRV station to connect Zone 3 to Zone 1, and 4200 feet new 16-inch piping to connect new supply to Zone 2
4	1200 feet new 16-inch piping in Chaparral Dr and new PRV station to connect Zone 3 to Zone 1, and 4200 feet new 16-inch piping to connect new supply to Zone 2

Water age was also considered for each alignment to determine if a significant difference in age exists between alignments. Overall, the difference in connection locations has minimal impact on water age in the LWW system, however, Alignment 1 results in a significant increase in water age to Penn Valley. For all alignments, the water is required to travel a fairly long distance from the E. George WTP to the LWW distribution system. However, this is offset in portions of the LWW system by more evenly distributed water age. This results because the supply from the pipeline enters the system at a more central location and in a higher pressure zone. In the existing system, all water is pumped up to the various pressure zones from a single source near the WTP, resulting in low water age near the supply but higher water age in many other parts of the distribution system. The average water age for the existing LWW system supplied by only the WTP, and the system supplied by the E. George pipeline are shown in Figure 4-8 and Figure 4-9.

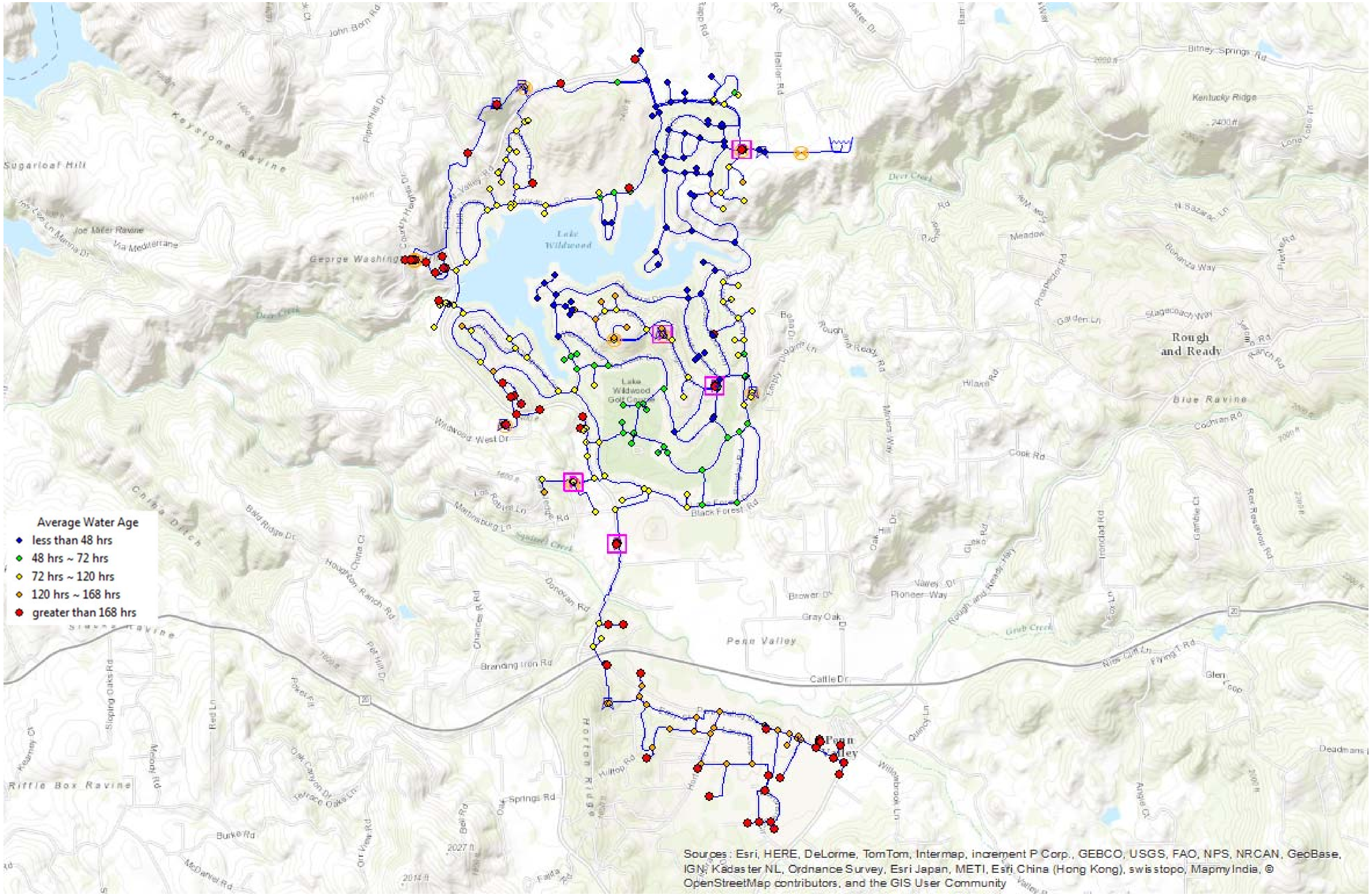

Figure 4-8: Existing LWW System Average Water Age (ADD)

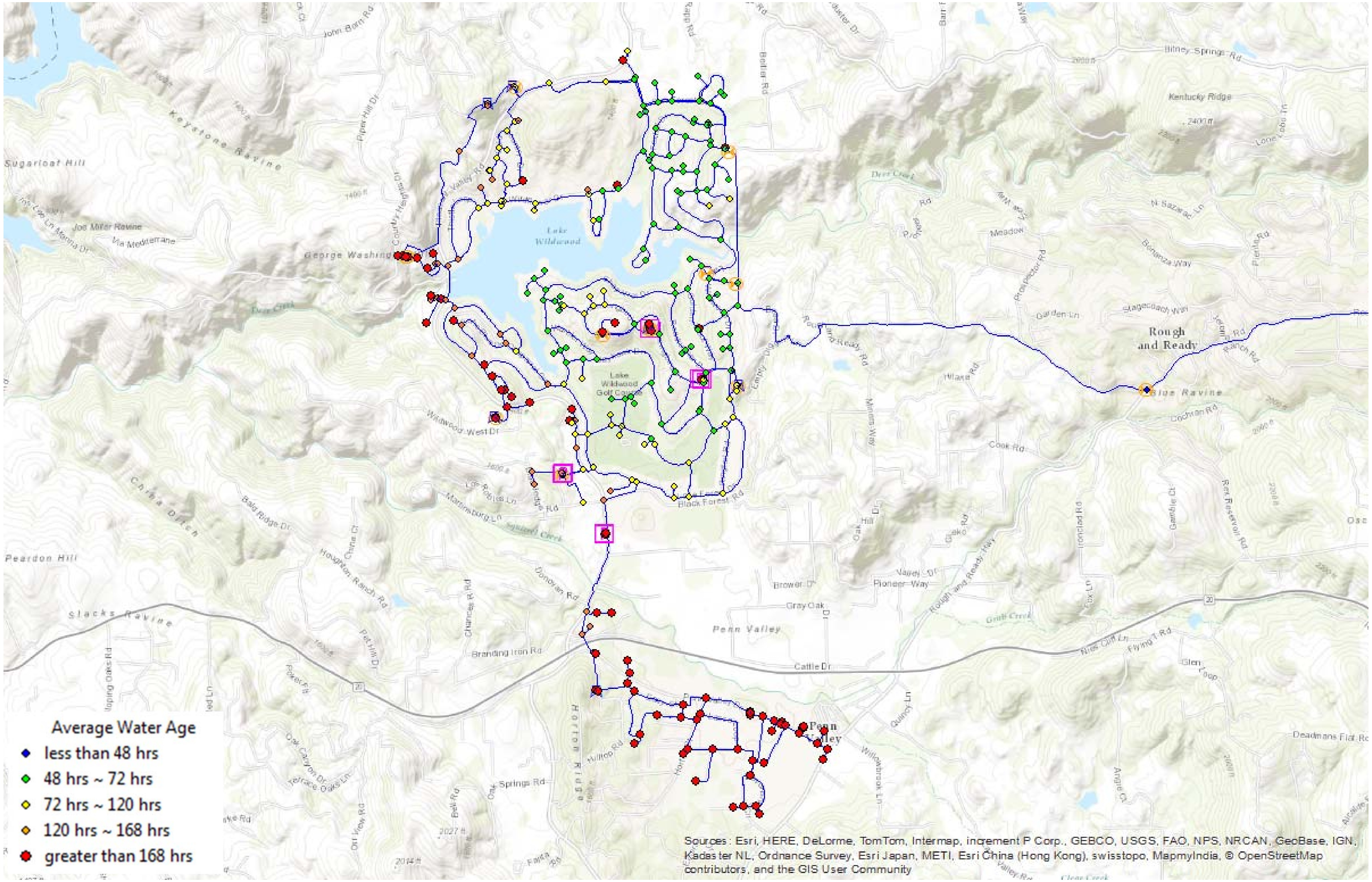

Figure 4-9: Pipeline Supply Only - LWW System Water Age (ADD)

As shown in the figures, the water age with the WTP only and the WTP/pipeline is not significantly different for the LWW distribution system. The analysis was completed with the pipeline to LWW only and the Penn Valley area continues to have the highest water age, however, this could be reduced significantly if the pipeline leg to Penn Valley is constructed, as shown in Figure 4-10. Since Alignment 1 does not include a pipeline to Penn Valley, water age in this area could be a significant issue with this alignment.

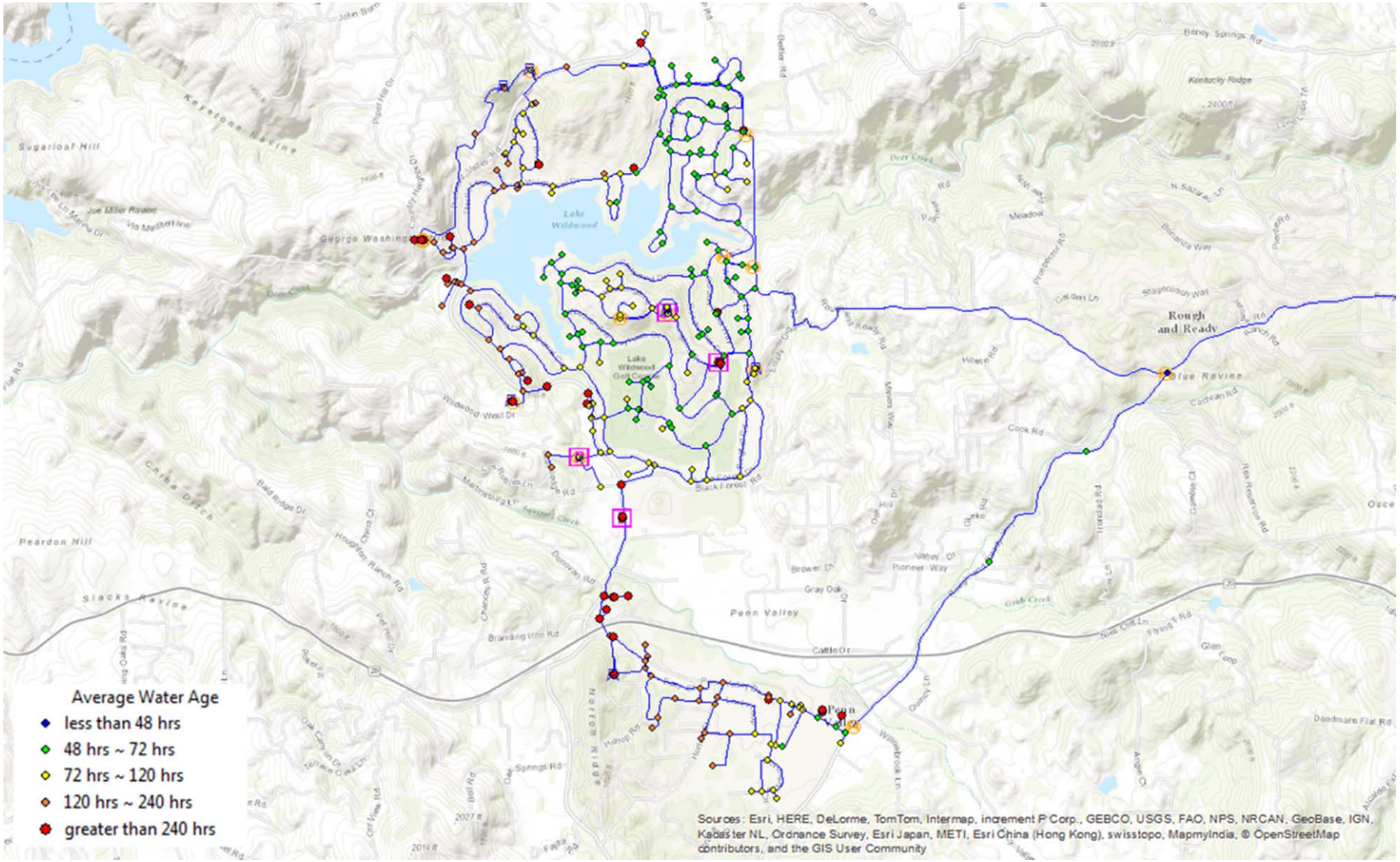

Figure 4-10: Pipeline Supply Only with Connection to Penn Valley - Water Age (ADD)

4.2 Alignment Evaluation Criteria

The analysis criteria below were selected and given percentages based on level of importance by NID staff. These criteria are shown in Table 4-5.

Table 4-5: Alignment Analysis Criteria Weighting

Criteria	Weight
Construction Cost	20%
Design Impacts/Considerations	15%
Operations & Maintenance	10%
Customer Availability	30%
Water Quality	25%

For each criterion, there were sub-criteria that were used for the final analysis. The ranking system used scores from 1 to 4 with 1 being the most favorable and 4 the least favorable. The other two scores were interpolated between 1 and 4 based upon comparison to the alignments that received the 1 or 4.

4.2.1 Construction Cost (20%)

A comparative cost estimate was calculated for each alignment. For a comparative estimate a base value of $210 per linear foot was used for the 14-inch pipelines (comparable to tabulated construction costs provided by NID). A base constructability factor (CF) of 1.0 was used to quantify overland construction on flat terrain at a base cost of $210 per linear foot. Other CFs used for the comparative estimate and additive factors (i.e. pavement restoration, traffic concerns, etc.) are shown in Table 4-6.

Table 4-6: Constructability Factors and Additives

Description of Construction Conditions	Factor
Overland construction, flat terrain	1
Pipe supported on bridge	3
Pipe support structure	5
Additive Factors:	
Pavement demo and restoration	0.25
Pavement addition	0.15
Extra rock, flat ground	0.5
Light traffic	0.1
Heavy traffic	0.2
Clearing and grubbing off road areas	1.5

The total cost of each alignment was the sum of the base cost multiplied by the CF and the length of each type of terrain in a given alignment. The cost tables for each alignment are shown in Appendix A. Easement costs were calculated at $4 per square foot (which was based upon a review of easement purchases by NID) with a 25 foot wide easement. Total costs and rank are summarized in Table 4-7 shown below with the full estimate given in Appendix B-1.

Table 4-7: Alignment Comparative Costs and Ranking

Alignment	Total Cost	Cost Rank
1	$ 16,930,000	4.0
2	$ 14,523,000	1.0
3	$ 15,161,000	1.8
4	$ 15,102,000	1.7

The construction cost will be offset over time due to the Pipeline Reimbursement Policy. The Pipeline Reimbursement Policy allows for District to recover certain costs as a result of District constructed pipelines. All parcels fronting the pipeline will have an opportunity to connect. At this time, for the purpose of service connection counts, variances and any possible waterline extension were not included so a cost per parcel is not currently determined. For the purpose of cost evaluations, the cost of construction of the pipeline and appurtenances can be offset based on the ratio of distribution to transmission main as indicated in the 2014 Bartle Wells Capacity Charge Update page 17 for a 16 inch pipe is 75% transmission and 25% distribution.

4.2.2 Design Impacts/Considerations (15%)

The design impacts ranking was calculated based upon the alignment rankings for constructability factor, pipeline length, easement length, difficulty of access into LWW, and feasibility of a micro-hydro power generation system.

MICRO HYDRO POWER GENERATION

The feasibility of a micro-hydro power generation system for each alignment was quantified based upon each benefit-cost ratio. For each alignment the generator size was calculated based upon the available head and what pressure relief was allowable at that section of the alignment. The cost and return estimates for a micro-hydro power generation system for each alignment are shown in Table 4-8. A detailed cost estimate is provided in Appendix B-2.

Table 4-8: Capital Cost and Benefit/Cost Ratio Estimates for Micro-Hydro Power Generation

Alignment	Head Available	Generator Size	Capital Cost	NPV of 20-year Revenue	B/C Ratio
1	194 ft	150 kW	$1,010,000	$510,000	0.50
2	230 ft	180 kW	$1,050,000	$670,000	0.64
3	230 ft	180 kW	$1,050,000	$670,000	0.64
4	230 ft	180 kW	$1,050,000	$670,000	0.64

4.2.3 Operations & Maintenance (10%)

The operations and maintenance ranking was determined through the total easement lengths that will need to be maintained by NID for access and the number of air release valves (ARVs) and blow-offs (BOs) that are required for each alignment.

4.2.4 Customer Availability (30%)

Customer availability for each alignment was ranked based upon access to construction conveyances and an estimation of the population density near the proposed pipeline. A map of construction conveyances was provided by NID during the initial phase of the project (Appendix D). The count of construction conveyances and possible service connections for each alignment is given in Table 4-9.

Table 4-9: Number of Construction Conveyances and Service Connections for Each Alignment

Alignment	# Constructed Conveyances	Total # Service Connections	
		Developed	Undeveloped
1	3	108	41
2	19	162	50
3	5	150	49
4	5	150	46

4.2.5 Water Quality (25%)

The ease of delivering supply to customers and water quality impacts (more testing, flushing, “living with” changed results that are state compliant, changes of operation of tanks, etc), and the customer impacts due to pressure changes were ranked based on modeling of each alternative. A significant factor for this criterion is the amount of system modification required to incorporate the pipeline supply into the LWW system. The rankings for each alignment are shown in Table 4-10.

Table 4-10: Alternative Alignment Water Quality Rankings

Alignment	Rank	Rationale
1	4	Longest = maximum water age, very high in Penn Valley
2	1	Shortest = minimum water age, connects at middle of system
3	3.5	Longer alignment, most improvements needed to connect to system
4	3	Second longest alignment, most improvements needed to connect to system

4.3 Evaluation Results

The results of the alignment analysis can be seen in Table 4-11. Alignment 2 received the lowest ranking total, making it the most favorable alternative, with Alignment 1 receiving the second best ranking total.

Table 4-11: Alignment Analysis Results

	Weight (%)	Alignment 1		Alignment 2		Alignment 3		Alignment 4	
		Rank[2]	Weighted	Rank[2]	Weighted	Rank[2]	Weighted	Rank[2]	Weighted
Construction Cost[1]	20%	4.0	0.8	1.0	0.2	1.9	0.4	1.8	0.4
		46,530 ft. total length, large bridge crossing		40,690 ft. total length, 1 bridge crossings		39,680 ft. total length, 2 bridge crossings		39,420 ft. total length, 1 bridge crossing	
Design Impacts/ Considerations	15%	1.9	0.3	1.0	0.2	4.0	0.6	3.8	0.6
		Largest length of construction with lowest CF[3], small easement purchase, and the lowest B/C[3] ratio for a hydro facility.		Second largest length of pipe, second smallest easement purchase, highest B/C[3] ratio for a hydro facility.		Second shortest pipe length, second largest easement purchase, highest B/C[3] ratio for a hydro facility.		Shortest pipe length, largest easement purchase, highest B/C[3] ratio for a hydro facility.	
Operations & Maintenance	10%	1.0	0.1	2.3	0.2	3.4	0.3	4.0	0.4
		Lowest number of required ARVs/BOs[3] and easiest access to pipeline route		Second smallest number of ARVs/BOs[3] and some easements making access somewhat difficult.		Largest number of ARVs/BOs[3] and largest easement purchase making access difficult.		Largest number of ARVs/BOs[3] and some easements making access somewhat difficult.	
Customer Serviceability	30%	4.0	1.2	1.0	0.3	2.6	0.8	2.7	0.8
		Lowest constructed conveyances, no Penn Valley connection, possible other extensions.		Large number of constructive conveyances, near denser population.		Small number of constructive conveyances and lower density population.		Small number of constructive conveyances and least dense population.	
Water Quality	25%	4.0	0.5	1.0	0.3	3.5	0.9	3.0	1.0
		Longest pipe length = maximum water age, especially in Penn Valley – very high age		Shortest pipe length = minimum water age, connects to the middle of the system		Longer pipe length with more improvements needed to connect to system		Second longest pipe length, most improvement needed to connect to the system	
Total	**100%**		**3.4**		**1.1**		**3.0**		**2.9**

Notes:
1. Length will be the primary driver of construction cost, and bridge crossings. Cost at $15/in-dia/ft.;
2. Relative ranking of alternatives will assign a 1 for the best alternative, and 4 for the worst alternative. Quantifiable rankings are interpolated between best score (1) and worst score (4). 3. CF = constructability factor; B/C = benefit/cost (20 year net present value); ARV = air release valve; BO = Blowoff valve.

5 Water Treatment Plant Upgrades

5.1 Background

The Lake Wildwood WTP has a permitted treatment capacity of 4 mgd. Before the drought, the treatment plant flow was as high as 3.8 mgd during the peak summer months. An increase in supply and reliability of treatment for the Lake Wildwood service area will be needed to meet current and future demands. There are several options to increase reliable supply, including expanding the WTP and/or providing partial supply from the Elizabeth George (E. George) WTP through a new pipeline.

The Lake Wildwood WTP was built in stages. The first stage was completed in 1972 and a second stage was completed in in 1986. The existing plant includes the following components:

- NID canal turnout and raw water pipeline to plant site
- Raw water reservoirs
- Upflow sludge blanket steel clarifiers
- Dual media circular steel filters
- Washwater ponds
- Clearwell
- Filter backwash pumps and air scour blower
- Chemical storage and feed facilities for: alum, polymer, lime, and sodium hypochlorite
- Control Building

The existing plant has generally operated well, however repairs and upgrades will be needed for continued successful operation – see Preliminary Capacity Analysis section.

5.2 Source Water Quality

The source water used by Lake Wildwood WTP originates in Deer Creek and flows through the Scott's Flat and Lower Scott's Flat Reservoirs, then through the Newtown Canal to the Lake Wildwood Water Treatment Plant (WTP). Raw water diverted from the Newtown canal is conveyed through a pipeline to the raw water ponds at the WTP site, located one half mile west of Lake Wildwood. The raw water is generally of good quality with turbidity that varies from 2 to 15 NTU with occasional turbidity spikes of 30 to 50 NTU that last for 3 or 4 days during the rainy season. The pH of the water ranges from 7.1 to 8.1 with average of about 7.6. Total organic carbon (TOC) is typically less than 2 mg/L with disinfection byproduct formation potential that meets state and EPA requirements. Because Cryptosporidium has been detected in the raw water supply, the plant has been classified as Bin 2 under the LT2ESWTR. A summary of the average and range of key water quality parameters for the raw water supply are shown in Table 5-1. This time frame encompasses both wet years and drought years; the wet year's data is presented because it will be more conservative for sizing WTP unit processes.

Table 5-1: Kay Water Quality, Flow and Residuals Generation Parameters (2011-2015)

Parameter	Average Summer	Range	Average Winter	Range	Annual Values
Temperature, deg-C	22	15-25	7.6	5-10	
Turbidity, NTU	2.5	1.2 -8.5	9.5	1.8-50	
Total Organic Carbon (TOC), mg/L	1.2	0.9 -1.9	1.3	1.0-1.9	
Alkalinity, mg//L as CaCO3	21	16-28	30	23-38	
Alum dose, mg/L	18.5	17-20	41	24-73	
Max Day Demand, mgd*					2.3
Average Daily Plant Production, mgd*	1.5		0.5		1.1
Calculated Residuals Generated, dry lb/yr					63,700

*Reference: HDR TM – Determination of Existing and Future Demands

5.3 Regulations and Treatment Goals

Treatment plants must be designed and operated to comply with California State Water Resources Control Board – Division of Drinking Water (DDW) and EPA regulations to safeguard public health. The most significant rules regarding surface water treatment include the Surface Water Treatment Rule (SWTR) and its updates, including the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) and the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), the stage 2 Disinfection/Disinfection Byproduct Rule (Stage 2 D/DBP). Because Cryptosporidium has been detected in the raw water supply, the plant has been classified as Bin 2 under the LT2ESWTR. For Bin 2, an additional 1.0 log of Cryptosporidium inactivation is required using method(s) in the EPA Tool Box. Currently the plant is using two of the Treatment Performance Tool Box components: combined filter effluent turbidity less than 0.15 NTU and individual filter effluent turbidity less than 0.15 NTU. Both of these must be achieved in at least 95 percent of measurements each month to get a 0.5-log removal credit for each component. The next most cost effective component would likely be installation of UV disinfection under the Inactivation Tool Box Components category.

The LWW system is in compliance with the Stage 1 and Stage 2 Disinfection and Disinfection Byproducts Rules (D/DBPR) based on the locational running annual average (LRAA) MCL of 80 ppb for TTHMs and 60 ppb for HAAs. In 2015, the TTHMs ranged from 43 to 68 ppb (62.8 ppb LRAA), and HAAs ranged from 22 to 56 ppb (37.5 ppb LRAA). There is concern that if water from the E. George is piped to the LWW system, the long retention time could result in possible higher LRAAs for TTHMs and HAAs. Simulated distribution system (SDS) testing should be performed to determine whether or not this will be a concern. SDS testing would involve taking treated water from the E. George WTP adding chlorine and holding the sample for the same length of time as would be expected in the new transmission main and LWW distribution system, including tanks. DBPs would then be measured to determine if DBP regulatory limits can be met. If the DBP levels are above regulatory limits, jar testing of various enhanced coagulation techniques could be tested and the SDS test repeated until a workable compliance strategy is found. Aeration of the tanks at the LWW system is another option that could be evaluated if high DBP levels are found. In addition to the above regulations, the water treatment plant will have to comply with the filter backwash rule (FBR), which requires that if filter backwash water is to be recycled, it must goes to the head of the plant prior to the coagulant addition point at a rate not to exceed 10 percent of the incoming flow.

The Lead and Copper Rule is intended to control the levels of lead and copper in the water system through corrosion control. This can be achieved by increasing the treated water pH and/or adding a corrosion inhibitor. The current practice of adding lime to raise the pH to 7.5 has kept the LWW water system in compliance for lead and copper. The plant has recently switched to adding sodium hydroxide, which should provide the same results as adding lime.

DDW also has design standards for new treatment plants. Title 22 California Code of Regulations Section 64658 requires that the average daily effluent turbidity goal is 0.2 NTU for conventional filtration plants (applies only if tool box for Cryptosporidium is not being used). Section 64659 requires that multiple filter units to provide redundant capacity for backwash and maintenance. Standard dual media filters may be designed for filtration rates up to 6.0 gpm/sf without any special approval required. A maximum filtration rate of 5.0 gpm/sf is considered to be conservative. Filters with less than standard media depth of are subject to possible lower filtration rates. Full scale testing may be required by DDW if rates above the current design are to be approved.

5.4 WTP Preliminary Capacity Analysis

Preliminary results of the Demand Analysis TM (Appendix A) show that a maximum day plant capacity of 3.9-4.9 mgd will be needed by the end of the 20-year planning period. Future average day demand is estimated to be in the range of 1.6-2.0 mgd. The existing WTP has a permitted treatment capacity of 4.0 mgd with net capacity of 3.6 mgd after allowing for up to 10 percent for recycle streams. A rating of the individual unit processes in the treatment plant and any limitation they may have are summarized in Table 5-2.

Table 5-2: Existing WTP Unit Process Ratings and Limitations

Unit Process	Stated Design Criteria	Estimated Capacity*	Current Limitations
Canal turnout: Outlet sump size Bar rack spacing Fine Screen openings	4 ft x 2.5 ft 2.5 in 1/4 in	6 mgd	• Vineyard screen plugs frequently and is a high maintenance item.
Raw Water Pipeline: Diameter Length to Reservoir 1 Length to Reservoir 2 Static head available	16 in 940 ft 1,440 ft 189 ft	7 mgd	• Existing valves and actuators need to be replaced due to old age. Condition of pipeline needs to be confirmed.

Unit Process	Stated Design Criteria	Estimated Capacity*	Current Limitations
Raw Water Reservoirs: Number Depth. each Volume, each	 2 13 ft 3.5 MG	6 mgd	• Outlets are at bottom causing occasional high turbidity events.
In-Plant Piping: Diameters Material Age Range	 6-IN – 21-IN Steel, DIP 31-45 years	4 mgd	• Condition of pipelines needs to be confirmed
Clarifiers: Type Number Diameter Side water depth Surface loading rate	 Upflow sludge blanket 2 45 ft 15 ft 0.98 gpm/sf	3.6 mgd	• There may be an operational issue with Clarifier #1 during windy conditions.
Filters: Number Diameter Filter Depth Water Depth over Media Area, each Total Area Media: Sand Anthracite Filtration rate (all in service) Filtration rate (1 out of service)	 4 18 ft 13.5 ft 6.0 ft 254 sf 1,016 sf 12 in 12 in 2.73 gpm/sf 3.65 gpm/sf	4 mgd	• Difficult to control the filter-to-waste operation. Due to permit requirements associated with Bin 2 for Cryptosporidium, operators must run for over 45 minutes to get the effluent turbidity down to 0.15 NTU. • Existing valves and actuators need to be replaced due to old age. • Shallow media and filter depth limits capacity to 4 mgd.
Backwash pumps: Number Capacity Motor size, each	 2 3,800 gpm 50 hp	4 mgd	• Equipment is over 40 years old and shows age
Air Scour Blowers: Number Capacity Motor size	 1 1,000 cfm 25 hp	4 mgd	• Equipment is approaching 30 years old.
Hypochlorite Feed System: Strength Storage tank volume Number of tanks Feed pump capacity Max Cl2 feed rate Maximum total chlorine dose	 5.25% 6,500 gal 2 830 gpd 350 lb/d 5 mg/L	6 mgd	• Problems with off-gassing and leakage at joints.
Coagulant Feed System Coagulant Storage tank size Feed pump capacity Max feed rate Maximum alum dose	 48% Alum 7,000 gal 830 gpd 4,000 lb/d 80 mg/L	6 mgd	

Unit Process	Stated Design Criteria	Estimated Capacity*	Current Limitations
Polymer Feed System	Alum pumps used for polymer feed	6 mgd	• Separate polymer feed system would improve operations.
Caustic Feed System Strength Storage tank volume Feed pump capacity Max NaOH feed rate Maximum total NaOH dose	 25% 4,000 gal 200 gpd 800 lb/d 12 mg/L	6 mgd	
Washwater Reclamation Ponds Number Volume, each Bottom Area, each	 2 180,000 gal 1400 sf	2.5 mgd as combined drying beds and WW ponds; 5 mgd as WW Ponds only	• Solids do not dry well in the ponds due to continual backwash water inflows and seepage of groundwater. Larger drying area is needed.

*Based on water quality during summer high demand season and annual sludge generation for washwater ponds.

Based on the capacity limitations described in Table 5-2 and the projected increase in demands, the existing WTP can meet system demands until 2027 provided the following interim improvements are made:

- Improvements to the canal turnout screen
- Addition of new drying beds to relieve the overloaded WW ponds.
- Potentially replacement of BW pumps and blower that may fail prior to 2027.

5.5 WTP Alternatives

Providing a reliable water supply for the Lake Wildwood service area can be accomplished by several different approaches that either retain the existing treatment plant or involve construction of new treatment units. Alternatives that utilize parts of the existing WTP will require condition assessments to verify the remaining useful life of components underground. The water supply to the Lake Wildwood service area could be entirely from the WTP via the Newtown Canal or a portion of the supply could be provided by a new pipeline from the E. George WTP.

Considering the range of raw water quality and current regulations, a robust treatment system is recommended that can handle raw water turbidity as high as 50 NTU and meet the additional 1.0 log Cryptosporidium inactivation required by the LT2ESWTR Bin 2 requirements.

For the treatment plant only scenario, the capacity of each alternative is up to 5.0 mgd net capacity to meet the high range of projected future demand. For purposes of comparison, adjustments to costs will be made for lesser capacity options on dollar per gallon per day capacity basis. For the options that include water supply from a new pipeline from the E. George WTP, the treatment plant upgrades could be sized for 2.0-2.5 mgd and provide redundancy. In this scenario, one-half of the existing WTP would be upgraded and the remaining system could be maintained for backup, as needed. This will allow for continued supply, with less than 30 percent reduction to the Lake Wildwood service area in the event of an interruption in the pipeline supply.

Design criteria for the two treatment plan options are presented in Table 5-3. Calculations for solids generation are presented in Appendix E.

Table 5-3: WTP Alternative Analysis Design Criteria

Parameter	Average Summer	Range	Average Winter	Range	LWW WTP Only	LWW WTP and Pipeline
Temperature, °C	22	15-25	7.6	5-10		
Turbidity, NTU	2.5	1.2 -8.5	9.5	1.8-50		
Total Organic Carbon (TOC), mg/L	1.2	0.9 -1.9	1.3	1.0-1.9		
Alkalinity, mg//L as $CaCO_3$	21	16-28	30	23-38		
Alum dose, mg/L	18.5	17-20	41	24-73		
Max Day Demand, MGD					5.3	2.6
Average Daily Plant Production, MGD					3.0	1.6*
Calculated Residuals Generated, dry lb/yr					173,200	48,400*

*During 8 months of year when operating

Based on discussions with NID staff the following alternatives listed in the section below are evaluated and are discussed in more detail. Preliminary layouts of the proposed alternatives are shown in Figure 5-1 through Figure 5-4.

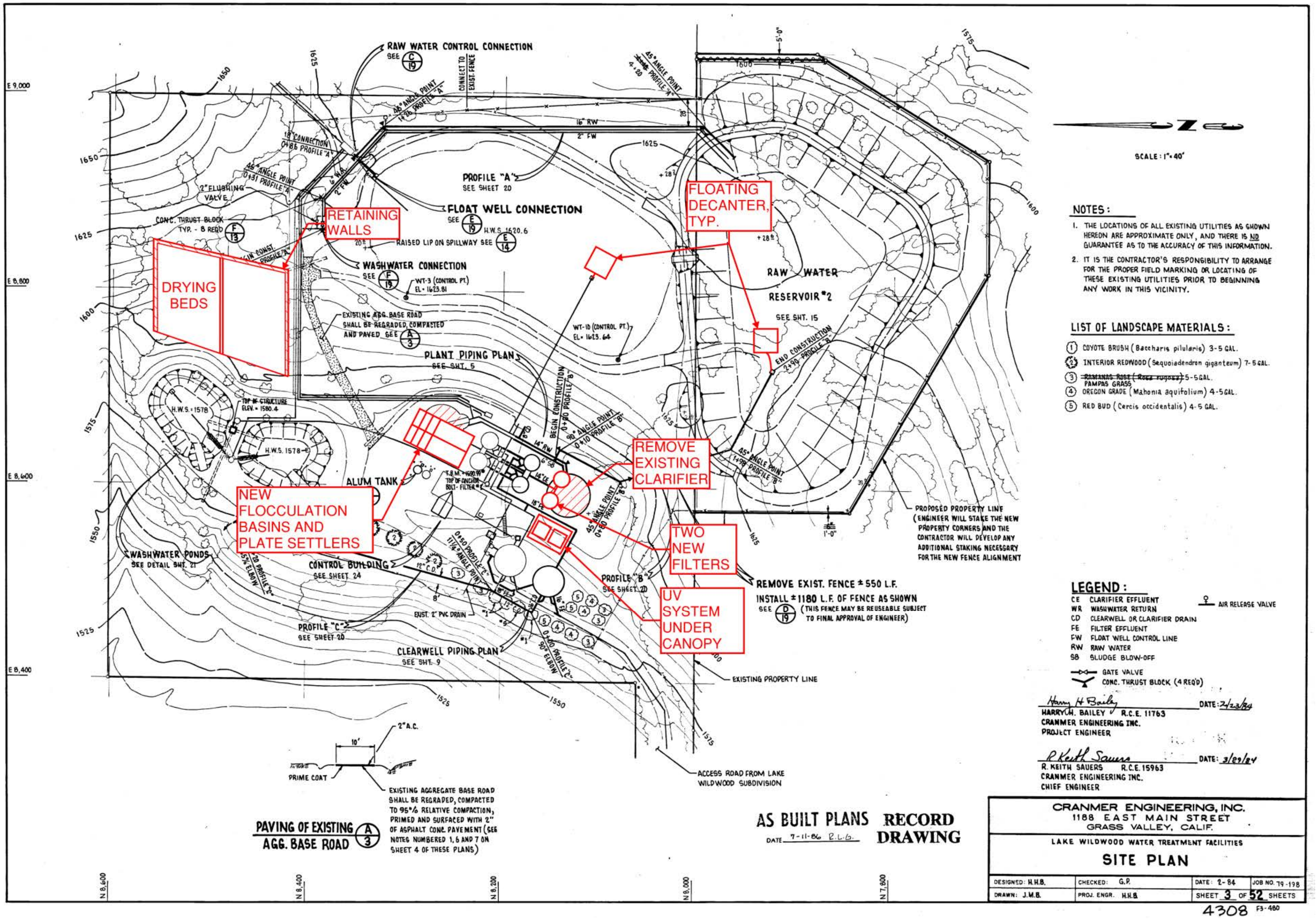

Figure 5-1: Alternative 1-A Upgrade and Expand Existing Treatment System

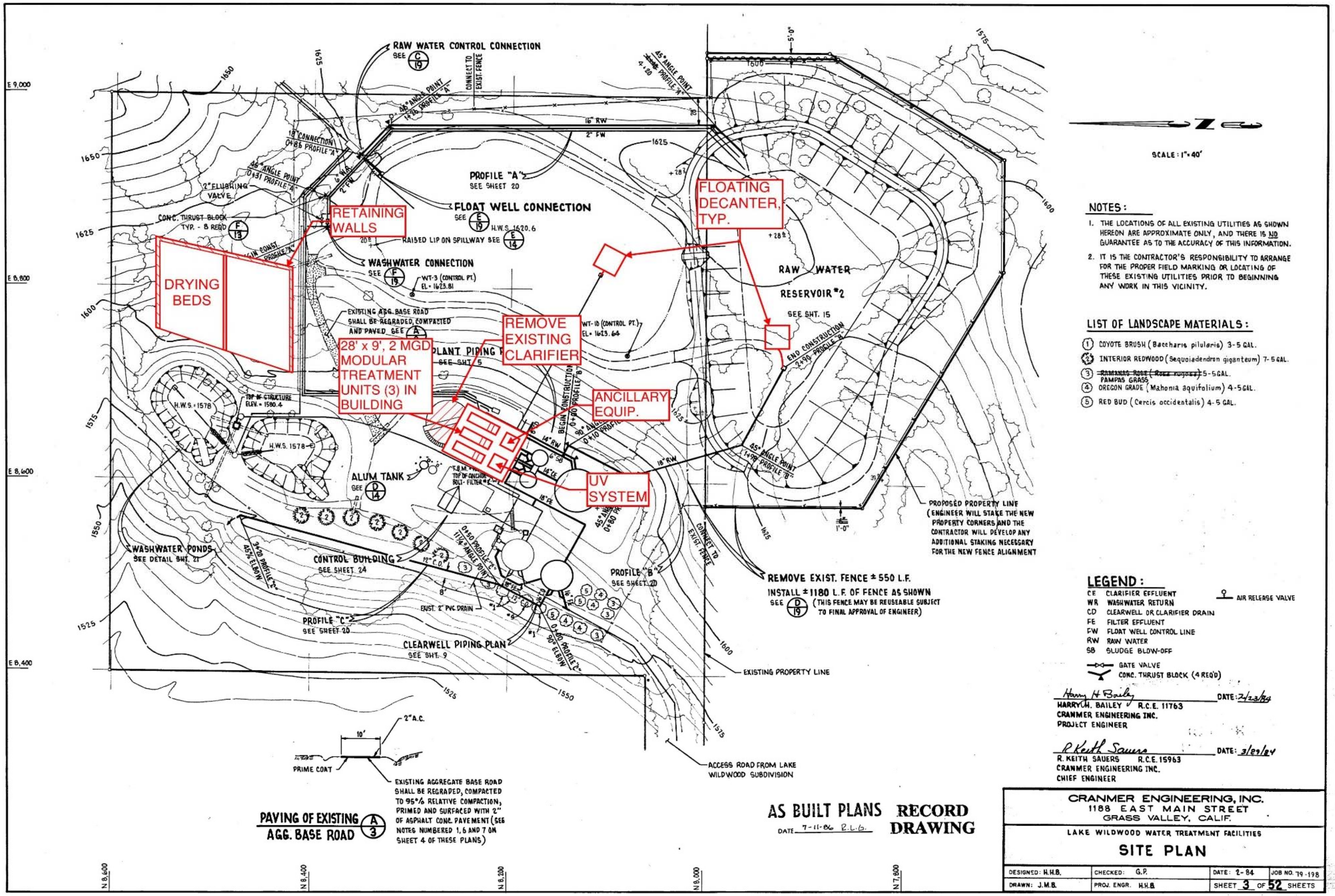

Figure 5-2: Alternative 1-B Modular Treatment Plant

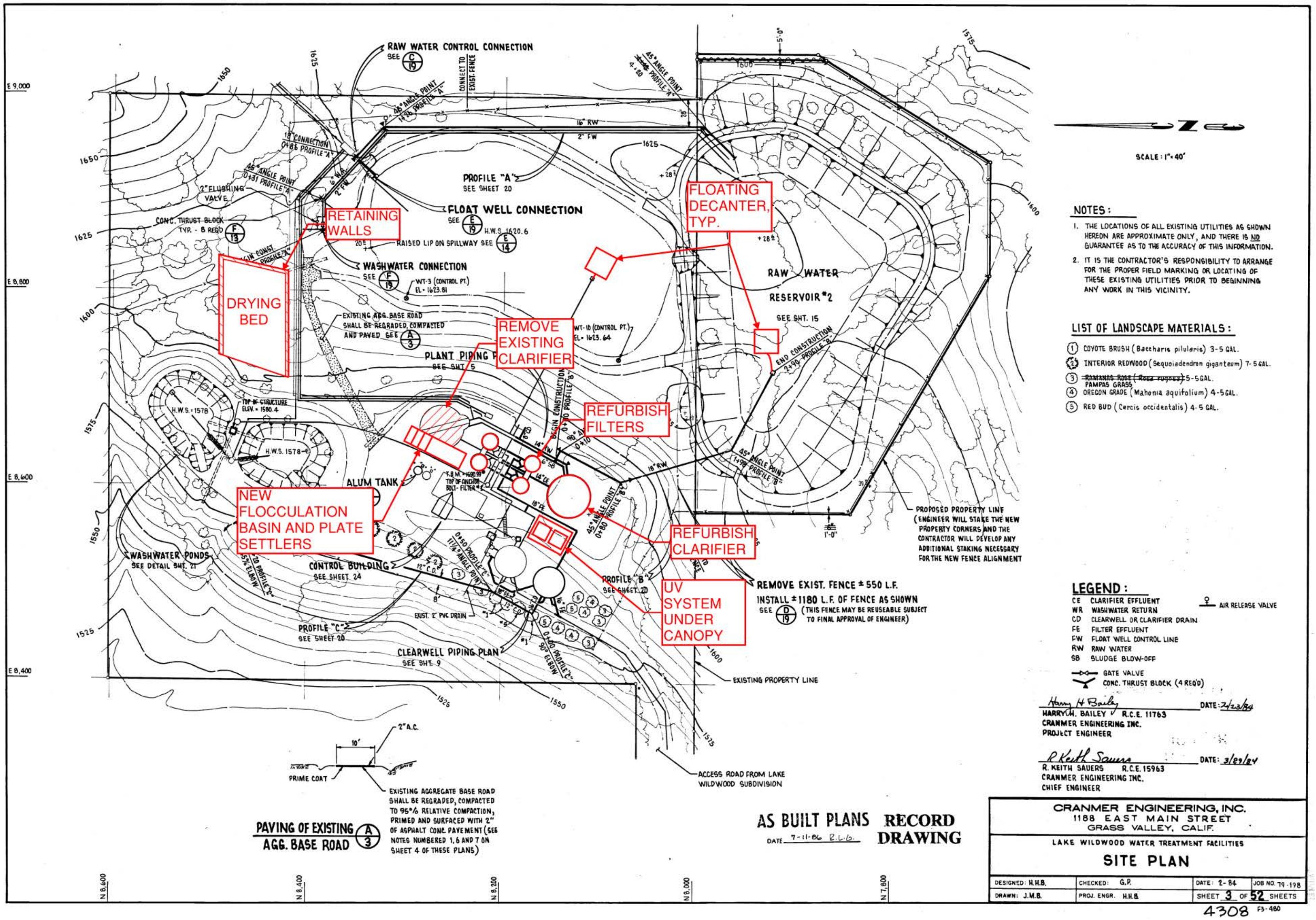

Figure 5-3: Alternative 2-A Pipeline Supply and Upgrade Existing Treatment System

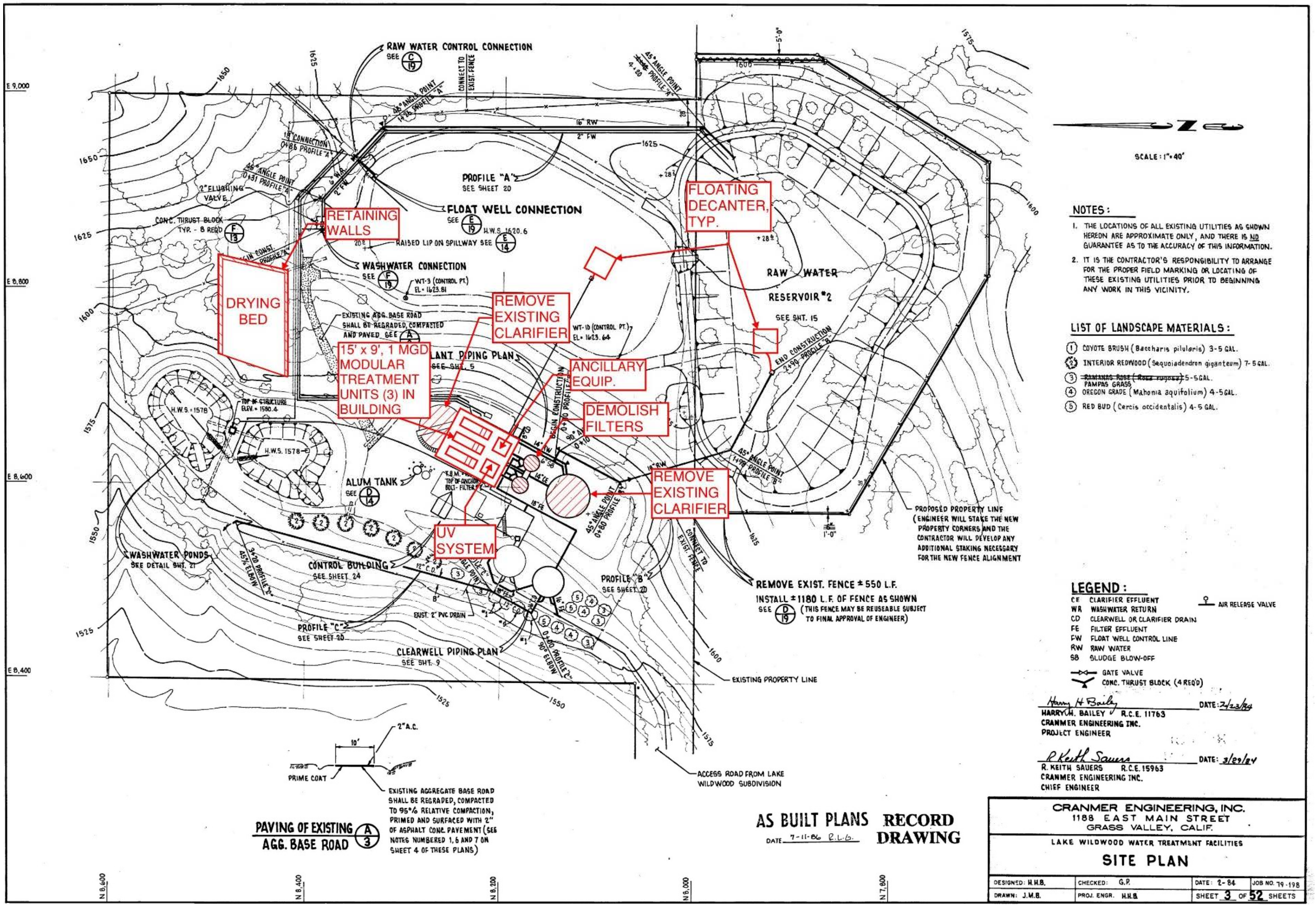

Figure 5-4: Alternative 2-B Pipeline Supply and New Modular WTP

5.5.1 Alternative 1: Future water supply from LWW WTP only

A. UPGRADE AND EXPAND EXISTING TREATMENT SYSTEM – DESIGN CAPACITY: 5.5 MGD TOTAL (5.0 MGD NET)

- Install new self-cleaning raw water screen either at WTP site or at canal. Options include a coanda screen at the intake, a travelling screen at the WTP, or a self-cleaning strainer at the WTP (Figure 5-5).

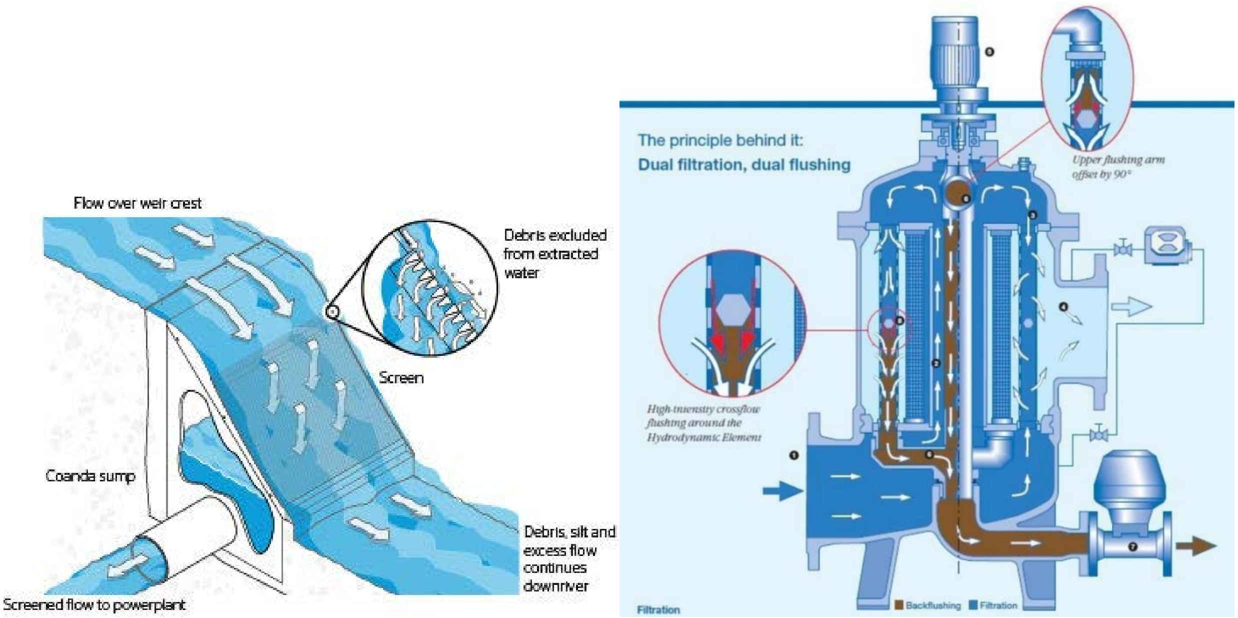

Figure 5-5: Coanda Screen (Left) and an Automatic Self Cleaning Strainer (Right)

- Install floating decanters in Raw Water Reservoirs.
- Replace existing clarifiers with two 2.75 mgd capacity flocculation basins and stainless steel plate settler units in concrete basins.
- Refurbish existing filters with new media and valves, replace backwash pumps and blower.
- Construct two new filters to increase number to 6.
- Construct crossover pipeline to allow settled water from either plate settler to go to all four filters.
- Install new UV disinfection system to treat filter effluent for Cryptosporidium inactivation and some organics reduction with peroxide addition, if needed. Operation with a UV disinfection system would provide greater flexibility in the operation of the filters by relaxing the effluent turbidity standard from 0.15 to 0.3 NTU. An example UV reactor is shown in Figure 5-6.

Figure 5-6: Trojan UV Swift Medium Pressure UV Reactor

- Construct two new soil cement lined solids drying lagoon (10,000 sf total area) in size to reduce loading to existing washwater ponds. The lagoons should be at a higher elevation to prevent groundwater intrusion into the lagoons. Possible locations include: area north of the raw water reservoirs, along the east side of Reservoir 1; or on property to be purchased (to the south of the plant site).
- Condition assessment and replacement of underground and electrical infrastructure as required.

B. CONSTRUCT NEW MODULAR TREATMENT PLANT – DESIGN CAPACITY: 5.5 MGD TOTAL (5.0 MGD NET)

- Install new raw water screen either at WTP site or at canal as described for Alternative 1-A.
- Install floating decanters in Raw Water Reservoirs.
- Replace existing clarifiers and filters with modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters. These systems are rated for raw water turbidities up to 75 NTU. Modular treatment units come in 1.0 or 2.0 mgd increments. To treat 5.5 mgd, three 2.0 mgd units would be needed. Installation of the third unit could be delayed until needed to meet future demands. These units can be placed outdoors or under a canopy (preferred). An example modular unit is shown in Figure 5-7.

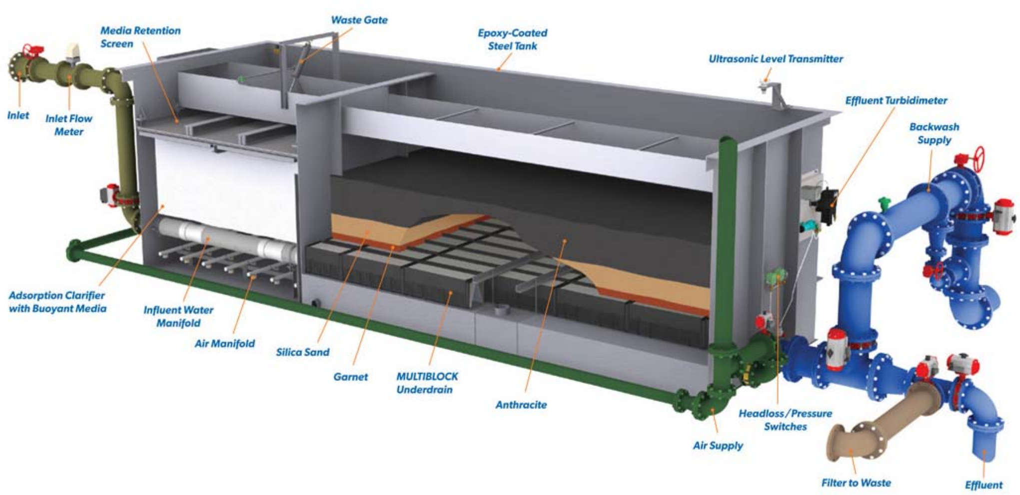

Figure 5-7: Trident Modular Treatment System

- Install new air scour blowers and backwash pumps sized for the new filtration units.
- Install new UV disinfection system for Cryptosporidium inactivation (see Alternative 1-A).
- Construct two new solids drying lagoons (see Alternative 1-A).

5.5.2 Alternative 2: Future water supply from Combination of LWW WTP and Intertie Pipeline

A. UPGRADE EXISTING TREATMENT SYSTEM – DESIGN CAPACITY: 2.0 -2.5 MGD (NEW UPGRADED CAPACITY) WITH EXISTING TREATMENT TRAIN 2 AS BACK-UP.

- Install new raw water screen either at WTP site or at canal (see Alternative 1-A).
- Install floating decanters in Raw Water Reservoirs.
- Replace existing Plant 1 clarifier with one new 2.75 mgd capacity flocculation basin and stainless steel plate settler unit in a concrete basin.
- Refurbish existing Plant #2 clarifier.
- Refurbish existing filters with new media and valves, replace backwash pumps and blower.
- Install new UV disinfection system for Cryptosporidium inactivation.
- Construct one new sludge lagoon to help reduce loading to existing ponds.
- Condition assessment and replacement of underground and electrical infrastructure as required.

B. CONSTRUCT NEW MODULAR TREATMENT PLANT - WITH DESIGN CAPACITY OF 2.0-2.5 MGD

- Install new raw water screen either at WTP site or at canal (see Alternative 1-A).
- Install floating decanters in Raw Water Reservoirs.
- Install three 1.0 mgd new modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters.
- Demolish existing Plant #2 clarifier and Plant #2 filters.
- Install new UV disinfection system for Cryptosporidium inactivation.
- Construct one new sludge lagoon to help reduce loading to existing ponds.

5.6 Evaluation of WTP Alternatives

An alternatives evaluation for each alternative including advantages and disadvantages are presented in Table 5-4.

Table 5-4: WTP Alternatives Advantages and Disadvantages

Alternative	Advantages	Disadvantages
1. Future Water Supply from LWW WTP only (5.5 MGD)		
A. Upgrade and Expand Existing Treatment System	• Minimize disruption to the plant site. • Flocculation and plate settlers provide better performance than existing clarifiers. • UV disinfection will provide greater flexibility in filter operation and reduce the required chlorine dose and DBP formation	• Depth of the filters and media not ideal requiring a lower design filtration rate. Two new filters are required to increase the plant capacity to 5.5 MGD. • Risk that refurbishing of old equipment may be more costly than currently estimated.

Alternative	Advantages	Disadvantages
B. Construct New Modular Treatment Plant	• Small foot print • Treatment equipment would be covered by canopy • Proven process performance • See UV comment above.	• Operators will need to be trained for operating a new system.
2. Water supply from combination of LWW WTP (4.0 MGD total) and new pipeline (2.0-2.5 MGD)		
A. Upgrade Existing Treatment System	• Having pipeline allows for the plant to shut down during the winter and run at lower capacity during the summer. • Having pipeline greatly reduces operation of the plant resulting in much lower annual sludge quantity. • Refurbishing the existing Plant 2 clarifier and all the filters reduces impacts and the need for re-training. • See UV comment above	• Depth of the filters not ideal reducing available head for operation. • Risk that refurbishing of old equipment may be more costly than currently estimated. • Additional treatment for TOC removal at the E. George WTP may be required to meet DBP limits.
B. Construct New Modular Treatment Plant - With Design Capacity of 4.0 mgd	• The modular design and small footprint simplifies construction. Project could be built in 2 phases as demand increases. • Proven process performance of modular systems. • Having pipeline greatly reduces operation of the plant resulting in much lower annual sludge quantity. • See UV comment above	• Operators will need to be trained for operating a new system. • Additional treatment for TOC removal at the E. George WTP may be required to meet DBP limits.

5.6.1 Preliminary Cost Estimates

Preliminary estimates are at a conceptual design level of accuracy and include a 30 percent contingency. The preliminary estimates are included in Appendix B-3. A summary of the costs is presented in Table 5-5.

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Table 5-5: Summary of Estimated Design and Construction Costs for Each Alternative

Alternative	Estimated Cost
Alternative 1-A – Upgrade and Expand Existing Treatment System	$7,753,000
Alternative 1-B – New Modular Treatment Plant	$8,561,000
Alternative 2-A – Upgrade Existing Treatment System	$4,683,000
Alternative 2-B – New Modular Treatment Plant	$5,383,000

5.6.2 Preliminary O&M Estimates

Preliminary estimates for operation and maintenance (O&M) for each alternative where prepared considering the differences in water treated and seasonal plant operation. For alternatives 2-A and 2-B, LWW could be served entirely by the pipeline for approximately six months a year, so the O&M costs at the LWW WTP are reduced. The preliminary estimates are included in Appendix B-4. A summary of the costs is presented in Table 5-6.

Table 5-6: Preliminary O&M Costs for Each Alternative

Alternative	Annual O&M Cost Per 1,000 Gallons	Net Present Value (20 years)
1-A and 1-B WTP Supply Only	$0.94	$6,870,000
2-A and 2-B WTP and Pipeline	$0.94 (LWW), $0.70 (E George)	$5,630,000

5.7 Evaluation Results

For the high growth scenario, the estimated maximum day water demand for the Lake Wildwood service area is 4.88 mgd. A design capacity of 5.0 mgd net capacity (5.5 mgd gross capacity) was used for evaluating the treatment plant alternatives.

The raw water turbidity ranges from an average of 2.5 NTU in the summer to as high as 50 NTU during the winger rainy season. TOC levels are typically less than 2.0 mg/L.

A new coanda screen is recommended at the canal turnout to reduce maintenance and prevent possible overtopping of the canal.

For the WTP supply only options, Alternative 1-A, Upgrade and Expand Existing Treatment System has the lowest initial cost, but relies on continued use of the existing filters that would be refurbished plus two new similar filters. Alternative 1-B is 11 percent higher in cost, but includes all new modular treatment units including deeper bed filters. Given the advantages of new treatment equipment, Alternative 1-B is recommended for the treatment plant only scenario.

For the WTP and Pipeline Supply options, Alternative 2-A, Upgrade Existing Treatment System with New Pipeline has the lowest estimated construction cost for the WTP options, but relies on continued use of the existing filters that would be refurbished. Alternative 2-B is 15 percent higher in cost, but includes all new modular treatment units including deeper bed filters. Given the advantages of new treatment equipment, Alternative 2-B is recommended for the combined smaller treatment plant and pipeline scenario.

In general, great risk is associated with upgrading the existing plant, especially since a condition assessment of underground infrastructure has not been completed. The incremental cost of new modular systems will likely be recovered in lower maintenance costs over the life of the plant.

The difference in treated water costs results in a reduction in O&M when LWW is partially supplied by E. George. The difference in net present value of the O&M costs over 20 years between Alternatives 1 (LWW only) and Alternative 2 (LWW + E. George) is $1.24M, with Alternative 2 being less due to this reduction in O&M.

6 Comparison of Pipeline and Water Treatment Plant Alternatives

6.1 Summary of Alternatives Compared

Two options were considered: upgrading the treatment plant to support the full future capacity and upgrade the treatment plant to operate in conjunction with the intertie pipeline. The details of these two options have been discussed throughout this section, and are summarized in Table 6-1.

Table 6-1: Pipeline and Water Treatment Plant Alternative Summary

WTP Upgrade Only	Pipeline & WTP Upgrade
Alternative 1-B	**Alternative 2-B, Alignment 2**
• Install new self-cleaning raw water screen either at WTP site or at canal. • Install floating decanters in Raw Water Reservoirs. • Construct one new sludge lagoon to help reduce loading to existing ponds • Replace existing clarifiers and filters with three 2.0 mgd modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters. • Install new UV disinfection system for Cryptosporidium inactivation	• Install new raw water screen either at WTP site or at canal. • Install floating decanters in Raw Water Reservoirs. • Construct one new sludge lagoon to help reduce loading to existing ponds • Install three 1.0 mgd new modular treatment units that include adsorption clarifiers (media contact clarifiers) and dual media filters. • Demolish existing Plant #2 clarifier and Plant #2 filters. • Install new UV disinfection system for Cryptosporidium inactivation • Pipeline Alignment 2 with connection points at Penn Valley and at Minnow Way in LWW. Supplying full demand for 6 months of the year. • *Optional* – One hydroelectric power generating unit on pipeline.

6.2 Evaluation of Combined Alternatives

6.2.1 Preliminary Cost Estimate

The summary of the preliminary cost estimates and 20 year net present values are shown in Table 6-2. Detailed cost estimates are provided in Appendix B.

Table 6-2: Preliminary Cost Estimates and 20 Year NPV

Cost	WTP Upgrade Only (Alternative 1-B)	Intertie Pipeline Only (Alignment 2)	WTP Upgrade & Pipeline (WTP Alt 2-B + Pipeline Alignment 2)
Construction Estimate	$8,561,000	$14,523,000	$19,636,000
LWW WTP O&M Per 1,000 Gallons Treated	$0.94	n/a	$0.94
E. George WTP O&M Per 1,000 Gallons Treated	n/a	n/a	$0.70
Total O&M 20 year NPV	**$6,870,000**	**n/a**	**$5,630,000**
Pipeline Reimbursement Policy	n/a	$3,631,000	$3,631,000
Total 20 year NPV Cost	**$15,431,000**	**$10,892,000**	**$21,635,000**
Optional			
Hydroelectric Cost Estimate	n/a	$1,050,000	$1,050,000
Hydroelectric 20 year NPV Revenue	n/a	$670,000	$670,000

6.2.2 Advantages and Disadvantages

The advantages and disadvantages of both options are provided in Table 6-3.

Table 6-3: Advantages and Disadvantages of WTP Upgrade Only and WTP Upgrade with Intertie Pipeline

Option	Advantages	Disadvantages
WTP Upgrade Only	• Construction limited to WTP Site • Lower water age due to proximity of supply • Lower capital cost	• No redundancy for WTP. If WTP fails, LWW tanks are only emergency water storage. • Reduced operational flexibility with single source of supply • No ability to add additional customers to the system along pipeline alignment
WTP Upgrade & Intertie Pipeline	• Redundancy between WTP and E. George supply • WTP can be offline for about 6 months of the year • WTP upgrade much easier because plant doesn’t need to be online constantly • Ability to add additional customers to the system along pipeline alignment • Constructed conveyance fees and hydroelectric power generation allows for some repayment over the facilities lifetime	• Higher capital investment for pipeline and WTP upgrades.

6.3 Recommendations

The recommended alternative is to construct the intertie pipeline along Alignment 2 to connect E. George to the LWW distribution system. As the pipeline is constructed, new customers along the alignment can be connected to the system.

6.3.1 Phasing

Due to the relatively long length of the new pipeline connecting the two water systems, it is not practical to construct in a single dry season. Therefore, it is anticipated the pipeline will be constructed in phases over 4 to 5 years. As the pipeline is constructed, new customer connections can be made, but considerations for water age in the dead-end pipeline will be needed to provide adequate quality water during the phasing period.

Once the pipeline is constructed the effort to upgrade the WTP, consistent with Alternative 2-B, can begin as the system will have a backup supply. This will make the upgrade much easier and cost effective since the WTP will not be required to be in service during the entire upgrade.

Some WTP improvements are recommended prior to the complete upgrade to maintain reliable operation. These include:

1. Improvements to the canal turnout screen supplying the raw water ponds.
2. Addition of new drying beds to relieve the overloaded WW ponds.
3. Evaluation and potential replacement of BW pumps and blower at the WTP.

Appendix A-1: Future Demand Analysis TM

HDR – 2016

Technical Memorandum

DETERMINATION OF EXISTING AND FUTURE DEMANDS

Nevada Irrigation District Lake Wildwood Water Treatment Plant Capacity Study and Options Analysis

October 3, 2016

Reviewed by: Andrew Graham

Prepared by: Jeff Lawrence, Sarah Pistorese

Background

The Nevada Irrigation District (NID) owns and operates the Lake Wildwood (LWW) Water Treatment Plant (WTP) located in Nevada County in northern California. The LWW WTP serves approximately 7,000 customers in a predominately residential area.

A number of factors have influenced population growth and water demands in the LWW area over the last decade. In 2008, economic recession resulted in a slowdown in development and population growth in the region. This region has also experienced prolonged drought conditions in recent years. In 2015, the Governor announced mandatory, temporary water demand reductions due to drought conditions. This resulted in a significant decline in per capita water use. NID recognizes that stagnant growth and low water usage in recent years may be a short-term response to recent drought and the lingering effects of economic recession. Therefore, it is possible that this low level of water usage does not reflect long-term water use trends. It is possible that per capita water use may rebound closer to pre-drought and pre-recession levels once conditions in the region have improved, and the District needs to be prepared to address potential increases in demand.

To plan for uncertainties related to future population and per capita water use, NID selected HDR Inc. to evaluate possible future demand scenarios and the potential for the LWW WTP to reach its firm capacity (3.6 MGD) within the next 20 years (2017 to 2037). This technical memorandum summarizes the methodology and results of that analysis.

Existing Demands

Historic Population and Water Use Trends

Based on data provided by NID, HDR evaluated the historical water use and population growth patterns for the area served by the LWW WTP. This data is summarized in Table 1. Table 1 shows that population remained relatively constant between 2006 and 2014. As discussed, mandatory water demand reductions were implemented in 2015. Due to these unusual circumstances, 2015 was not included in this analysis. In recent years, per capita water use and total water production have decreased. Between 2006 and 2010, the average per capita water use was approximately 175 gallons per capita per day (gpcd). During this period water use was relatively constant. Between 2011 and 2014, the average per capita water use declined to approximately 151 gpcd. As discussed, this decline in water use is largely due to drought conditions and some conservation in recent years.

Table 1. Summary of LWW Historic Demand (2006-2014)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average (2006 – 2014)
Total Population	7,579	7,178	7,194	7,194	7,189	7,173	7,173	7,142	7,103	7,214
Total Production (MG)	482	482	498	449	406	373	415	429	364	433
Per Capita Demand (gpcd)	174	184	190	171	155	142	158	164	140	164

Historic Average Day and Maximum Day Demands

The California Code of Regulations (22 CCR § 64554) requires that, "at all times, a public water system's water source(s) have the capacity to meet the system's maximum day demand (MDD)". The CCR defines MDD as "the day with the highest usage in the past ten years". Table 2 summarizes the historic average day demand (ADD) and MDD for the LWW WTP for the past ten years. This data was used to calculate the historic MDD to ADD ratio (i.e. peaking factor).

Table 2 shows that the highest MDD in the past ten years was in 2007 (2.9 million gallons per day (MGD)). This coincides with the highest peaking factor observed in the past ten years (2.2). NID has historically used a peaking factor of 2.5 for future MDD planning purposes. Since the last decade has been impacted by economic recession and drought, NID recognizes that demands could rebound in the future. Therefore, a conservative peaking factor of 2.5 for future MDD planning purposes has been used for this study.

Table 2. Summary of Historic ADD and MDD

Year	ADD (MGD)[1]	MDD (MGD)[1]	Peaking Factor
2006	1.32	2.81	2.1
2007	1.32	2.94	2.2
2008	1.36	N/A[2]	N/A
2009	1.23	2.54	2.1
2010	1.11	2.29	2.1
2011	1.02	2.14	2.1
2012	1.14	2.36	2.1
2013	1.17	2.27	1.9
2014	1.00	2.01	2.0
Annual Average	**1.19**	**2.42**	**2.1**

Sources: Annual Reports to the Drinking Water Program and Public Water System Statistics for the LWW WTP
(1) Data based on total water treated at the LWW WTP.
(2) MDD data for 2008 was not available.

Future Demands

Future Demand Scenarios and Assumptions

As discussed previously, per capita water use was relatively constant prior to drought conditions. In addition, per capita water use for the LWW service area is already low (well below NID's 2020 per capita water use target of 197 gpcd). Therefore, this assessment assumes that per capita water use would remain constant into the future at the 2006 to 2014 average value of 164 gpcd. As such, population growth is assumed to be the primary driver of future water use patterns.

Table 3 summarizes the four scenarios and assumptions used in this analysis. These scenarios represent a range of possible future population growth trends for the LWW service area. It is assumed that the stagnant population growth observed in the last decade may not be a good representation of future conditions. Therefore, in addition to examining historic growth trends, this analysis also examined three alternative growth scenarios. For each scenario, a different growth rate was selected which was used to project future ADDs. The starting ADD for each scenario was assumed to be the ten year annual average value (1.2 MGD) (see Table 2). The MDD for each year was calculated by multiplying the ADD by the peaking factor planning value (2.5).

Table 3. Summary of Future Demand Scenarios

Scenario	Average Annual Population Growth Rate (%)	Description	Assumptions
Scenario 1: Historic Demand	0	Population will continue to grow at the same rate as observed between 2006 and 2014. Due to economic conditions this rate is uncharacteristically low.	Based on the historic average annual population growth rate (2006 – 2014)
Scenario 2: Low Demand	1.3	Population will grow at a rate lower than the long term historical average.	Based on the low average annual growth rate estimated in the 2015 NID Urban Water Management Plan (2016).
Scenario 3: High Demand	2.4	Population will grow at a rate higher than the long term historical average.	Based on the high average annual growth rate estimated in the 2015 NID Urban Water Management Plan (2016).
Scenario 4: Full Build-out	3.0	Implementation of all proposed developments in the LWW service area (including Penn Valley) within the next twenty years (2017-2037) (see Table 4).	Includes the proposed developments identified in the *Penn Valley Fire Flow Analysis* technical memorandum (2015). Other proposed developments in the LWW area were provided by the Nevada County Planning Department (Attachment A).

It should be noted that the high growth scenario represents developments in excess of those identified in the current general plan. Scenario 4 assumes that all available land and proposed developments are implemented, as identified in the current general plan. Table 4 summarizes the number of new units and associated demand expected at full build-out under Scenario 4. These proposed new developments are estimated to increase ADD by approximately 0.48 MGD at full build-out. For this assessment, it was assumed that the new developments would be implemented evenly over the 20-year period, such that an additional 0.02 MGD of demand is added each year.

Table 4. Scenario 4 – Estimated ADD from Future Developments

	Units	gpd/unit	ADD (MGD)
Lake Wildwood Residential [a]	1,009 DU	300 [c]	0.30
Penn Valley Area [b]			
Residential	400 DU	300	0.12
Mobile Home	140 DU	250	0.04
Commercial	39,000 sf	0.50	0.02
Total Build-Out Demand			**0.48**

DU = Dwelling Units, sf = square feet

a. Source: Nevada County Planning Department (see Attachment A)

b. Source: *Penn Valley Fire Flow Analysis* Technical Memorandum (2015)

c. Water use per residential unit was assumed to be 300 gallons per day per unit, consistent with the assumptions in the *Penn Valley Fire Flow Analysis* Technical Memorandum (2015).

Future Demand Assessment Results

Table 5 summarizes the ADD and MDD results for each future demand scenario. The capacity of the LWW WTP is approximately 3.6 MGD of supply capacity (about 10% of the 4.0 MGD capacity is needed for process water). Under Scenario 1, MDD is still within the capacity of the LWW WTP by 2037. Under Scenarios 2, 3, and 4, demands exceed the capacity of the LWW WTP prior to 2037. Figure 1 illustrates the demand scenarios.

Table 5. Future ADD and MDD 10- and 20-year Forecast

Scenario 1: Historic	**2017**	**2027**	**2037**
ADD (MGD)	1.19	1.19	1.19
MDD (MGD)	2.97	2.97	2.97
Scenario 2: Low			
ADD (MGD)	1.20	1.37	1.56
MDD (MGD)	3.00	3.42	3.89
Scenario 3: High			
ADD (MGD)	1.21	1.54	1.95
MDD (MGD)	3.04	3.85	4.88
Scenario 4: Build-Out			
ADD (MGD)	1.21	1.44	1.66
MDD (MGD)	3.02	3.59	4.16

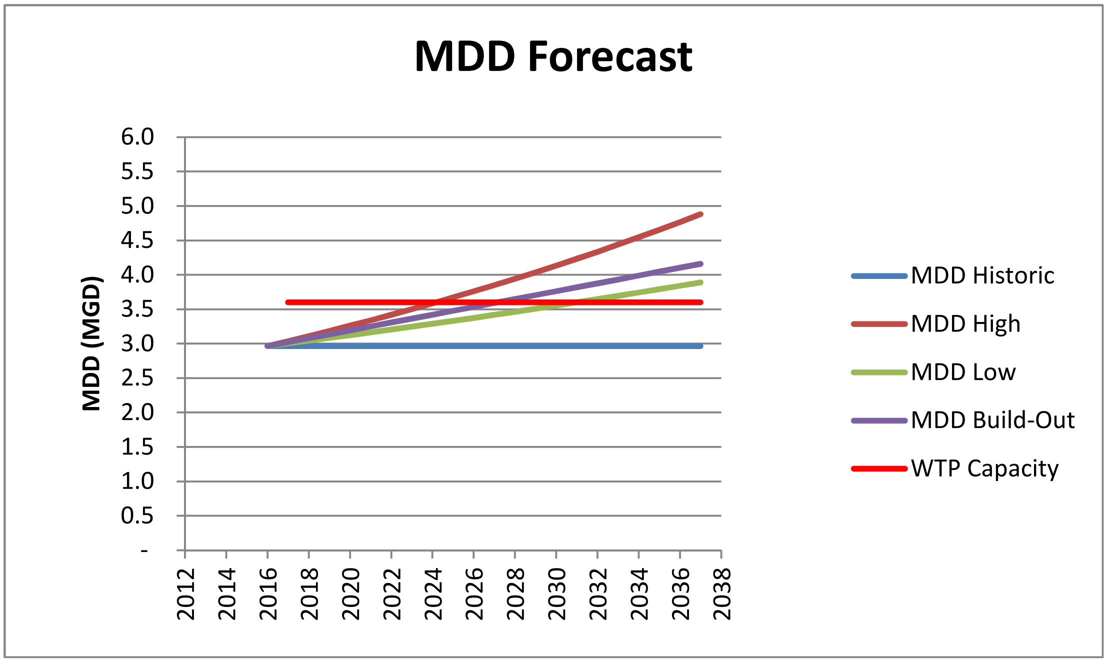

Figure 1. Future MDD Forecast

Table 6 summarizes the year that the MDD for each scenario would exceed the capacity of the LWW WTP. This table suggests that MDD could exceed the capacity of the LWW WTP within approximately 8 to 20 years.

Table 6. Future Demand Timeframe to Exceed LWW WTP Capacity

Scenario	Year MDD Exceeds LWW WTP Capacity
Scenario 1: Historic	Not Exceeded by 2037
Scenario 2: Low	2031
Scenario 3: High	2024
Scenario 4: Build-Out	2027

Limitations on Potential New Developments

New developments have the potential to significantly increase demand on the water system. This assessment assumed that the full 0.48 MGD of new development demand would be gradually introduced over the 20 year period. However, often new developments are implemented in blocks, such that a sudden increase in demands could be experienced.

Table 7 shows that the WTP capacity would be exceeded if approximately 0.25 MGD of ADD from new developments were added to the system. This would result in a MDD of 3.6 MGD. Therefore, it is recommended that NID expand the LWW WTP prior to approving new developments that could exceed an ADD of approximately 0.25 MGD. This would be equivalent to approximately 820 new residential dwelling unit connections. As shown in Table 4, approximately 1,400 new residential developments are proposed for the LWW and Penn Valley areas. This residential development is in addition to the existing mobile home (currently served by a well) and commercial developments shown in Table 4.

Table 7. Limitations on Proposed Future Developments

	ADD (MGD)	MDD (MGD)
Existing Demand (2006-2014 Average)	1.19	2.97
Additional Build-out Demand to Reach WTP Capacity[1]	0.25	0.63
Total Allowable Demand Given WTP Capacity (3.6 MGD)	1.44	**3.6**

(1) Scenario 4 assumes that all proposed developments are implemented. Full build-out of proposed developments would result in an additional 0.48 MGD of ADD. This would result in a MDD of 4.16 MGD, which exceeds the capacity of the LWW WTP.

It should be noted that this analysis assumes a constant per capita water use over time. As discussed, the 2006 to 2014 average value of 164 gpcd was used in all four scenarios. In reality, per capita water use is a dynamic variable. Over the long term, this variable can be influenced by trends in temperature and precipitation, changes in state policies, local demand-management programs, land development practices, and landscaping choices made by NID customers. The recent state-wide drought and associated policies, news coverage, and changes in public opinion may also affect per capita use in the coming years, but these effects cannot be predicted with certainty. Therefore, it is recommended that NID continue to monitor per capita water use rates closely and periodically evaluate if actual per capita water use varies significantly from the value used in this water demand forecast.

References

Nevada Irrigation District. 2015. *Final Technical memorandum: Penn Valley Fire Flow Analysis Project*. Table 3. Prepared by IDModeling, Inc. for Nevada Irrigation District. July, 2015.

Nevada Irrigation District. 2016. *201 5 Urban Water Management Plan*. Table 2-3. Prepared by Brown and Caldwell for Nevada Irrigation District. June, 2016.

Attachment A

Nevada County provided the following data to support the estimate of build-out in the Lake Wildwood area.

Lake Wildwood Sanitation District Unimproved Estimated Build-Out Potential

Potential Lots/Units	Zoning
1	R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
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1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD

Legend:
R1= Residential
PD = Planned Development
IDR = Interim Development Reserve
C1=commercial
OS=Open Space

Potential Lots/Units	*Zoning*
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
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1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD

Potential Lots/Units	Zoning
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
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1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD

Potential Lots/Units	Zoning
1	R1-PD-SP
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	IDR-R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
1	R1-PD
2	R1-PD
2	R1-PD
2	R1-PD
2	IDR-R1-PD
2	R1-PD
2	R1-PD
2	R1-PD
2	R1-PD
2	IDR-R1-PD
2	R1-PD
2	R1-PD
2	IDR-R1-PD
2	R1-PD
2	IDR-R1-PD
2	IDR-R1-PD
2	R1-PD
2	R1-PD
2	R1-PD
2	IDR-R1-PD
2	R1-PD
2	IDR-R1-PD
2	IDR-R1-PD

Potential Lots/Units	Zoning
2	R1-PD
2	R1-PD
2	R1-PD
2	R1-PD-SP
2	R1-PD
2	R1-PD-SP
2	R1-PD
2	IDR-R1-PD
3	R1-PD-SP
3	R1-PD
3	R1-PD
4	R1-PD
4	R1-PD
4	R1-PD
4	R1-PD
5	R1-PD
8	IDR-R1-PD
8	C1
9	R1-PD
100*	R1-PD
671*	R1-PD,OS,OS,OS
1,009 (626)*	

* Site is "Wildwood Ridge" Development which was approved for 388 residential units (1,009-771=238+388=626)

Appendix A-2: Demand Analysis Data and Calculations

Nevada Irrigation District - Lake Wildwood Water Treatment Plant
Historic Water Demand Summary Table

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average (2006-2015)	Avg (2006-2014)
Total Population	7,579	7,178	7,194	7,194	7,189	7,173	7,173	7,142	7,103	8,969	7,389	7,214
Total Production (MG)	482	482	498	449	406	373	415	429	364	310	421	433
Per Capita Demand (gpcd)	174	184	190	171	155	142	158	164	140	95	157	164
Total Production =ADD (MGD)	1.32	1.32	1.36	1.23	1.11	1.02	1.14	1.17	1.00	0.85	1.15	1.19
ADD (MGD)	1.32	1.32	1.36	1.23	1.11	1.02	1.14	1.17	1.00	0.85	1.15	1.19
												1.19

Reference Data:

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Annual Average	Avg (2006-2014)
Total Population	7,579	7,178	7,194	7,194	7,189	7,173	7,173	7,142	7,103	8,969	7,389	
Total Active Connections	3,158	3,176	3,184	3,183	3,181	3,174	3,174	3,160	3,143	3,188	3,172	3,170
Total Consumption (MG)	452	452	468	419	385	356	410	393	337	287	396	
Total Production (MG)	482	482	498	449	406	373	415	429	364	310	421	
Total Consumption (MGD)	1.24	1.24	1.28	1.15	1.05	0.98	1.12	1.08	0 92	0.79	1	
Annual Average (gpapd)	418	416	429	386	350	322	358	372	318	267	363	374
Annual Average (gpcd)	163	173	178	160	147	136	157	151	130	88	148	
Total Production (MGD)	1.32	1.32	1.36	1.23	1.11	1.02	1.14	1.17	1.00	0.85	1.15	
DSL	6%	6%	6%	7%	5%	4%	1%	8%	7%	8%	6%	
Adjusted for DSL (gpapd)	418	416	429	386	350	322	358	372	318	267	363	
Adjusted for DSL (gpcd)	174	184	190	171	155	142	158	164	140	95	157	

	2006-2015	2006-2014
Population growth rate	1.8%	-0.7%
Production growth rate	-3.6%	-2.7%
gpcd growth rate	-4.6%	-2.1%
Connection growth rate	0.1%	-0.1%

Conversion Factors

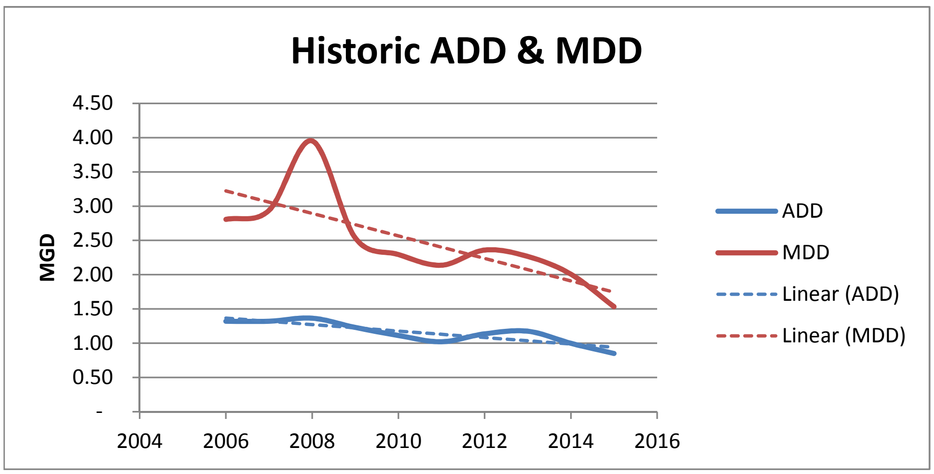
Days/year	365
gal to MG	1,000,000
ccf to MG	0.001

NID gpcd 2020 target: 197 gpcd
Source: NID2015_UWMP-6-01-16

Nevada Irrigation District - Lake Wildwood Water Treatment Plant
Historic Average Day and Max Day Demand

ADD, MDD, PHD (MGD)				
Year	**ADD**	**MDD**	**Peaking Factor**	
2006	1.32	2.81	2.1	
2007	1.32	2.94	2.2	
2008	1.36	3.95	2.9	Note: 2008 MDD not included in analysis, since there was an error in this data
2009	1.23	2.54	2.1	
2010	1.11	2.29	2.1	
2011	1.02	2.14	2.1	
2012	1.14	2.36	2.1	
2013	1.17	2.27	1.9	
2014	1.00	2.01	2.0	
2015	0.85	1.53	1.8	Note: 2015 Not included in analysis, since 2015 was an abnormal year
Annual Average	**1.19**	**2.42**	**2.1**	

Values based on water production at the LWW WTP, not consumption. This
Source: LWW Annual Reports
Lake Wildwood Max Days-Months



Nevada Irrigation District - Lake Wildwood Water Treatment Plant

Future Demand Scenarios 2006-2015 Avg

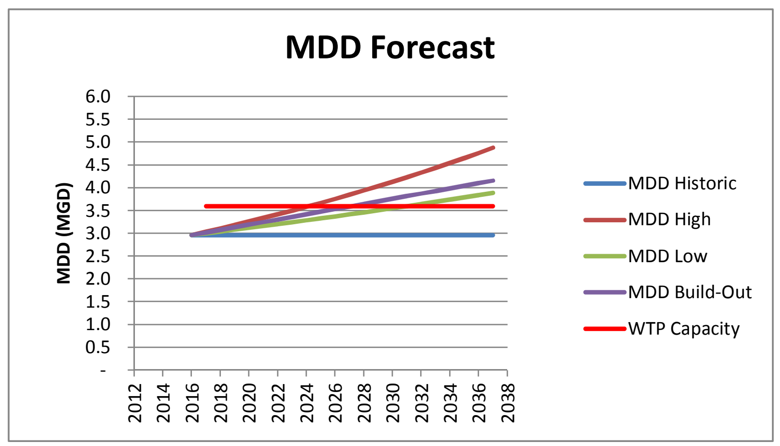
Scenario 1: Historic	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
ADD (MGD) (2006-2014 avg)	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
MDD (MGD)	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
Population	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214	7,214
Water Use (ADD)	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
Connections	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170	3,170
Water Use (ADD)	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
Water Use (MDD)	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
Scenario 3: High																						
ADD (MGD)	1.19	1.21	1.24	1.27	1.30	1.34	1.37	1.40	1.43	1.47	1.50	1.54	1.58	1.61	1.65	1.69	1.73	1.78	1.82	1.86	1.91	1.95
MDD (MGD)	2.97	3.04	3.11	3.18	3.26	3.34	3.42	3.50	3.59	3.67	3.76	3.85	3.94	4.04	4.13	4.23	4.33	4.44	4.55	4.65	4.77	4.88
Scenario 2: Low																						
ADD (MGD)	1.19	1.20	1.22	1.23	1.25	1.27	1.28	1.30	1.32	1.33	1.35	1.37	1.39	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.54	1.56
MDD (MGD)	2.97	3.00	3.04	3.08	3.12	3.16	3.20	3.25	3.29	3.33	3.37	3.42	3.46	3.51	3.55	3.60	3.65	3.69	3.74	3.79	3.84	3.89
Scenario 4: Build-Out (includes PV & LWW Future Developments)																						
ADD (MGD)	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.35	1.37	1.39	1.41	1.44	1.46	1.48	1.50	1.53	1.55	1.57	1.60	1.62	1.64	1.66
MDD (MGD)	2.97	3.02	3.08	3.14	3.19	3.25	3.31	3.36	3.42	3.48	3.53	3.59	3.65	3.70	3.76	3.82	3.88	3.93	3.99	4.05	4.10	4.16
New Development		0.02	0.05	0.07	0.09	0.11	0.14	0.16	0.18	0.20	0.23	0.25	0.27	0.30	0.32	0.34	0.36	0.39	0.41	0.43	0.45	0.48
Max Capacity	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60

Growth Rates:		check compound annual growth rate equation:
Historic	0.0%	0.0%
low	1.3%	1.3%
high	2.4%	2.4%
Buildout	1.6%	
Source,Table 2-3	NID2015_UWMP-6-01-16	

Development trigger = 0.41 MGD

Equivalent all 1,363.92

MDD/ADD ratio (planning value)	2.5
LWW WTP Capacity (MGD)	4.0
Total Future Development (MGD)	0.48
Annual Development (MGD)	0.02



Summary Table

Scenario 1: Historic	**2017**	**2027**	**2037**
ADD (MGD)	1.19	1.19	1.19
MDD (MGD)	2.97	2.97	2.97
Scenario 2: Low			
ADD (MGD)	1.20	1.37	1.56
MDD (MGD)	3.00	3.42	3.89
Scenario 3: High			
ADD (MGD)	1.21	1.54	1.95
MDD (MGD)	3.04	3.85	4.88
Scenario 4: Build-Out			
ADD (MGD)	1.21	1.44	1.66
MDD (MGD)	3.02	3.59	4.16

	ADD (MGD)	**MDD (MGD)**
Existing Demand (2006-2014 Ave	1.19	2.97
Additional Build-out Demand to R	0.41	1.02
Total WTP Capacity	1.60	3.99
Full Build-Out Demand	0.48	1.19
	1.66	4.16

(1) Full build-out would result in an additional 0.48 MGD of ADD. This would result in a MDD of 4.16 MGD, which exceeds the capcity of the LWW WTP.

Appendix B-1: Alternative Alignment Construction Costs

Alternative Alignments Comparative Costs

Constructibilty Factor Key

Description of Alignment	**Factor**
Overland construction, flat terrain	1
Pipe supported on bridge	3
Pipe support structure	5
Pavement demo and restoration (add)	0.25
Pavement addition (add)	0.15
Extra rock, flat ground (add)	0.5
Light traffic (add)	0.1
Heavy traffic (add)	0.2
Clearing and grubbing off road areas (add)	1.5

Cost Estimate Key		
Easement Costs / SF	4	$/SF
Pipeline Diameter	12	inch
Easement Width	15	Feet

Summary	
Alignment	**Total Cost**
1	$ 12,642,000
2	$ 10,808,000
3	$ 11,240,000
4	$ 11,177,000

Alignment 1

Section	Base Cost	Constructibility Factor	Weighted CF	Unit Cost	Length (ft)	Construction Cost	Easement Required	Easement Footage	Easement Costs
Bitney Springs Rd, Pleasant Valley Rd	$ 180.00	1.45	1.33	$ 261.00	42645.5	$ 11,130,475.50	No	0	
Bridge Crossing, supported on bridge	$ 180.00	3.2	0.01	$ 576.00	200	$ 115,200.00	No	0	
Areas without Road to WTP	$ 180.00	2.5	0.09	$ 450.00	1700	$ 765,000.00	Yes	1700	$ 102,000
Unpaved road to WTP	$ 180.00	1.15	0.05	$ 207.00	1981.5	$ 410,170.50	Yes	1981.5	$ 118,890
Total			**1.34**		**46527**	**$ 12,420,846.00**		**3681.5**	**$ 220,890**

Alignment 2

Section	Base Cost	Adjustment Factor	Weighted CF	Unit Cost	Length (ft)	Construction Cost	Easement Required	Easement Footage	Easement Costs
Rough and Ready Highway to Penn Valley Dr	$ 180.00	1.45	0.86	$ 261.00	24125	$ 6,296,625.00	No	0	
Rough and Ready Road up to Riffle Box Rd	$ 180.00	1.35	0.31	$ 243.00	9268	$ 2,252,075.40	No	0	
Non-County Maintained Road	$ 180.00	1.15	0.13	$ 207.00	4600	$ 952,200.00	Yes	4600	$ 276,000
Areas without Road	$ 180.00	2.5	0.06	$ 450.00	897	$ 403,650.00	Yes	897	$ 53,820
Bridge Crossing on Penn Valley Dr	$ 180.00	5.2	0.01	$ 936.00	100	$ 93,600.00	Yes	100	$ 6,000
Rocky Area on Rough and Ready Hwy	$ 180.00	1.55	0.06	$ 279.00	1700	$ 474,300.00	No	0	
Total			**1.43**		**40690**	**$ 10,472,450.40**		**5597**	**$ 335,820**

Alignment 3

Section	Base Cost	Constructibility Factor	Weighted CF	Unit Cost	Length (ft)	Construction Cost	Easement Required	Easement Footage	Easement Costs
Rough and Ready Highway to Penn Valley Dr	$ 180.00	1.45	0.86	$ 261.00	24125	$ 6,296,625.00	No	0	
Cook Road to Dolomite Ct	$ 180.00	1.35	0.14	$ 243.00	4230	$ 1,027,890.00	No	0	
Non-County Maintained Road	$ 180.00	1.15	0.18	$ 207.00	6359	$ 1,316,313.00	Yes	6359	$ 381,540
Areas without Road	$ 180.00	2.5	0.19	$ 450.00	3106	$ 1,397,700.00	Yes	3106	$ 186,360
Bridge Crossing on Cook Rd	$ 180.00	5.2	0.01	$ 936.00	60	$ 56,160.00	Yes	60	$ 3,600
Bridge Crossing on Penn Valley Dr	$ 180.00	5.2	0.01	$ 936.00	100	$ 93,600.00	Yes	100	$ 6,000
Rocky Area on Rough and Ready Hwy	$ 180.00	1.55	0.06	$ 279.00	1700	$ 474,300.00	No	0	
Total			**1.46**		**39680**	**$ 10,662,588.00**		**9625**	**$ 577,500**

Alignment 4

Section	Base Cost	Constructibility Factor	Weighted CF	Unit Cost	Length (ft)	Construction Cost	Easement Required	Easement Footage	Easement Costs
Rough and Ready Highway to Penn Valley Dr	$ 180.00	1.45	0.86	$ 261.00	24125	$ 6,296,625.00	No	0	
Valley Dr.	$ 180.00	1.35	0.12	$ 243.00	3607	$ 876,501.00	No	0	
Non-County Maintained Road	$ 180.00	1.15	0.19	$ 207.00	6637	$ 1,373,941.80	Yes	6637.4	$ 398,244
Areas without Road	$ 180.00	2.5	0.20	$ 450.00	3251	$ 1,462,770.00	Yes	3250.6	$ 195,036
Bridge Crossing on Penn Valley Dr	$ 180.00	5.2	0.01	$ 936.00	100	$ 93,600.00	Yes	100	$ 6,000
Rocky Area on Rough and Ready Hwy	$ 180.00	1.55	0.06	$ 279.00	1700	$ 474,300.00	No	0	
Total			**1.44**		**39420**	**$ 10,577,737.80**		**9988**	**$ 599,280**

Appendix B-2: Hydroelectric Unit Cost Estimates

	Option 1-1				Option 1-2				Option 2-1				Option 2-2			
	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended
Turbine-generator	150	kW	$ 1,250	$ 187,500	410	kW	$ 1,250	$ 512,500	180	kW	$ 1,250	$ 225,000	310	kW	$ 1,250	$ 387,500
Switchgear	1	LS	$ 100,000	$ 100,000	3	LS	$ 100,000	$ 300,000	1	LS	$ 100,000	$ 100,000	3	LS	$ 100,000	$ 300,000
Powerhouse (20'x30')																
Concrete (foundation, tailrace)	50	CY	$ 1,000	$ 50,000	150	CY	$ 1,000	$ 150,000	50	CY	$ 1,000	$ 50,000	150	CY	$ 1,000	$ 150,000
Structure (CMU)	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000
Roof (trusses, metal roofing)	1	LS	$ 15,000	$ 15,000	3	LS	$ 15,000	$ 45,000	1	LS	$ 15,000	$ 15,000	3	LS	$ 15,000	$ 45,000
Electrical (lighting, fans, station service)	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000
Transformer (480V/12.47)	150	kVA	$ 50	$ 7,500	410	kVA	$ 50	$ 20,500	180	kVA	$ 50	$ 9,000	310	kVA	$ 50	$ 15,500
SCADA/Communications	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000	1	LS	$ 75,000	$ 75,000	3	LS	$ 75,000	$ 225,000
Transmission/interconnection	1	LS	$ 100,000	$ 100,000	3	LS	$ 100,000	$ 300,000	1	LS	$ 100,000	$ 100,000	3	LS	$ 100,000	$ 300,000
Subtotal				$ 685,000				$ 2,003,000				$ 724,000				$ 1,873,000
Engineering			15%	$ 110,000			15%	$ 310,000			15%	$ 110,000			15%	$ 290,000
Contingency			30%	$ 210,000			30%	$ 610,000			30%	$ 220,000			30%	$ 570,000
Total (rounded)				$ 1,010,000				$ 2,920,000				$ 1,050,000				$ 2,730,000

	Alignment 1		Alignments 2-4		Option 3		Option 4	
	1 Unit	2 Units	1 Unit	2 Units	1 Unit	2 Units	1 Unit	2 Units
Head Available (psi)	194	350	230	350	230	350	230	350
Flow (MGD)	2.9	1.45	2.9	1.45	2.9	1.45	2.9	1.45
Generator Size (kW)	150	130 (x 2)	180	130 (x 2)	180	130 (x 2)	180	130 (x 2)
Capital Cost	$ 1,010,000	$ 2,920,000	$ 1,050,000	$ 2,730,000	$ 1,050,000	$ 2,940,000	$ 1,050,000	$ 2,920,000
NPV of 22-year Revenue	$510,000	$1,930,000	$670,000	$1,340,000	$670,000	$4,150,000	$670,000	$4,080,000
B/C	0.50	0.66	0.64	0.49	0.64	1.41	0.64	1.40

	Option 1-1				Option 1-2				Option 2-1				Option 2-2				Option 3				Op ion 4			
	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended	Quantity	Unit	Unit Price	Extended
Turbine-generator	200	kW	$ 1,250	$ 250,000	260	kW	$ 1,250	$ 325,000	200	kW	$ 1,250	$ 250,000	260	kW	$ 1,250	$ 325,000	210	kW	$ 1,250	$ 262,500	260	kW	$ 1,250	$ 325,000
Switchgear	1	LS	$ 100,000	$ 100,000	2	LS	$ 100,000	$ 200,000	1	LS	$ 100,000	$ 100,000	2	LS	$ 100,000	$ 200,000	1	LS	$ 100,000	$ 100,000	1	LS	$ 100,000	$ 100,000
Powerhouse (20'x30')																								
Concrete (foundation, tailrace)	50	CY	$ 1,000	$ 50,000	100	CY	$ 1,000	$ 100,000	50	CY	$ 1,000	$ 50,000	100	CY	$ 1,000	$ 100,000	50	CY	$ 1,000	$ 50,000	50	CY	$ 1,000	$ 50,000
Structure (CMU)	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	1	LS	$ 75,000	$ 75,000
Roof (trusses, metal roofing)	1	LS	$ 15,000	$ 15,000	2	LS	$ 15,000	$ 30,000	1	LS	$ 15,000	$ 15,000	2	LS	$ 15,000	$ 30,000	1	LS	$ 15,000	$ 15,000	1	LS	$ 15,000	$ 15,000
Electrical (lighting, fans, station service)	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	1	LS	$ 75,000	$ 75,000
Transformer (480V/12.47)	200	kVA	$ 50	$ 10,000	260	kVA	$ 50	$ 13,000	200	kVA	$ 50	$ 10,000	260	kVA	$ 50	$ 13,000	210	kVA	$ 50	$ 10,500	260	kVA	$ 50	$ 13,000
SCADA/Communications	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	2	LS	$ 75,000	$ 150,000	1	LS	$ 75,000	$ 75,000	1	LS	$ 75,000	$ 75,000
Transmission/interconnec ion	1	LS	$ 100,000	$ 100,000	2	LS	$ 100,000	$ 200,000	1	LS	$ 100,000	$ 100,000	2	LS	$ 100,000	$ 200,000	1	LS	$ 100,000	$ 100,000	1	LS	$ 100,000	$ 100,000
Subtotal				$ 750,000				$ 1,318,000				$ 750,000				$ 1,318,000				$ 763,000				$ 828,000
Engineering			15%	$ 120,000			15%	$ 200,000			15%	$ 120,000			15%	$ 200,000			15%	$ 120,000			15%	$ 130,000
Con ingency			30%	$ 230,000			30%	$ 400,000			30%	$ 230,000			30%	$ 400,000			30%	$ 230,000			30%	$ 250,000
Total (rounded)				$ 1,100,000				$ 1,920,000				$ 1,100,000				$ 1,920,000				$ 1,110,000				$ 1,210,000

Turbine Sizing (example)		
Q	2.9	MGD
H	276	psi
W2W efficiency	0.85	
kW	207	

Economic Parameters	
Base rate (/kWh)	$ 0.0892
Escala ion	4 00%
Inflation	2 00%
Discount	4 00%
O&M	$ 18,000

Future Water Supply

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Total Supply																						
ADD (MGD)	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.35	1.37	1.39	1.41	1.44	1.46	1.48	1.50	1.53	1.55	1.57	1.60	1.62	1.64	1.66
MDD (MGD)	2.97	3.02	3.08	3.14	3.19	3.25	3.31	3.36	3.42	3.48	3.53	3.59	3.65	3.70	3.76	3.82	3.88	3.93	3.99	4.05	4.10	4.16
Flow in New Pipeline																						
ADD (MGD)	0.83	0.85	0.86	0.88	0.89	0.91	0.93	0.94	0.96	0.97	0.99	1.01	1 02	1.04	1.05	1.07	1.09	1.10	1.12	1.13	1.15	1.17
MDD (MGD)	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.36	2.40	2.44	2.48	2.52	2 56	2.60	2.63	2.67	2.71	2.75	2.79	2.83	2 87	2 91
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Annual Energy, MWh	516	526	536	546	556	566	575	585	595	605	615	625	635	645	655	664	674	684	694	704	714	724
Rate	$ 0.0892	$ 0.0928	$ 0.0965	$ 0.1004	$ 0.1044	$ 0.1086	$ 0.1129	$ 0.1174	$ 0.1221	$ 0.1270	$ 0.1321	$ 0.1374	$ 0.1429	$ 0.1486	$ 0.1545	$ 0.1607	$ 0.1671	$ 0.1738	$ 0.1808	$ 0.1880	$ 0.1955	$ 0.2033
Revenue	$ 46,053	$ 48,813	$ 51,720	$ 54,782	$ 58,005	$ 61,399	$ 64,972	$ 68,732	$ 72,689	$ 76,853	$ 81,233	$ 85,841	$ 90,687	$ 95,784	$ 101,144	$ 106,779	$ 112,703	$ 118,930	$ 125,474	$ 132,353	$ 139,580	$ 147,175
Expenses	$ (18,000)	$ (18,360)	$ (18,727)	$ (19,102)	$ (19,484)	$ (19,873)	$ (20,271)	$ (20,676)	$ (21,090)	$ (21,512)	$ (21,942)	$ (22,381)	$ (22,828)	$ (23,285)	$ (23,751)	$ (24,226)	$ (24,710)	$ (25,204)	$ (25,708)	$ (26,223)	$ (26,747)	$ (27,282)
Net Revenue	$ 28,053	$ 30,453	$ 32,993	$ 35,680	$ 38,522	$ 41,526	$ 44,701	$ 48,056	$ 51,599	$ 55,341	$ 59,291	$ 63,460	$ 67,859	$ 72,499	$ 77,393	$ 82,553	$ 87,992	$ 93,725	$ 99,766	$ 106,130	$ 112,833	$ 119,893
Cummulative Net Revenue	$ 28,053	$ 58,507	$ 91,500	$ 127,180	$ 165,701	$ 207,227	$ 251,928	$ 299,984	$ 351,583	$ 406,924	$ 466,215	$ 529,675	$ 597,533	$ 670,033	$ 747,426	$ 829,978	$ 917,971	$ 1,011,696	$ 1,111,462	$ 1,217,592	$ 1,330,426	$ 1,450,318

NPV	$860,000
Avg. Annual Energy (MWh)	620

Appendix B-3: WTP Alternative Cost Estimates

Job Number: 272811

Computation

Project:	Lake Wildwood WTP Evaluation	**Computed:**	RS
Subject:	Preliminary Cost Estimate	**Date:**	4/6/2017
Task:	Alternative 1-A -Upgrade and Expand Existing Treatment System	**Reviewed:**	
	Capacity = 5.5 mgd	**Date:**	

	DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
DIVISION 1 - GENERAL REQUIREMENTS					
	Mobilization	1	LS	2.50%	$ 99,884
	Start-up and commissioning	1	LS	2.50%	$ 99,884
	Demobilization	1	LS	2.50%	$ 99,884
	Bonds, Insurance, General Conditions	1	LS	5.00%	$ 199,768
	SUBTOTAL				**$ 499,419**
DIVISION 2 - SITE WORK					
	Demolition of clarifiers	1	LS	$ 20,000.00	$ 20,000
	Site grading for new plate settlers and filter	1	LS	$ 12,000.00	$ 12,000
	Excavation of canal for new screen	1	LS	$ 7,000.00	$ 7,000
	Soil cement sludge lagoon	10000	SF	$ 20.00	$ 200,000
	Modular Retaining Walls	3000	SF	$ 18.00	$ 54,000
	SUBTOTAL				**$ 293,000**
DIVISION 3 - CONCRETE					
	Hydraulic Structure for Coanda Screen	10	CY	$ 1,500.00	$ 15,000
	Flocculation and Plate Settler Basins (common wall)	440	CY	$ 1,200.00	$ 528,000
	Pad for New Filter	10	CY	$ 900.00	$ 9,000
	Pad for UV Equipment	15	CY	$ 900.00	$ 13,500
	SUBTOTAL				**$ 565,500**
DIVISION 4 - MASONRY					
					$ -
	SUBTOTAL				**$ -**
DIVISION 5 - MISCELLANEOUS METAL					$ -
	Miscellaneous supports, walkways and stairs	1	LS	$ 35,000.00	$ 35,000
	Refurbish filter tanks	1	LS	$ 36,000.00	$ 36,000
	SUBTOTAL				**$ 36,000**
DIVISION 7 - THERMAL AND MOISTURE CONNECTION					
	SUBTOTAL				**$ -**
DIVISION 8 - DOORS AND WINDOWS					
					$ -
	SUBTOTAL				**$ -**
DIVISION 9 - FINISHES					
	Painting and Protective Coatings (piping, filters, and equipment)	1	LS	$ 48,000.00	$ 48,000
	SUBTOTAL				**$ 48,000**
DIVISION 10 - SPECIALTIES					
	Identification, Stenciling, and Tagging System	1	LS	$ 1,500.00	$ 1,500
	SUBTOTAL				**$ 1,500**
DIVISION 11 - EQUIPMENT					
	Coanda Screen	1	EA	$ 25,000	$ 25,000
	Floating decanter	2	EA	$ 22,500	$ 45,000
	Flocculators	2	EA	$ 65,000	$ 130,000
	Flocculators installation	2	EA	$ 16,250	$ 32,500
	SST Plate Settlers	2	EA	$ 165,000	$ 330,000
	SST Plate Settlers installation	2	EA	$ 41,250	$ 82,500
	Sludge Collectors	2	EA	$ 40,000	$ 80,000
	Sludge Collectors installation	2	EA	$ 10,000	$ 20,000
	UV Disinfection System (1 duty, 1 standby)	1	LS	$ 209,000	$ 209,000
	UV Disinfection Unit installation	1	LS	$ 52,250	$ 52,250
	Backwash Pumps	2	EA	$ 37,500	$ 75,000
	Air Scour Blower	1	EA	$ 35,000	$ 35,000
	New circular filter	2	EA	$ 200,000	$ 400,000
	SUBTOTAL				**$ 1,516,250**
DIVISION 13 - SPECIAL CONSTRICTION					
	Pre-engineered metal canopy for UV equipment	400	SF	$ 60.00	$ 24,000
					$ -
	SUBTOTAL				**$ 24,000**
DIVISION 15 - MECHANICAL					
	Piping connection to new Flocculation/Plate Settlers	1	LS	$ 16,000	$ 16,000
	Replace Existing Filter Valves	1	LS	$ 100,000	$ 100,000
	Replace piping in poor condition	1	LS	$ 200,000	$ 200,000
	Piping to new sludge lagoon	1	LS	$ 20,000	$ 20,000
	Piping for UV System	1	LS	$ 25,000	$ 25,000
					$ -
					$ -
	SUBTOTAL				**$ 361,000**
	SUBTOTAL DIVISIONS 2-15				**$ 2,845,250**
DIVISION 16 - ELECTRICAL					
	Electrical panels and wiring	30	%	Div 2-15	$ 853,575
	Lighting	1	LS	$ 12,000	$ 12,000
	SUBTOTAL				**$ 865,575**
DIVISION 17 - INSTRUMENTATION					
	Controls and Programming	10	%	Div 2-15	$ 284,525
	SUBTOTAL				**$ 284,525**

ONSITE CONSTRUCTION (LESS DIV 1) SUBTOTAL	$ 3,995,350
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$ 499,419
SUBTOTAL	$ 4,494,769
OH & PROFIT (15%)	$ 674,215
SUBTOTAL	$ 5,168,984
CONTINGENCY (30%)	$ 1,550,695
ENGINEERING AND CM (20%)	$ 1,033,797
GRAND TOTAL	$ 7,753,000

Job Number:		

Computation

Project:	Lake Wildwood WTP Evaluation	**Computed:**	RS
Subject:	Preliminary Cost Estimate	**Date:**	4/6/2017
Task:	Alternative 1-B -New Modular Treatment Plant	**Reviewed:**	
	Capacity = 5.5 mgd	**Date:**	

	DESCRIPTION	**QUANTITY**	**UNITS**	**UNIT COST**	**TOTAL COST**
DIVISION 1 - GENERAL REQUIREMENTS					
	Mobilization	1	LS	2.50%	$ 110,283
	Start-up and commissioning	1	LS	2.50%	$ 110,283
	Demobilization	1	LS	2.50%	$ 110,283
	Bonds, Insurance, General Conditions	1	LS	5.00%	$ 220,566
	SUBTOTAL				**$ 551,414**
DIVISION 2 - SITE WORK					
	Demolition of clarifiers and filters	1	LS	$ 35,000.00	$ 35,000
	Site grading for new treatment modules	1	LS	$ 12,000.00	$ 12,000
	Excavation of canal for new screen	1	LS	$ 7,000.00	$ 7,000
	Modular Retaining Walls	3000	SF	$ 18.00	$ 54,000
	Soil cement sludge lagoon	10,000	SF	$ 20.00	$ 200,000
	SUBTOTAL				**$ 308,000**
DIVISION 3 - CONCRETE					
	Hydraulic Structure for Coanda Screen	10	CY	$ 1,500.00	$ 15,000
	Pad for Modular Treatment Units	100	CY	$ 900.00	$ 90,000
	Pad for UV Equipment	15	CY	$ 900.00	$ 13,500
	SUBTOTAL				**$ 118,500**
DIVISION 4 - MASONRY					
					$ -
	SUBTOTAL				**$ -**
DIVISION 5 - MISCELLANEOUS METAL					$ -
	Miscellaneous supports, walkways and stairs	1	LS	$ 25,000.00	$ 25,000
	SUBTOTAL				**$ -**
DIVISION 7 - THERMAL AND MOISTURE CONNECTION					
	SUBTOTAL				**$ -**
DIVISION 8 - DOORS AND WINDOWS					
					$ -
	SUBTOTAL				**$ -**
DIVISION 9 - FINISHES					
	Painting and Protective Coatings (piping and equipment)	1	LS	$ 35,000.00	$ 35,000
	SUBTOTAL				**$ 35,000**
DIVISION 10 - SPECIALTIES					
	Identification, Stenciling, and Tagging System	1	LS	$ 1,000.00	$ 1,000
	SUBTOTAL				**$ 1,000**
DIVISION 11 - EQUIPMENT					
	Coanda Screen	1	EA	$ 25,000	$ 25,000
	Floating decanter	2	EA	$ 22,500	$ 45,000
	Modular Treatment Unit (2 mgd each)	3	EA	$ 500,000	$ 1,500,000
	Modular Treatment Unit installation	3	EA	$ 125,000	$ 375,000
	UV Disinfection System (1 duty, 1 standby)	1	LS	$ 209,000	$ 209,000
	UV Disinfection Unit installation	1	LS	$ 52,250	$ 52,250
	Backwash Pumps	2	EA	$ 62,500	$ 125,000
	Air Scour Blower	1	EA	$ 50,000	$ 50,000
	SUBTOTAL				**$ 2,381,250**
DIVISION 13 - SPECIAL CONSTRICTION					
	Pre-engineered metal canopy for Modular Treatment Units	2200	SF	$ 60.00	$ 132,000
	Pre-engineered metal canopy for UV equipment	400	SF	$ 60.00	$ 24,000
					$ -
	SUBTOTAL				**$ 156,000**
DIVISION 15 - MECHANICAL					
	Piping connection to new Modular Treatment Units	1	LS	$ 24,000.00	$ 24,000
	Replace piping in poor condition	1	LS	$ 200,000.00	$ 200,000
	Piping to new sludge lagoon	1	LS	$ 20,000.00	$ 20,000
	Piping for UV System	1	LS	$ 15,000.00	$ 15,000
					$ -
					$ -
	SUBTOTAL				**$ 259,000**
	SUBTOTAL DIVISIONS 2-15				**$ 3,258,750**
DIVISION 16 - ELECTRICAL					
	Electrical panels and wiring	25	%	Div 2-15	$ 814,688
	Lighting	1	LS	$ 12,000	$ 12,000
	SUBTOTAL				**$ 826,688**
DIVISION 17 - INSTRUMENTATION					
	Controls and Programming	10	%	Div 2-15	$ 325,875
	SUBTOTAL				**$ 325,875**

ONSITE CONSTRUCTION (LESS DIV 1) SUBTOTAL	**$ 4,411,313**
(ADDITIVE FOR) DIVISION 1 (ABOVE)	**$ 551,414**
SUBTOTAL	**$ 4,962,727**
OH & PROFIT (15%)	**$ 744,409**
SUBTOTAL	**$ 5,707,136**
CONTINGENCY (30%)	**$ 1,712,141**
ENGINEERING AND CM (20%)	**$ 1,141,427**
GRAND TOTAL	$ 8,561,000

Job Number: 272811

Computation

Project:	Lake Wildwood WTP Evaluation			**Computed:**	RS
Subject:	Preliminary Cost Estimate			**Date:**	4/6/2017
Task:	Alternative 1-B -Upgrade Existing Treatment System			**Reviewed:**	
	Capacity = 2.5 mgd			**Date:**	

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
DIVISION 1 - GENERAL REQUIREMENTS					
	Mobilization	1	LS	2.50%	$ 60,334
	Start-up and commissioning	1	LS	2.50%	$ 60,334
	Demobilization	1	LS	2.50%	$ 60,334
	Bonds, Insurance, General Conditions	1	LS	5.00%	$ 120,668
	SUBTOTAL				**$ 301,669**
DIVISION 2 - SITE WORK					
	Demolition of clarifier	1	LS	$ 11,000.00	$ 11,000
	Excavation of canal for new screen	1	LS	$ 7,000	$ 7,000
	Modular Retaining Walls	2250	SF	$ 18.00	$ 40,500
	Soil cement sludge lagoon	5000	SF	$ 25.00	$ 125,000
	SUBTOTAL				**$ 183,500**
DIVISION 3 - CONCRETE					
	Hydraulic Structure for Coanda Screen	10	CY	$ 1,500.00	$ 15,000
	Flocculation and Plate Settler Basin	230	CY	$ 1,200.00	$ 276,000
	Pad for UV Equipment	15	CY	$ 900.00	$ 13,500
	SUBTOTAL				**$ 304,500**
DIVISION 4 - MASONRY					
					$ -
	SUBTOTAL				**$ -**
DIVISION 5 - MISCELLANEOUS METAL					$ -
	Miscellaneous supports, walkways and stairs	1	LS	$ 25,000	$ 25,000
	Refurbish clarifier	1	LS	$ 20,000	$ 20,000
	Refurbish filter tanks	1	LS	$ 36,000	$ 36,000
	SUBTOTAL				**$ 81,000**
DIVISION 7 - THERMAL AND MOISTURE CONNECTION					
	SUBTOTAL				**$ -**
DIVISION 8 - DOORS AND WINDOWS					
					$ -
	SUBTOTAL				**$ -**
DIVISION 9 - FINISHES					
	Painting and Protective Coatings (piping, filters, clarifiers and equipment)	1	LS	$ 90,000	$ 90,000
	SUBTOTAL				**$ 90,000**
DIVISION 10 - SPECIALTIES					
	Identification, Stenciling, and Tagging System	1	LS	$ 1,000.00	$ 1,000
	SUBTOTAL				**$ 1,000**
DIVISION 11 - EQUIPMENT					
	Coanda Screen	1	EA	$ 25,000	$ 25,000
	Floating decanter	2	EA	$ 22,500	$ 45,000
	Flocculators	1	EA	$ 65,000	$ 65,000
	Flocculators installation	1	EA	$ 16,250	$ 16,250
	SST Plate Settlers	1	EA	$ 156,000	$ 156,000
	SST Plate Settlers installation	1	EA	$ 39,000	$ 39,000
	Sludge Collectors	1	EA	$ 40,000	$ 40,000
	Sludge Collectors installation	1	EA	$ 10,000	$ 10,000
	UV Disinfection System (1 duty, 1 standby)	1	LS	$ 152,000	$ 152,000
	UV Disinfection Unit installation	1	LS	$ 38,000	$ 38,000
	Backwash Pumps	2	EA	$ 37,500	$ 75,000
	Air Scour Blower	1	EA	$ 35,000	$ 35,000
	SUBTOTAL				**$ 696,250**
DIVISION 13 - SPECIAL CONSTRICTION					
	Pre-engineered metal canopy for UV equipment	400	SF	$ 60.00	$ 24,000
					$ -
	SUBTOTAL				**$ 24,000**
DIVISION 15 - MECHANICAL					
	Replace Existing Filter Valves	1	LS	$ 100,000.00	$ 100,000
	Replace piping in poor condition	1	LS	$ 200,000.00	$ 200,000
	Piping to new sludge lagoon	1	LS	$ 20,000.00	$ 20,000
	Piping for UV System	1	LS	$ 15,000.00	$ 15,000
					$ -
					$ -
	SUBTOTAL				**$ 335,000**
	SUBTOTAL DIVISIONS 2-15				**$ 1,715,250**
DIVISION 16 - ELECTRICAL					
	Electrical panels and wiring	30	%	Div 2-15	$ 514,575
	Lighting	1	LS	$ 12,000	$ 12,000
	SUBTOTAL				**$ 526,575**
DIVISION 17 - INSTRUMENTATION					
	Controls and Programming	10	%	Div 2-15	$ 171,525
	SUBTOTAL				**$ 171,525**

ONSITE CONSTRUCTION (LESS DIV 1) SUBTOTAL	**$ 2,413,350**
(ADDITIVE FOR) DIVISION 1 (ABOVE)	**$ 301,669**
SUBTOTAL	**$ 2,715,019**
OH & PROFIT (15%)	**$ 407,253**
SUBTOTAL	**$ 3,122,272**
CONTINGENCY (30%)	**$ 936,681**
ENGINEERING AND CM (20%)	**$ 624,454**
GRAND TOTAL	$ 4,683,000

Job Number:					

Computation

Project:	Lake Wildwood WTP Evaluation			**Computed:**	RS
Subject:	Preliminary Cost Estimate			**Date:**	4/6/2017
Task:	Alternative 2-B -New Modular Treatment Plant			**Reviewed:**	
	Capacity = 2.5 mgd			**Date:**	

DESCRIPTION		**QUANTITY**	**UNITS**	**UNIT COST**	**TOTAL COST**
DIVISION 1 - GENERAL REQUIREMENTS					
	Mobilization	1	LS	2.50%	$ 69,353
	Start-up and commissioning	1	LS	2.50%	$ 69,353
	Demobilization	1	LS	2.50%	$ 69,353
	Bonds, Insurance, General Conditions	1	LS	5.00%	$ 138,705
	SUBTOTAL				**$ 346,763**
DIVISION 2 - SITE WORK					
	Demolition of clarifiers and filters	1	LS	$ 35,000.00	$ 35,000
	Site grading for new treatment modules	1	LS	$ 12,000.00	$ 12,000
	Excavation of canal for new screen	1	LS	$ 7,000.00	$ 7,000
	Modular Retaining Walls	2250	SF	$ 18.00	$ 40,500
	Soil cement sludge lagoon	5,000	SF	$ 25.00	$ 125,000
	SUBTOTAL				**$ 219,500**
DIVISION 3 - CONCRETE					
	Hydraulic Structure for Coanda Screen	10	CY	$ 15,000.00	$ 150,000
	Pad for Modular Treatment Units	70	CY	$ 900.00	$ 63,000
	Pad for UV Equipment	15	CY	$ 900.00	$ 13,500
	SUBTOTAL				**$ 226,500**
DIVISION 4 - MASONRY					
					$ -
	SUBTOTAL				**$ -**
DIVISION 5 - MISCELLANEOUS METAL					$ -
	Miscellaneous supports	1	LS	$ 15,000.00	$ 15,000
	SUBTOTAL				**$ -**
DIVISION 7 - THERMAL AND MOISTURE CONNECTION					
	SUBTOTAL				**$ -**
DIVISION 8 - DOORS AND WINDOWS					
					$ -
	SUBTOTAL				**$ -**
DIVISION 9 - FINISHES					
	Painting and Protective Coatings (piping and equipment)	1	LS	$ 25,000.00	$ 25,000
	SUBTOTAL				**$ 25,000**
DIVISION 10 - SPECIALTIES					
	Identification, Stenciling, and Tagging System	1	LS	$ 1,000.00	$ 1,000
	SUBTOTAL				**$ 1,000**
DIVISION 11 - EQUIPMENT					
	Coanda Screen	1	EA	$ 25,000	$ 25,000
	Floating decanter	2	EA	$ 22,500	$ 45,000
	Modular Treatment Unit (1.0 mgd each)	3	EA	$ 250,000	$ 750,000
	Modular Treatment Unit installation	2	EA	$ 62,500	$ 125,000
	UV Disinfection System (1 duty, 1 standby)	1	LS	$ 152,000	$ 152,000
	UV Disinfection Unit installation	1	LS	$ 38,000	$ 38,000
	Backwash Pumps	2	EA	$ 37,500	$ 75,000
	Air Scour Blower	1	EA	$ 35,000	$ 35,000
	SUBTOTAL				**$ 1,245,000**
DIVISION 13 - SPECIAL CONSTRICTION					
	Pre-engineered metal canopy for Modular Treatment Units	900	SF	$ 60.00	$ 54,000
	Pre-engineered metal canopy for UV equipment	400	SF	$ 60.00	$ 24,000
					$ -
	SUBTOTAL				**$ 78,000**
DIVISION 15 - MECHANICAL					
	Piping connection to new Modular Treatment Units	1	LS	$ 16,000.00	$ 16,000
	Replace piping in poor condition	1	LS	$ 200,000.00	$ 200,000
	Piping to new sludge lagoon	1	LS	$ 20,000.00	$ 20,000
	Piping for UV System	1	LS	$ 15,000.00	$ 15,000
					$ -
	SUBTOTAL				**$ 251,000**
	SUBTOTAL DIVISIONS 2-15				**$ 2,046,000**
DIVISION 16 - ELECTRICAL					
	Electrical panels and wiring	25	%	Div 2-15	$ 511,500
	Lighting	1	LS	$ 12,000	$ 12,000
	SUBTOTAL				**$ 523,500**
DIVISION 17 - INSTRUMENTATION					
	Controls and Programming	10	%	Div 2-15	$ 204,600
	SUBTOTAL				**$ 204,600**

ONSITE CONSTRUCTION (LESS DIV 1) SUBTOTAL	**$ 2,774,100**
(ADDITIVE FOR) DIVISION 1 (ABOVE)	**$ 346,763**
SUBTOTAL	**$ 3,120,863**
OH & PROFIT (15%)	**$ 468,129**
SUBTOTAL	**$ 3,588,992**
CONTINGENCY (30%)	**$ 1,076,698**
ENGINEERING AND CM (20%)	**$ 717,798**
GRAND TOTAL	$ 5,383,000

Appendix B-4: WTP O&M Cost Estimates

Operation and Maintenance Cost Opinion
Date: 5/25/17

Unit Costs:		
LWW O&M	$ 0.94	/ 1,000 gallons treated
E. George O&M	$ 0.70	/ 1,000 gallons treated

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Total Supply																						
ADD (MGD)	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.35	1.37	1.39	1.41	1.44	1.46	1.48	1.50	1.53	1.55	1.57	1.60	1.62	1.64	1.66
MDD (MGD)	2.97	3.02	3.08	3.14	3.19	3.25	3.31	3.36	3.42	3.48	3.53	3.59	3.65	3.70	3.76	3.82	3.88	3.93	3.99	4.05	4.10	4.16
Flow in New Pipeline																						
ADD (MGD)	0.83	0.85	0.86	0.88	0.89	0.91	0.93	0.94	0.96	0.97	0.99	1.01	1.02	1.04	1.05	1.07	1.09	1.10	1.12	1.13	1.15	1.17
MDD (MGD)	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.36	2.40	2.44	2.48	2.52	2.56	2.60	2.63	2.67	2.71	2.75	2.79	2.83	2.87	2.91
WTP Upgrades Only																						
LWW O&M	$ 405,499	$ 413,270	$ 421,040	$ 428,810	$ 436,580	$ 444,350	$ 452,120	$ 459,890	$ 467,660	$ 475,430	$ 483,200	$ 490,970	$ 498,740	$ 506,511	$ 514,281	$ 522,051	$ 529,821	$ 537,591	$ 545,361	$ 553,131	$ 560,901	$ 568,671
NPV	**$ 6,870,000**																					
WTP and Pipeline																						
E. George O&M	$ 211,108	$ 215,154	$ 219,199	$ 223,244	$ 227,289	$ 231,334	$ 235,380	$ 239,425	$ 243,470	$ 247,515	$ 251,560	$ 255,606	$ 259,651	$ 263,696	$ 267,741	$ 271,786	$ 275,832	$ 279,877	$ 283,922	$ 287,967	$ 292,012	$ 296,058
LWW O&M	$ 121,434	$ 123,761	$ 126,088	$ 128,415	$ 130,742	$ 133,069	$ 135,395	$ 137,722	$ 140,049	$ 142,376	$ 144,703	$ 147,030	$ 149,357	$ 151,684	$ 154,011	$ 156,337	$ 158,664	$ 160,991	$ 163,318	$ 165,645	$ 167,972	$ 170,299
Total	$ 332,542	$ 338,915	$ 345,287	$ 351,659	$ 358,031	$ 364,403	$ 370,775	$ 377,147	$ 383,519	$ 389,891	$ 396,263	$ 402,635	$ 409,008	$ 415,380	$ 421,752	$ 428,124	$ 434,496	$ 440,868	$ 447,240	$ 453,612	$ 459,984	$ 466,356
NPV	**$ 5,630,000**																					

Appendix C: Required System Improvements from Modeling

Lake Wildwood System: Extended Period Modeling Results

Existing Average Water Age – LWW Average Day Demand (1.2 mgd)

(using 20170125_LWWLUpdatedModel)

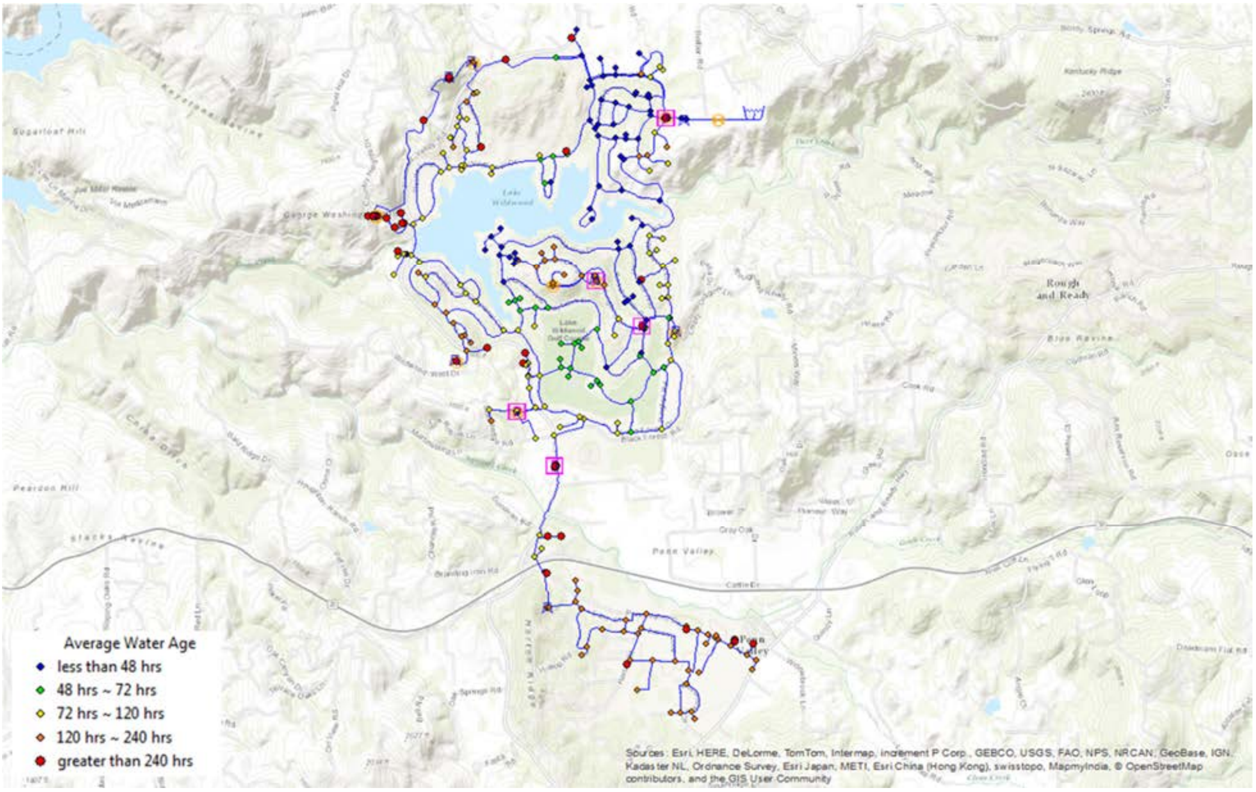


Figure 1. Existing LWW System Average Water Age (ADD)

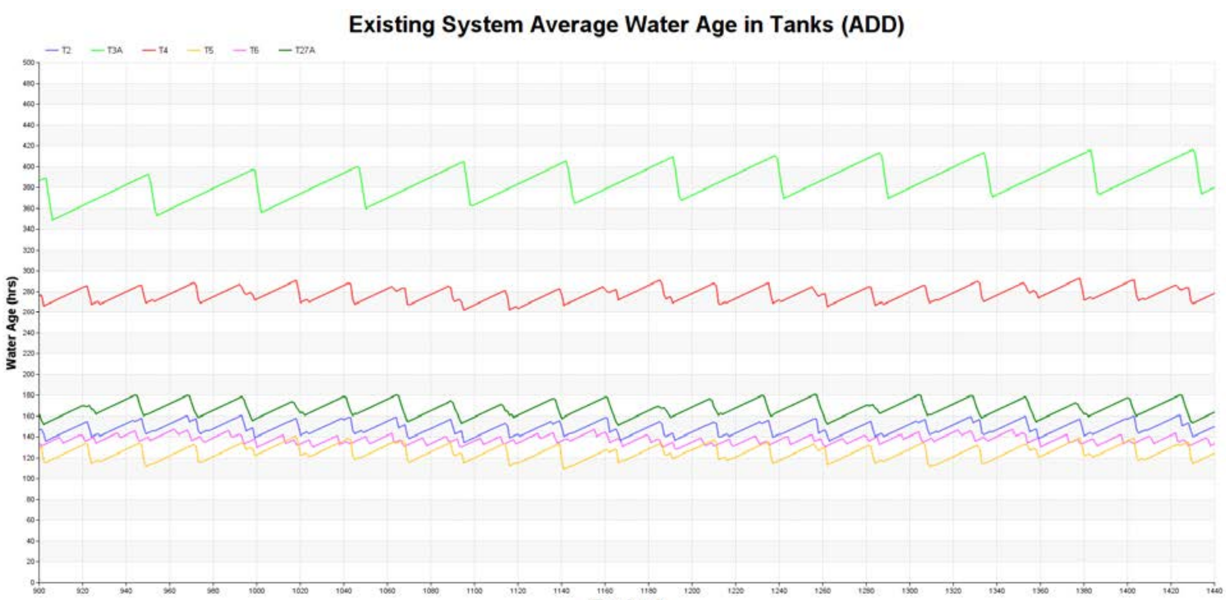
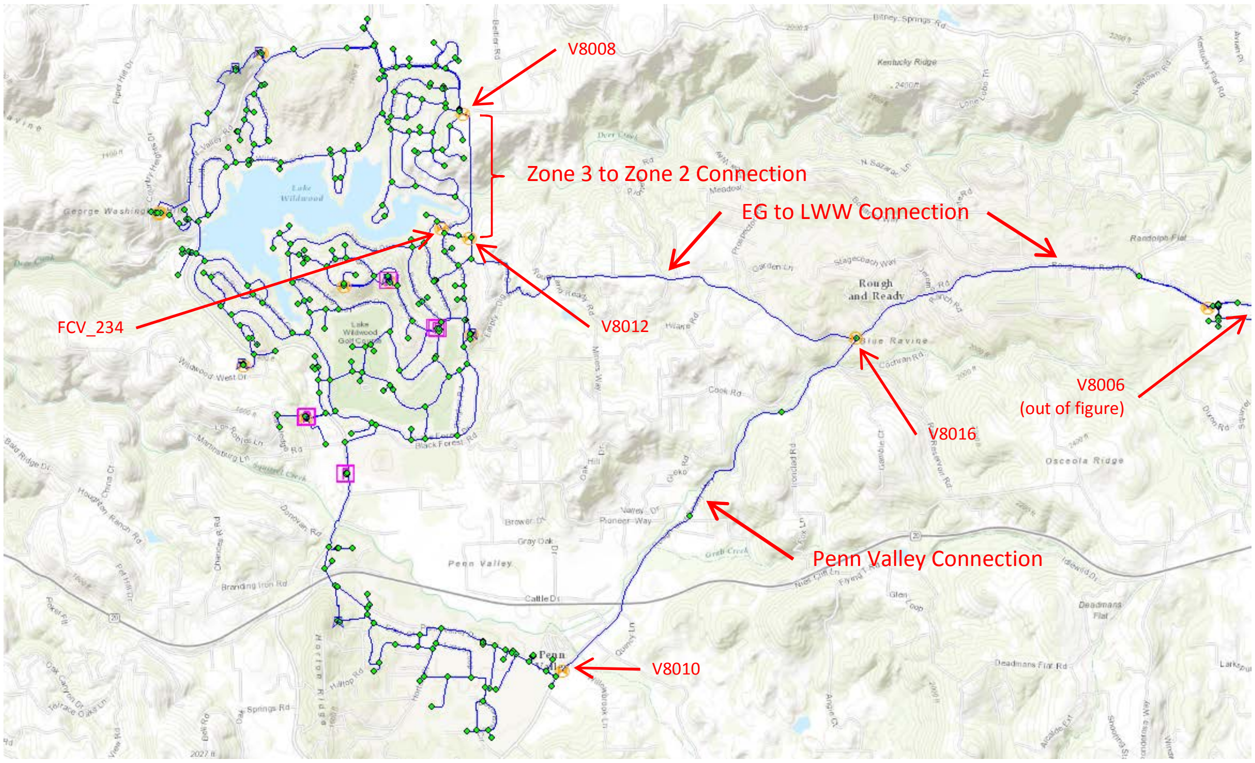


Figure 2. Existing System Average Water Age in Tanks (ADD)

Combined System Average Water Age – LWW Average Day Demand (1.2 mgd)

(using Combined_EGeorge_LWW_HDR_20170628)

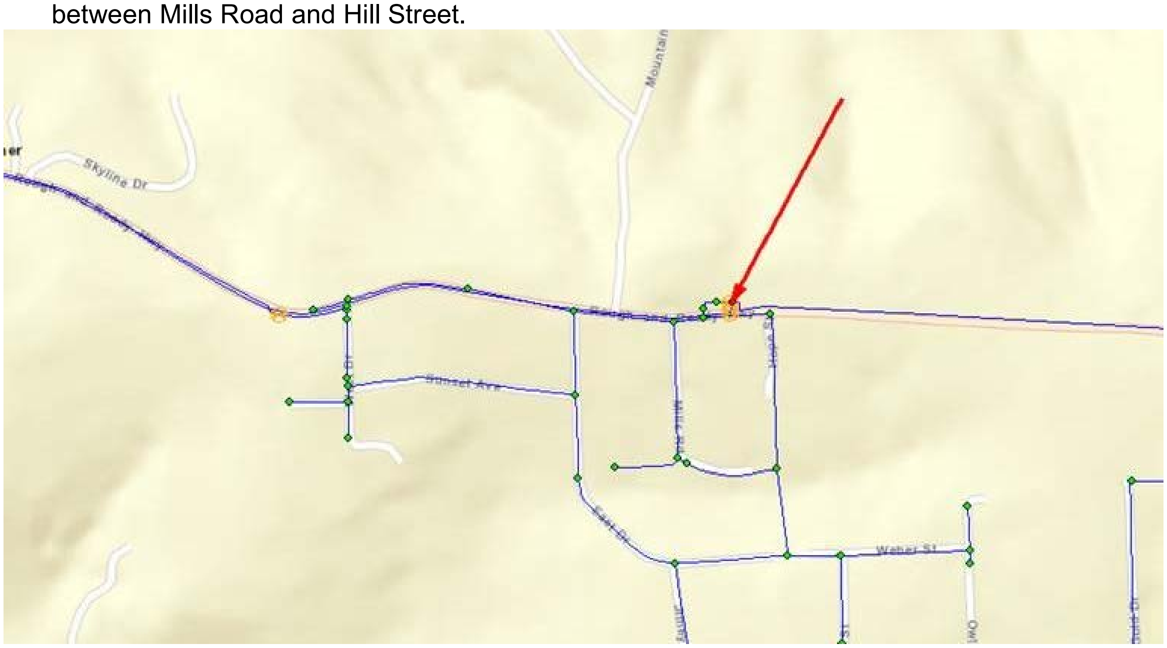


Supply only from Elizabeth George system

Model file here: COMBINED_EGEORGE_LWW_HDR_20170628

New Infrastructure:

- Upsized pipes in Elizabeth George System: New T-Main extends along Rough and Ready to between Mills Road and Hill Street.



- Pipe improvements in Penn Valley (in accordance with Phase 1 through Phase 3 shown on Figure 11 Penn Valley Improvements)
- Connection between Elizabeth George and Lake Wildwood Systems:
  - 16” transmission pipeline connecting Elizabeth George (EG) system to Lake Wildwood (LWW) system. Connection to LWW Zone 3.
  - 16” transmission pipe Zone 3 to Zone 2 connection is about 4,200 ft.
  - 12” transmission pipeline connection to Penn Valley.
- New control valves:
  - Control Flow from EG to LWW (V8006)
  - Prevent negative pressure in new transmission line (V8016). *[Note this was needed in the model due to upstream flow control and may not be needed in reality.]*
  - PRV (setting at 90 psi) from new transmission pipeline to Zone 3 (V8012)
  - Control flow from LWW Zone 3 to Zone 1 (maximum flow set at 750 gpm) to allow cycling of tank T2 (FCV_234)
  - Control flow from new transmission pipeline to Zone 2 (maximum flow set at 750 gpm) to allow cycling of tank T3A (V8008)
  - Control flow to Penn Valley (maximum flow set to 250 gpm) to allow cycling of tank T27A (V8010)
- Pump Stations deactivated:
  - Jayhawk Pump Station (from Zone 1 to Zone 3; filled tank T6)
  - Pleasant Valley Pump Station (filled tank T27A)
- Valve controls as follows:

Valve Model ID	Model Valve Type	Controls	Purpose
V8006	Flow Control Valve	Setting at 1460 gpm	Limit flow to LWW to 2.1 mgd
V8016	Vacuum Breaker Valve	None	Used in model to prevent negative pressure due to upstream flow control (V8006)
V8012	Pressure Reducing Valve	If T6 level above 29.5 ft valve closed; If T6 level below 18 ft valve set at 90 psi	Allows flow into Zone 3 and fill tank T6
FCV_234	Flow Control Valve	If T2 level above 26 ft valve closed; If T2 level below 17 ft valve allows 750 gpm	Fills tank T2 (in Zone 1). Flow limited to prevent pressure drop in Zone 3.
V8008	Flow Control Valve	If T3A level above 22 valve closed; If T3A level below 16 valve allows 750 gpm	Fills tank T3A (in Zone 2)
V8010	Flow Control Valve	If T27A level above 18 valve closed; If T27A level below 12 valve allows 250 gpm	Fills tank T27A

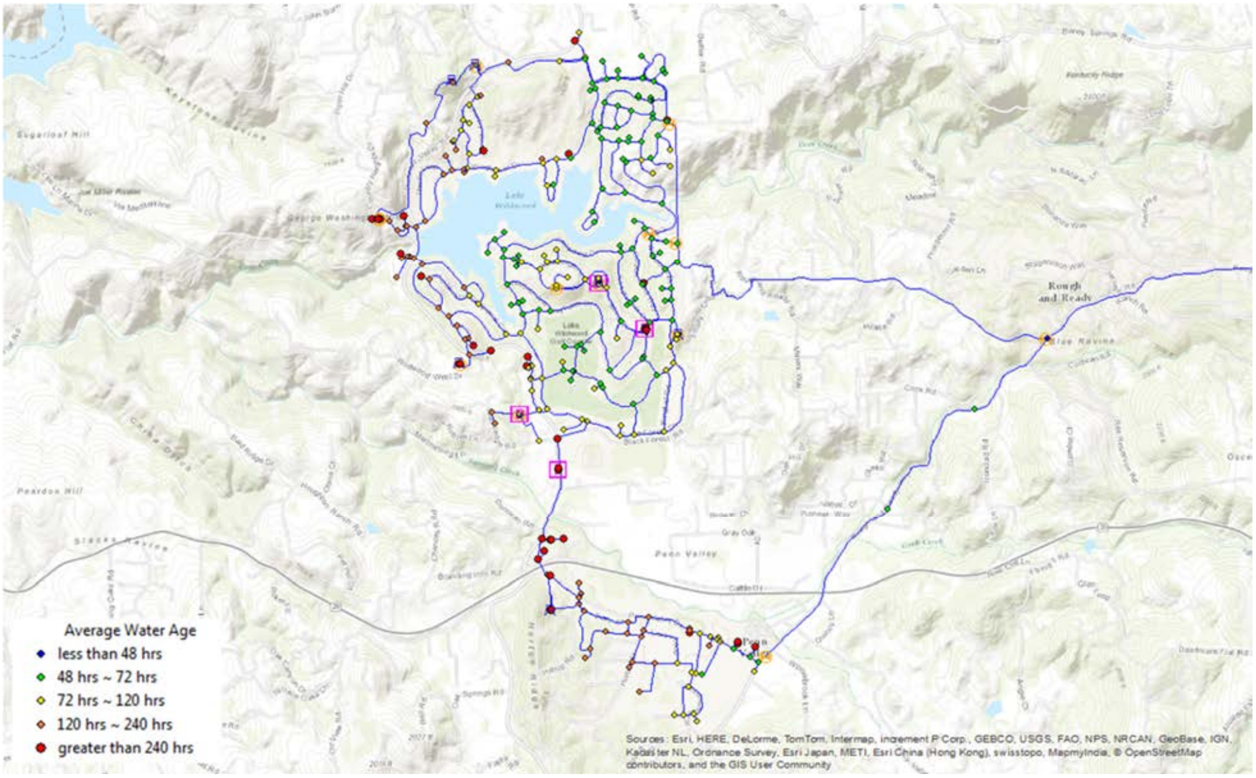


Figure 3. Combined LWW System Water Age (ADD)

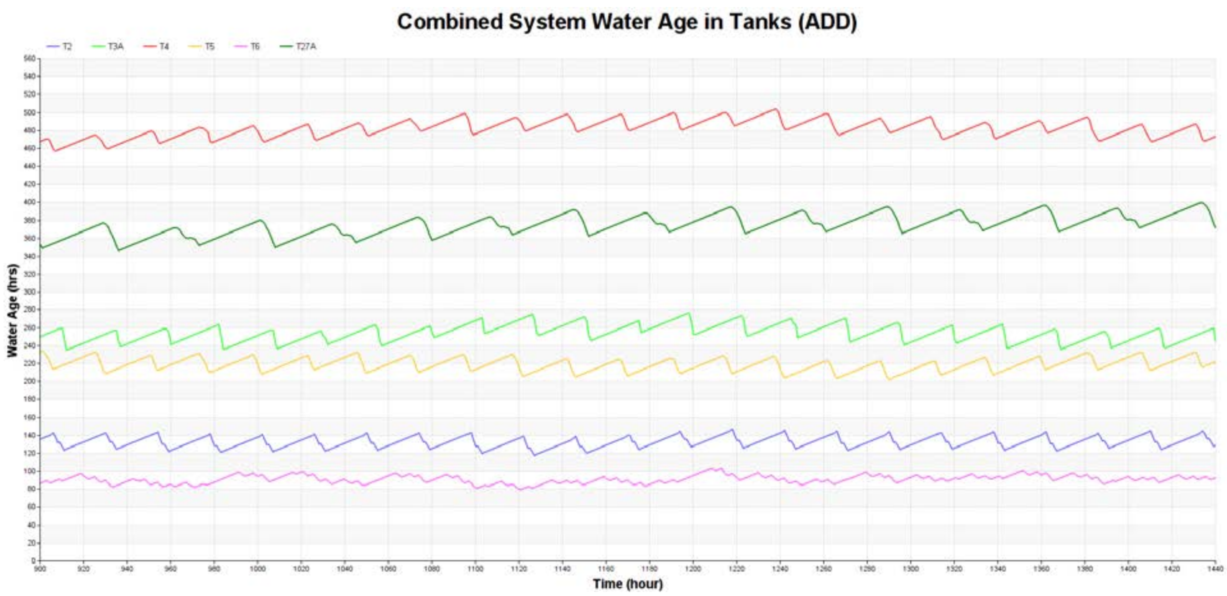


Figure 4. Combined System Average Water Age in Tanks (ADD)

Combined System Min Pressure – LWW Max Day Demand (2.1 mgd)

(using Combined_EGeorge_LWW_HDR_20170628)

Supply only from Elizabeth George system

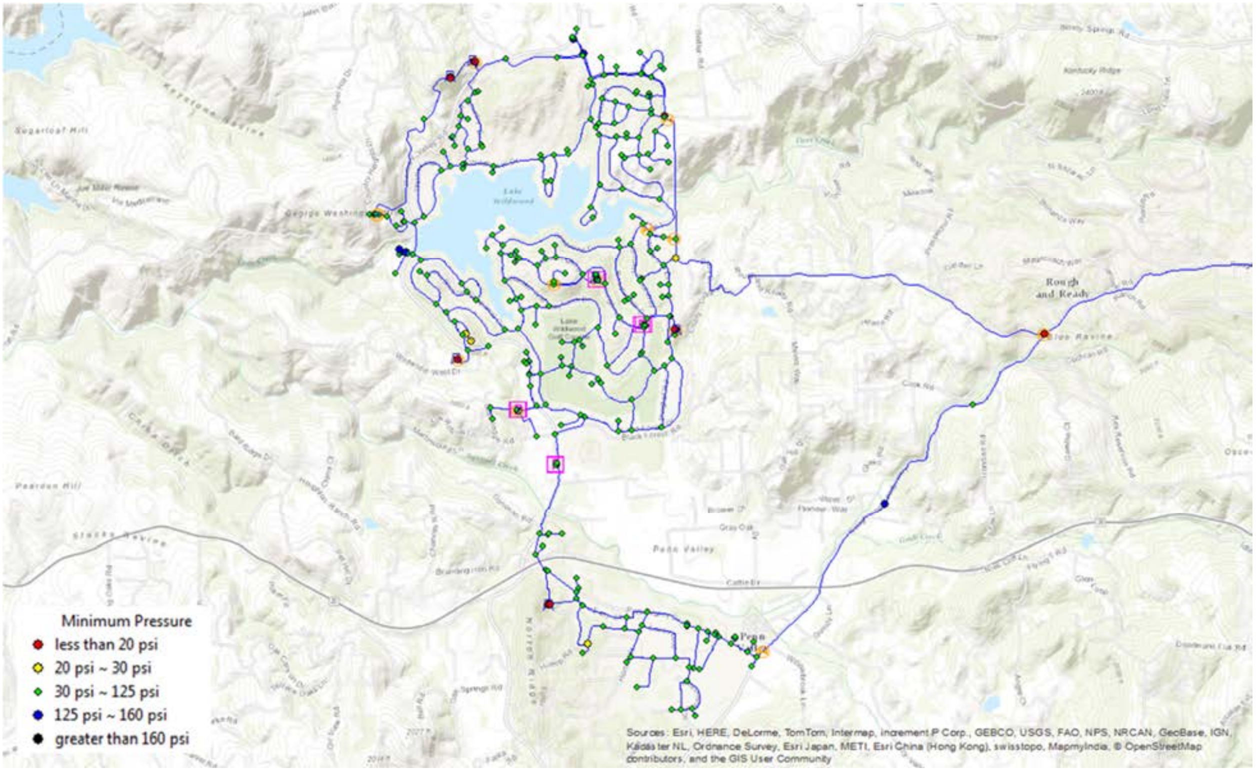


Figure 5. Combined LWW System Minimum Pressure (MDD)

Combined System Min Pressure – LWW Future Max Day Demand (4.2 mgd)

(using Combined_EGeorge_LWW_HDR_20170628)

Supply from both existing treatment plan and from Elizabeth George system (EG supply limited to 2.1 mgd)

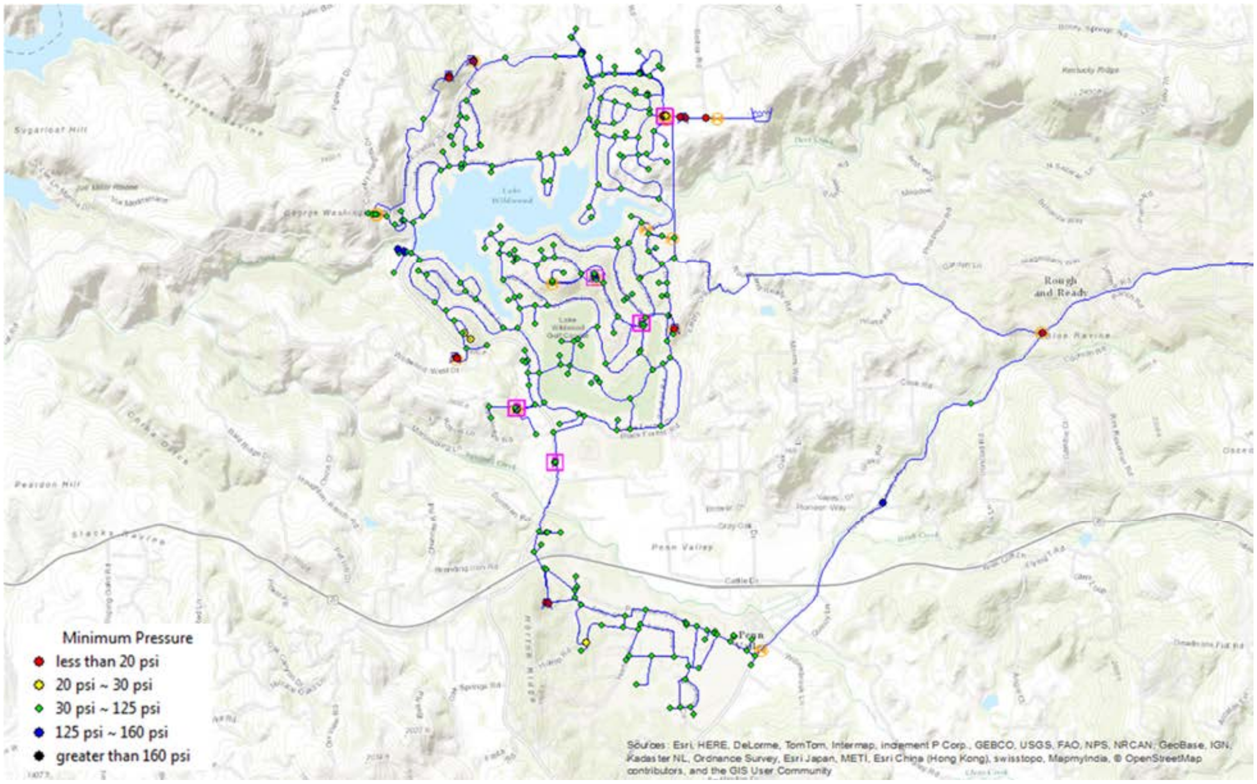


Figure 6. Combined LWW System Minimum Pressure (Future MDD)

Appendix D: Constructed Conveyance Map

S:\arcview\EG_LR_LWW_Pipeline\EG_LR_LWW_PipelineOptions.mxd

NID

NEVADA IRRIGATION DISTRICT

NEVADA COUNTY -- PLACER COUNTY
GRASS VALLEY, CALIFORNIA

E. GEORGE / LOMA RICA TO LAKE WILDWOOD PIPELINE OPTIONS - DRAFT

Drawn By: D. HUNT | Date: 2/19/2016 | Scale: NO SCALE | Sheet: 1 of 1

Appendix E: Solids Generation Calculation

Lake Wildwood WTP - Residuals Generation Calculations

Current Conditions

Date	Treatment Plant Flow		Avg Raw Water Turbidity'	Alum Dose	Equivalent Dry Sludge Generation
	(mgd)		(NTU)	mg/L	(lb/mo)
Jan	0.640		8.8	41	4,790
Feb	0.500		7.0	41	3,444
Mar	0.770		19.2	20	6,607
Apr	0.900		10.4	20	5,107
May	1.150		9.1	20	6,006
Jun	1.400		6.8	18	5,973
Jul	1.800		6.9	18	7,719
Aug	1.800		4.8	18	6,448
Sep	1.540		3.4	18	4,831
Oct	1.150		5.1	25	5,135
Nov	0.900		3.0	30	3,902
Dec	0.640		4.2	41	3,805
Average	1.10			Annual Total	63,768

* Based on wet year conditions

Future Conditions (maximum demand scenario)

Date	Treatment Plant Flow	Treatment Plant Flow with pipeline	Avg Raw Water Turbidity'	Alum Dose	LWW Only - Equivalent Dry Sludge Generation	LWW and Pipeline
	(mgd)	(mgd)	(NTU)	mg/L	(lb/d)	(lb/d)
Jan	1.7		8.8	41	13,013	0
Feb	1.4		7.0	41	9,355	0
Mar	2.1		19.2	20	17,950	0
Apr	2.4	0.4	10.4	20	13,873	2,080.97
May	3.1	1.1	9.1	20	16,316	5,063.48
Jun	3.8	1.8	6.8	18	16,227	7,211.90
Jul	4.9	2.9	6.9	18	20,971	11,853.18
Aug	4.9	2.9	4.8	18	17,516	9,900.35
Sep	4.2	2.2	3.4	18	13,125	6,394.41
Oct	3.1	1.1	5.1	25	13,950	4,329.45
Nov	2.4	0.4	3.0	30	10,601	1,590.19
Dec	1.7		4.2	41	10,338	0
Average	3.0	1.6		Annual Total	173,236	48,424