Final Technical Memorandum

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Prepared for: City of Flagstaff Water Services Division

Project Title: Reclaimed Water Master Plan

Project No.: 155320

Technical Memorandum

Subject: Reclaimed Water Study Technical Memorandum

Date: August 2021

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Section 1: Introduction and Background

The City of Flagstaff (City) Reclaimed water study was performed to evaluate management options for Flagstaff's uncommitted reclaimed water, which includes all reclaimed water produced by Rio de Flag (RDF) and Wildcat Hill (WCH) Water Reclamation Plants (WRP)'s that is not currently provided to a contracted reclaimed water customer. This uncommitted quantity of reclaimed water is a function of seasonal demand, growth rate, and conservation. The City requested Brown and Caldwell (BC)'s assistance in developing an implementation strategy to meet long-term water supply by further exploring how reclaimed water fits into their water resources portfolio over the next 55 years, or through their expected build-out condition based on projected population growth.

Reclaimed water is already a major component of the City's water resources portfolio and could be a more significant portion in the future. Opportunities to further expand direct reuse, replenish aquifers or surface water bodies (indirect potable reuse), or augment untreated and treated water supplies (direct potable reuse) were investigated in one of many studies the City has already led focused on reclaimed water usage that has been completed to date. The following studies led by the City were used as a baseline in this study:

- The Flagstaff City Manager's CEC Advisory Panel Final Report, completed in January 2019 summarizes the work and findings from the City Manager's compounds of emerging concern (CEC) Advisory Panel. This work included five years of study and two years of sampling CEC's in source water (untreated lake water and groundwater), potable water, and reclaimed water.
- Water Supply Alternatives Costs Technical Memorandum, completed in August 2017 by Carollo Engineers. This study developed AACE Class 5 Estimates for many of the alternatives, including indirect potable reuse (IPR) via aquifer recharge with or without advanced treatment, IPR via surface water blending with or without advanced treatment, and direct potable reuse (DPR). Treatment and infrastructure costs were developed for each of these alternatives in a high-level estimate.
- Advanced Water Reclamation Feasibility Study, completed in June 2018 BC. This study developed AACE Class 4 cost estimates for two alternative DPR treatment trains. The cost estimate focused exclusively on the cost of treatment necessary for DPR and did not include any infrastructure costs "outside the fence" of the treatment facility. Operation and maintenance costs for treatment were also developed.

To determine the most optimal use of reclaimed water for the City of Flagstaff, a greater understanding of the availability, economics, and risk to human and environmental health is needed. This technical memorandum (TM) summarizes the approach to better understand and inform the City of favorable alternatives for the best and highest use of reclaimed water and identifies recommended next steps for the City as a result of the findings. This study is intended to build upon the valuable work the City has led to date. The scope of this study includes:

- Developing a reclaimed water balance projected through the planning horizon. This water balance includes reasonably certain water conservation measures that may reduce the quantity of reclaimed generated. The water balance includes seasonal variations in reclaimed water demands. This analysis provides the City with an anticipated quantity of available reclaimed water.
- Reviewing the City's current policy and reclaimed water services, including costs associated with providing reclaimed water, revenue requirements, and current rate structure, and provide recommendations and considerations for evaluating the value of reclaimed water. This portion of the work was performed by West Water Research, and their TM summarizing these findings is attached in Appendix A.

- Providing recommendations for an enhanced sampling program for reclaimed water. The recommendations include a listing of water quality parameters, sampling locations, and frequency. This analysis provides the City with water quality considerations for various future uses.
- Engaging with a community stakeholder group to identify community-specific values regarding use of reclaimed water and receive guidance on decision criteria, including reclaimed water quality, for evaluating reclaimed water management strategies. This engagement effort was used as a platform to collect feedback on community preferences for six reclaimed water management strategies.

The following sections summarize the effort and findings from each of the above.

Section 2: Reclaimed Water Balance

The objective of this task was to determine the quantity of unallocated, or excess, reclaimed water that will be available as a supply for the preferred use. Current uses of the reclaimed water vary seasonally, where much of the resource is used for irrigation in the summer, and for snow making in the winter, but spring and fall don't exhibit a significant demand of reclaimed water. BC developed a model using GoldSim software to determine available reclaimed water through the year 2075 and better understand the seasonal variability. The following sections discuss the historic reclaimed water use, model assumptions, architecture, and findings from this portion of the work.

2.1 Historic Reclaimed Water Use

Reclaimed Water Production

The City provided the total monthly reclaimed water production and reclaimed water use for the years 2019 and 2020. The amount subtracted from the production and reclaimed water use equals the total available excess reclaimed water. Figure 2-1 below shows the monthly reclaimed water production for these years in million gallons per day.

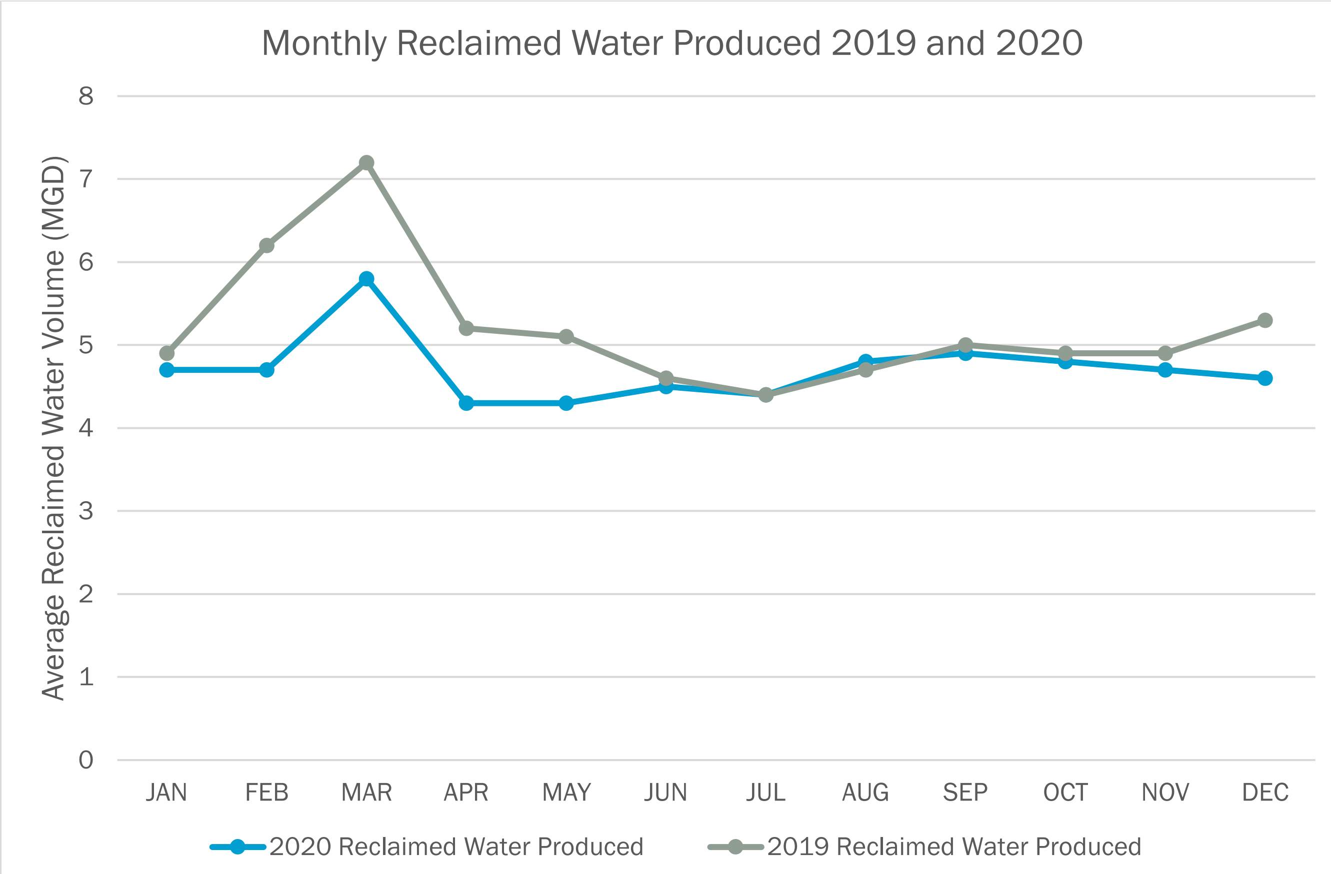

Figure 2-1. Total reclaimed water produced 2019 and 2020

As shown above, 2019 began as a much higher production year of reclaimed water than 2020. Although a higher production of reclaimed water in 2020 would be expected, there was a sharp decline instead, roughly 15 percent, beginning in March of 2020. That specific time-period is of interest because at this exact time period, the United States experienced the effects of a global pandemic that was declared at that same time. The City of Flagstaff has both a large tourist as well as student population, which were both significantly affected by the pandemic, including an immediate travel halt as well as school closure. This trend in low reclaimed water production continued through May, which marked the time that the Governor of Arizona began to lift business closure requirements and tourism began to pick up in the State.

Although an event like a global pandemic cannot be reliably predicted to happen in a given year, there are aspects to be learned from the effects it can have on water demand and supply. Understanding that impact will help in planning for an uncertain future in reclaimed water's role as a water resource. One method of achieving this is through scenario planning, which involves exploring a number of potential uncertainties and identifies which uncertainties have the greatest risk and impact on the City in terms of water supply. This might be something for the City to consider in future planning efforts.

Reclaimed Water Use

Reclaimed water produced, committed use (including all contracted users, as well as City uses) and quantity discharged to the Rio de Flag are shown in Figures 2-2 and 2-3 below. Volume discharged to the Rio de Flag includes the volume of reclaimed water that is not conveyed to the purple pipe system in the City from WCH or RDF, except for 200 gallons per minute which is committed by contract to Arizona Game & Fish Department.

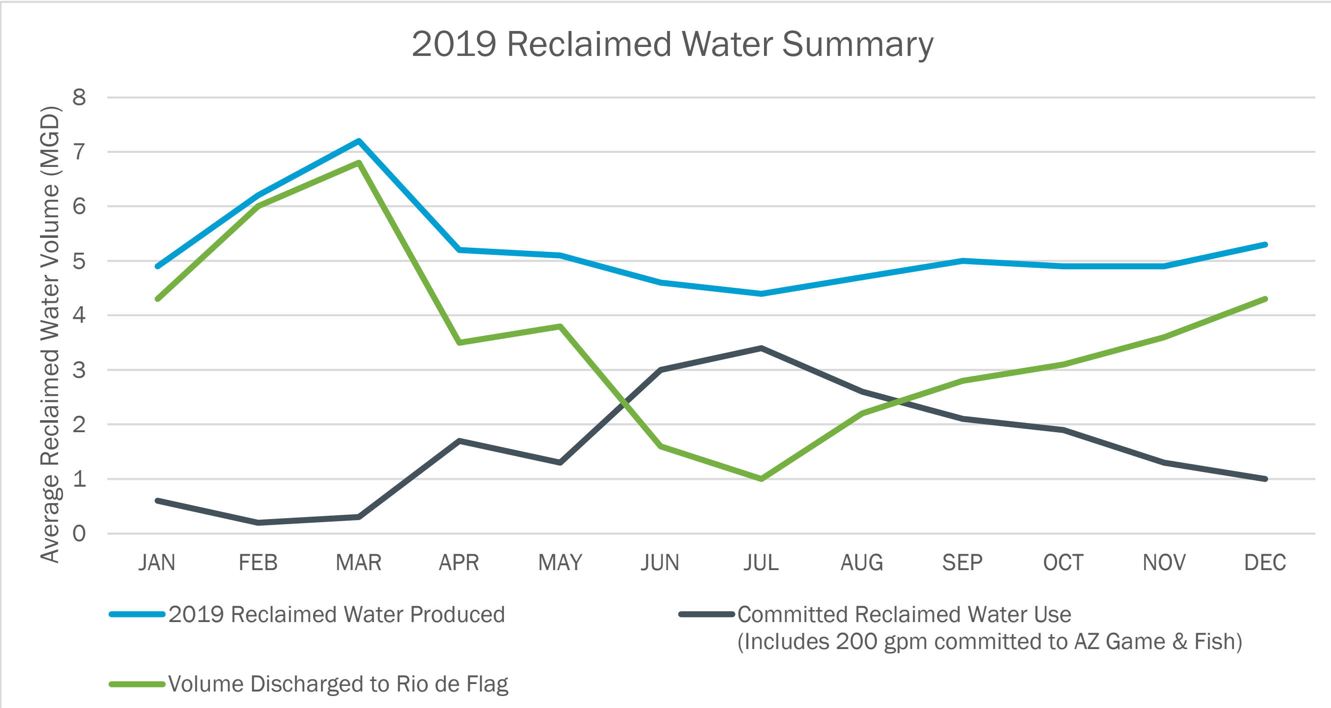

Figure 2-2. Reclaimed water summary 2019

2.2 General Modeling Approach

The goal of the reclaimed water balance was to project the available reclaimed water through the City's anticipated buildout population (155,000 people). We based this projection off of an per capita wastewater generation rate in gallons per capita per day (GPCD). This is an average assumed potable water use for each member of the population. That number was used to calculate an average wastewater flow generated per day. The historic flow split for the two treatment plants was used to determine and average influent to each facility. A typical loss factor was applied across the treatment process to generate the total treated wastewater generated from each facility or reclaimed water generated. To determine the available excess reclaimed water, the total contracted water use was subtracted from the total reclaimed water generated. The reclaimed water generated through a population of 155,000 people was projected at a specific growth rate to determine the future available quantity of excess reclaimed water. The assumptions made for these calculations are summarized in the following section.

2.3 Assumptions

BC collected the following data from the City to use as a basis for the model:

- 2015-2019 water production reports from the City. These were used to develop an average percent loss of water between the sewer collection system and reclaimed water produced, as well as to understand seasonal water demand patterns. A typical loss of 3 percent through the wastewater collection and treatment system was used for all projections and negligible impact from infiltration/exfiltration of stormwater into/out of the sewers. However, it is important to note that during major storm events, infiltration of stormwater can significantly increase inflows, however for a conservative estimate of available reclaimed water assumes the impact is negligible.

- All current reclaimed water commitments and other current uses on a monthly basis. This data represents the seasonal variability of the resource demand.
- The projected excess reclaimed water assumed current committed reclaimed remains constant and demand on the current system does not increase over time.
- Projected growth rate (1.3 percent), provided by the City planning department
- Flagstaff buildout is defined as 155,000 people. Using a growth rate of 1.3 percent, this occurs around the year 2075.
- Per capita wastewater generation, including current use and predicted use to account for water conservation efforts. Three residential per-capita wastewater generation scenarios were modeled including high (78 GPCD), moderate (68 GPCD), and low (60 GPCD) scenarios. These three scenarios represent the potential effects of water conservation on community wastewater generation. The City preferred scenario for the City is somewhere between the low and moderate scenarios.
- The average per capita wastewater generation in 2019 was 72 GPCD, which falls between the moderate and high GPCD cases.

This information was collected from the City and used to develop the GoldSim model.

2.4 Model Architecture

GoldSim software was used to develop a model to determine the annual and monthly reclaimed water availability through 2075. Figure 2-4 below shows the model schematic representing the overall model architecture, including data input and output.

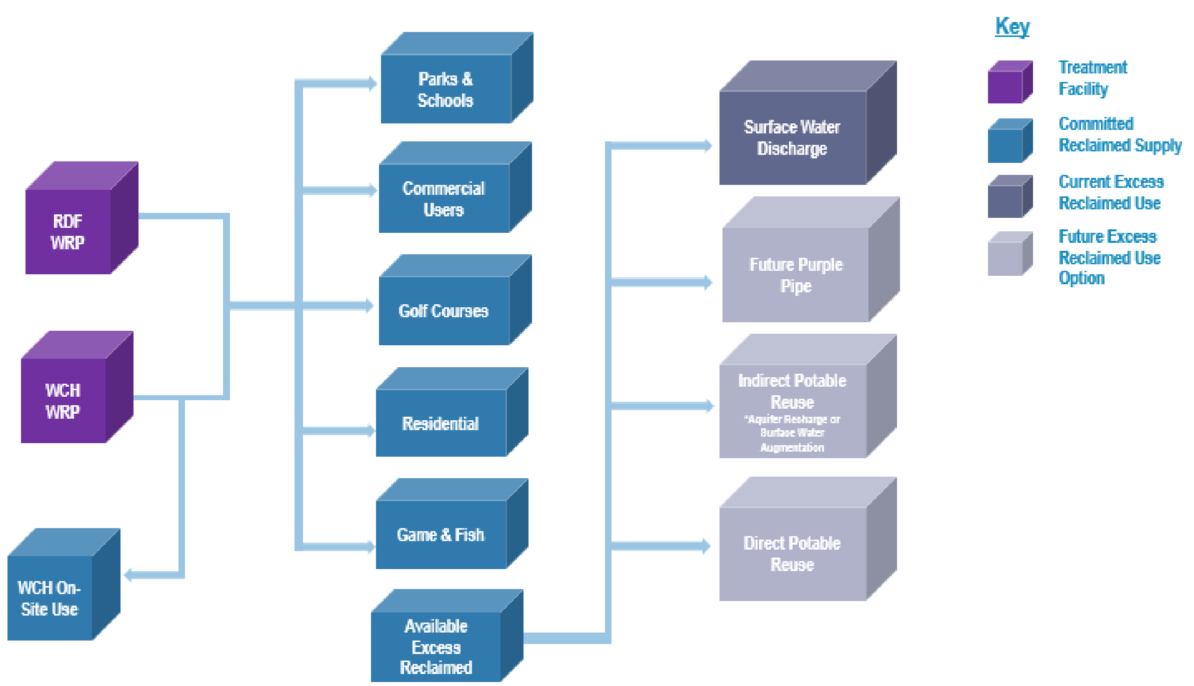

Figure 2-3. GoldSim Model Schematic

The purple boxes in the figure above represent the two water reclamation facilities: Rio de Flag (RDF WRP) and Wildcat Hill (WCH WRP). The effluent flow from those facilities was determined by first determining the total flow to those facilities. The projected water demand in the City through the year 2075 was estimated using a growth rate of 1.3 percent and assuming three different water demand scenarios:

- Scenario 1: Low residential wastewater generation, 60 GPCD, reflects a significant water conservation strategy
- Scenario 2: Moderate residential wastewater generation, 68 GPCD, reflects close to the current average per capita wastewater flow in the City, around 72 GPCD, which includes some effects from conservation
- Scenario 3: High residential wastewater generation, 78 GPCD, reflects the projected per capita flow without any conservation

The projected growth rate is a variable that can be revised to better match projected conditions. The software uses the projected population and various water demand scenarios to determine the total water supply, applies a 3 percent loss to estimate the total system loss, and applies a historic split between the WCH and RDF WRPs (roughly 2/3 to WCH and 1/3 to RDF). The total effluent from each plant is the total reclaimed water generated for use. As shown in Figure 2-4 above, the effluent flow from the two facilities is combined in the reclaimed water system for contracted users.

The blue boxes in the figure above represent current users of the reclaimed water system. As shown above, a portion of the reclaimed water from WCH is used for on-site uses. The remaining boxes represent current contracted allocations or historic uses. The remaining amount after subtracting the current allocations from the system represents the excess reclaimed water, and the light grey boxes show the potential strategies for reclaimed water management. The dark grey box represents the current use of the excess reclaimed water, which is discharged to the Rio de Flag as described in Section 2.1 above.

2.5 Findings

The model projected excess reclaimed water for each scenario. The following graphs show the excess reclaimed water anticipated through 2075. Common practice in water resource studies is to report quantities in acre-feet per year (AFY) which is a metric used to represent annual available water supply. These units are useful when comparing water resource alternatives, such as available groundwater or surface water rights. Figure 2-5 below shows the projected annual available reclaimed water at low, moderate, and high residential water use scenarios through the year 2075 in AFY.

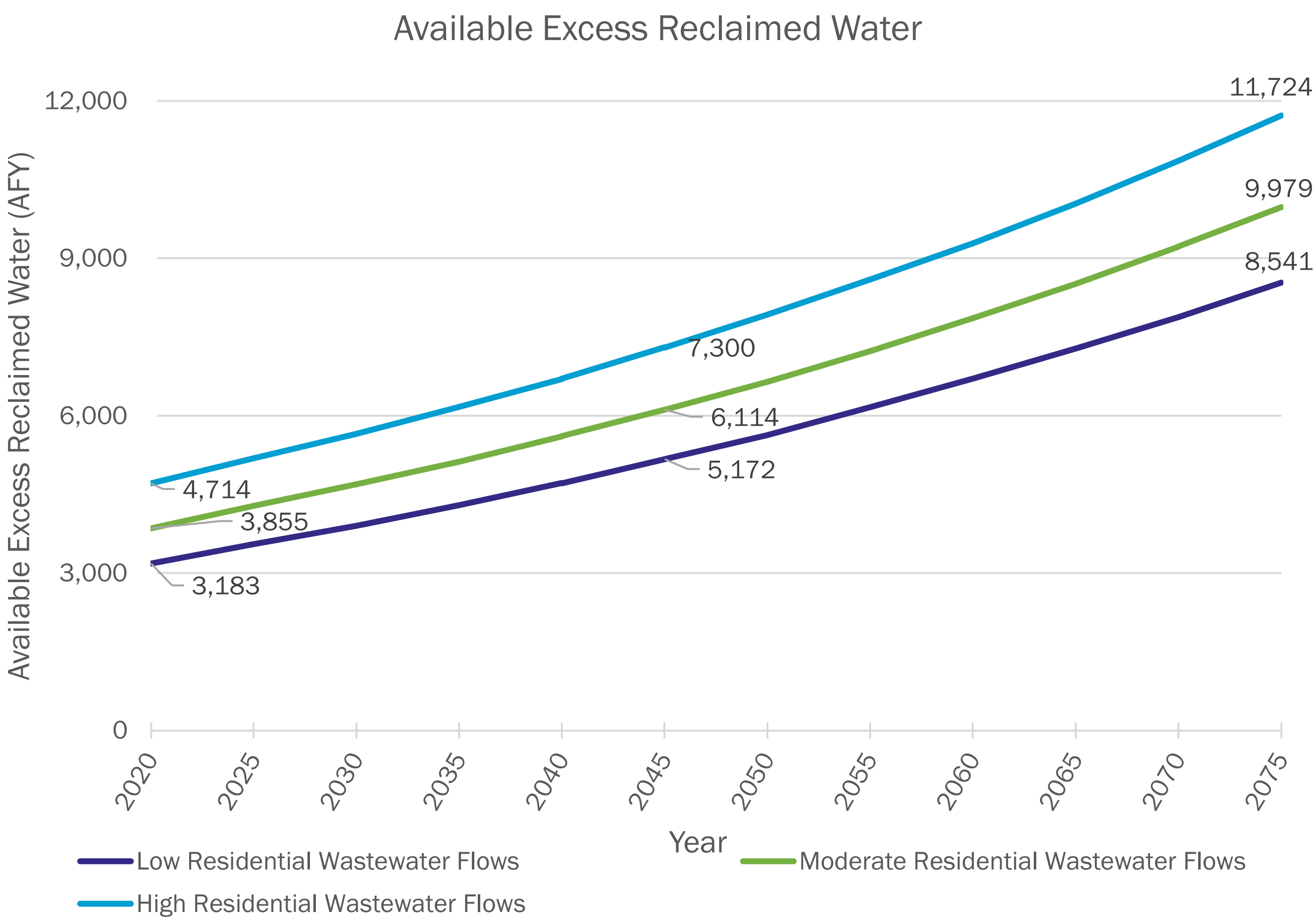

Figure 2-4. Available excess reclaimed water through buildout under low, moderate, and high residential wastewater flow scenarios

As shown in the figure above, the annual available excess reclaimed ranges from about 8,500 AFY up to around 11,700 AFY in the high unit flow scenario by the year 2075. All of the scenarios show a significant volume of reclaimed water available for use. Table 2-1 below shows how the range of available excess reclaimed water compares with other current and future water resources in the City.

Table 2-1. City Water Resources Portfolio

Source	Maximum Yield (AFY)
Direct Delivered Reclaimed[a]	2,200
Surface Water (Upper Lake Mary)	2,240
C-Aquifer	9,913
Red Gap Ranch (future potential water supply)	8,000-12,000
Excess Available Reclaimed Water for Purple Pipe Expansion, Indirect Potable Reuse, or Direct Potable Reuse	8,500 to 11,700[b]

a. *Direct delivered reclaimed water is an offset to potable water demand*

b. *Excess available reclaimed water at year 2075 assuming 1.3% growth rate*

The available quantity of reclaimed water provides a significant annual volume of water to the City water resources portfolio. Common industry units conversion states one acre foot is equivalent to 325,851 gallons. However, due to the seasonal use of the resource, available reclaimed water varies on month-to-month basis. When reporting daily, monthly, or seasonal values, water quantities are reported in million gallons per day (mgd), which is a more commonly used measure for reporting capacity of treatment and conveyance facilities. One mgd over an entire year is equivalent to 1120 AFY.

The daily flow is used to meet seasonal demand and to size treatment facilities. As the City further explores their best use of excess reclaimed water, it is important to consider how the supply may vary over the course of a year. In the winter months, demand will be low because of the reduced demand in reclaimed water for irrigation. However, in the summer time, especially if it is a dry year with little to no rainfall, a significant demand on the reclaimed water system for irrigation will be exhibited. When considering the highest and best use of the resource, it is important to consider how the reclaimed water management strategy will use the reclaimed water. Table 2-2 below summarizes the considerations for each.

Table 2-2. Reclaimed Water Volume Considerations

Reclaimed Water Management Strategy	Consideration
Direct Reuse (purple pipe expansion)	This strategy will follow the current pattern of reclaimed water use. Reclaimed water use will be high in the summer time and a large volume of water will be discharged in the cooler months when irrigation demand is low
Indirect Potable Reuse – surface water augmentation or recharge	Any of these strategies will manage the seasonal variation of the resource
Indirect Potable Reuse with Additional Treatment	Any of these strategies will manage the seasonal variation of the resource, however the treatment system will be designed to accommodate a variation of flow over a given year, which is around 67% variation between lowest and highest excess reclaimed water months.
Direct Potable Reuse	The available supply to customers will vary throughout the year, and the treatment facility to treat this water to drinking water standards will need to be designed to accommodate variation of flow over a given year, which is around 67% variation between lowest and highest excess reclaimed water months.

Section 3: Water Quality Considerations

The objective of this task is to establish a list of water quality parameters relevant to potable reuse and aquatic environments, provide guidance on appropriate concentrations of trace compounds based on known or potential effects on human health and the environment, and provide guidance for sampling locations and frequency. The following sections discuss the current users within the catchment area, and the water quality considerations that are important when considering using reclaimed water as a part of the overall water supply.

3.1 Flagstaff’s Catchment Area

Flagstaff’s sewer network includes collection of residential wastewater discharge and nine industrial users, seven of which are classified as significant industrial users and one (which includes two sites) as non-categorical users. Industrial users in the City include medical, bottling, laundry services, dog food manufacturing, ice cream cone manufacturing, and biomedical equipment manufacturing. The discharged wastes include pharmaceutical, microbial, sterols and hormones, volatile organic compounds (VOCs), consumer products, detergents, and surfactants which could include CECs of interest to public health when considering reclaimed water for future potable use and discharge to aquatic environments.

3.2 Compounds of Concern in Reclaimed Water

A potable reuse program must include chemical controls that are protective of public health. This includes controlling those CECs regulated under the National Primary Drinking Water Regulations (NPDWR) and should also include certain unregulated CECs that could also pose a health risk. In the past two decades, the advent of improved analytical techniques has allowed researchers to quantify some CEC's in water to the part per trillion level. One of the challenges with such sensitive testing is the risk of sample contamination. These tests are so sensitive that there have been reports of samples being contaminated by fire retardants from ceiling tiles and caffeine from the breath of technicians collecting samples. Additionally, research has shown that many man-made organic chemicals persist through conventional wastewater treatment processes and may pose a chronic health or environmental risk even at very low concentrations (Cáñez, 2020)

The following list provides a general description of the categories of CECs of concern in potable reuse applications. This list includes only CECs and does not include microbial contaminants, aggregate parameters like biochemical oxygen demand (BOD), or physical parameters like pH or UV254 absorbance.

- Metals. The group of metals include regulated[1] and unregulated constituents. Regulated metals are generally associated with a variety of chronic health conditions including liver or kidney damage, hair loss, skin damage, and effects in physical or mental development in infants and children. Regulatory limits for most metals are in the parts per million or parts per billion range. Also included in the listing of metals for this study are naturally occurring minerals that have no known deleterious health effects but are relevant for design and operation of advanced treatment unit processes such as reverse osmosis and advanced oxidation.
- Disinfection byproducts (DBPs). The group of DBPs include organic and inorganic compounds that form as a result of CECs present in the water and chemicals used for disinfection. Many DBPs have been associated with various health effects including an increased risk of cancer or miscarriage. Total trihalomethanes (TTHMs) and a grouping if five halo-acetic acids (HAA5) are the most commonly known DBPs in drinking water and are part of routine sampling and reporting by public water systems. Concentration limits for most regulated DBPs are in the parts per billion range. The recommended limit for nitrosamines, which can be created as a disinfection byproduct or be present from industrial discharges, is in the parts per trillion range.
- Synthetic organic chemicals. There are hundreds of thousands of synthetic organic chemicals manufactured for a variety of uses. In addition, there are organic chemicals that result from the biotransformation of many of these chemicals.
  - Pharmaceuticals and personal care products. This category includes prescription drugs, over the counter medications, cosmetics, insect repellants, and other consumer products. This may also include the chemicals resulting from biotransformation of these chemicals.
  - Detergents and disinfectants. This includes both consumer and industrial products.

[1] Maximum contaminant levels (MCLs) have been established under the Safe Drinking Water Act and includes microbial contaminants, metals, volatile organic compounds (VOCs), pesticides/herbicide/fungicides, disinfection byproducts, radiological contaminants and nitrate. These do not include aesthetic or secondary standards referred to as Secondary Maximum Contaminant Levels (SCMLs).

  - Sterols and hormones. A subset of pharmaceuticals and personal care products that is often evaluated separately, this category includes both natural and synthetic hormones and their metabolites. The presence of these CECs in treated wastewater has been linked to developmental problems in humans and aquatic organisms. Little was understood about how widespread these CECs are in the aquatic environment until modern analytical techniques allowed their detection in the parts per trillion range.
  - Pesticides, herbicides, and fungicides. This is a broad category of CECs, most of which are currently regulated at part per billion levels.
  - Flame retardants and per- and polyfluoroalkyl substances (PFAS). By design, these tend to be very resistant to oxidation and biodegradation and very persistent in the environment. The per-fluorinated compounds, which includes PFAS and PFOA, are currently candidates for regulation for contaminated groundwater and have been often associated with military bases and airports where firefighting foam is used. In communities where these compounds have been found in water supplies, wastewater or reclaimed water, it is common for these occur in the parts per trillion concentrations.
- Volatile organic compounds (VOCs). Many industrial cleaners and solvents contain VOCs, and many are regulated. There are also VOCs which are candidates for future regulations or only have health-based limits (e.g., 1,4-dioxane). These compounds may be partially removed through conventional wastewater treatment processes but may or may not exist in reclaimed water above regulated or recommended limits.
- Natural organic matter (NOM). Water, particularly surface waters like Lake Mary, contains organic matter. NOM covers a broad spectrum of CECs of varying properties and the composition is highly influenced by the ecology, climate and geology of the area. Some forms of NOM are responsible for taste and odor (e.g., geosmin) and others become precursors to disinfection byproducts. Many naturally organic CECs are persistent in the environment and can remain unchanged through drinking water treatment processes, consumer usage, and wastewater treatment.

The Guidance Framework for Direct Potable Reuse in Arizona (Framework), published by the National Water Research Institute (NWRI) in 2018, describes a three-tiered approach for evaluating both regulated and unregulated CECs in wastewater, reclaimed water and advanced treated water. The ADEQ Recycled Water Work Group Final Report of 2018 further refined the recommendations of the Framework to include sampling of Class A+ source water for primary drinking water MCLs, secondary MCLs, CECs on EPA's contaminant candidate list (CCL) and CECs listed under the EPA Unregulated Contaminant Monitoring Rule (UCMR).

Tier 1 includes all regulated CECs under State and Federal Primary Drinking Water Standards. These are all of the CECs for which MCLs have been established. The list for Tier 1 includes 101 CECs.

Tier 2 includes unregulated CECs, secondary and aesthetic standards including CECs of emerging concern. These are CECs for which there is reason to believe they pose a risk to human health and the environment but are not currently regulated. The list of Tier 2 CECs includes those CECs for which:

- EPA has made a preliminary regulatory determination. CECs on one of the Regulatory Determination lists are under consideration for regulation. The criteria for being added to this list are
  - Whether a chemical may have adverse health effects
  - Whether a chemical is found or likely to be found in a public water system and with a frequency and quantity of concern.
  - Whether the EPA determines there is meaningful opportunity to reduce public health risk.
- EPA has issued a provisional short-term health advisory
- Substantiated research indicates there is an adverse risk to human health or the environment

- Other State regulatory bodies have developed maximum contaminant levels, guidance values, risk-based action levels or other notification levels
- Secondary and aesthetic standards

The proposed list for Tier 2 includes 217 CECs. Among some of the most recognizable Tier 2 CECs are:

- BPA. Plasticizer used in many consumer products, including water bottles
- DEET. Insect repellant
- PFAS. A category that includes 29 compounds used in a variety of consumer products, firefighting foam, and other manufacturing.
- 1,4-Dioxane. Used in manufacturing of consumer goods including paints, dyes, antifreeze, cosmetics, and others.
- Nitrosamines including N-Nitrosodimethylamine (NDMA) and N-Nitrosodiethylamine (NDEA)
- Estrogenic compounds. Includes pharmaceutical products and metabolic byproducts
- Total Dissolved Solids. Aggregate measure if dissolved minerals. The Federal Secondary Standard (aesthetics) is 500mg/l.
- Iron. Sustained exposure to levels well above existing secondary (aesthetic) standard may have adverse human health effects. Also important for design of advanced water purification processes.
- Manganese. High levels of exposure have been associated with neurotoxicity. Current secondary (aesthetic) standard is well below levels thought to be of concern to human health. Also important for design of advanced water purification processes.

Tier 3 includes unregulated CECs for which there are no known risks to human health and the environment but are known to frequently occur in wastewater and reclaimed water. Monitoring these CECs is helpful with evaluation of advanced treatment processes, particularly with respect to processes that remove organic CECs of anthropogenic origin. The list of Tier 3 CECs should consider whether the chemical can be expected in reclaimed water and be of molecular properties that are reflective of Tier 2 CECs.

The proposed list for Tier 3 includes 21 CECs, most of which are inorganic materials. Among some of the Tier 3 CECs are:

- Sucralose
- Caffeine
- Progesterone
- Calcium
- Chloride

The complete list of CECs recommended for monitoring reclaimed water for future potable reuse applications is included in Attachment C. The list of references supporting the recommendation for sampling the CEC's is provided in Attachment B. This list should be reviewed and updated periodically as EPA updates their UCMR (unregulated chemical monitoring rule) and RD (regulatory determination) lists.

3.3 Sampling Recommendations

BC recommends expanding the sampling and testing efforts from the City Manager's CEC Advisory Panel Report, which sampled raw and treated surface water, raw groundwater, the treated water distribution system, and the reclaimed water distribution system for chemicals specified in the U.S. EPA's UCMR 3. BC recommends sampling and testing the reclaimed water effluent produced at both WRPs for the CECs provided in Attachment B for future potable uses to understand if any of the chemical constituents are measured at or above the monitoring limits listed. Additional parameters recommended include CEC's from EPA's UCMR 4, EPA's CCL5, and criteria provided in NWRI's Guidance Framework, which includes all primary drinking water parameters, as well CEC's identified for testing and sampling from recently completed BC source water monitoring and sampling plans. These recommended CEC's for sampling update the sampling parameter list to reflect current trends in drinking water regulation.

An updated round of sampling that BC recommends be performed in the near future is provided in Attachment C, and also shows the CEC's tested in the Advisory Panel Report for which have already been sampled. Sampling of parameters shown in Attachment C, for which samples have not yet been collected, should be conducted in the near term to help inform the decision process for future reclaimed water use. BC specifically recommends sampling and testing for perfluorinated compounds which were sampled for in the drinking water supply but not the reclaimed water during the City Manager's CEC Advisory Panel sampling effort. If the City is considering some type of potable reuse in the future, it is critical to understand whether or not these CEC's are introduced into the system via the sewer catchment area.

Upon sampling, if high levels of a CEC are discovered in the reclaimed water effluent, the City should first determine if these CECs are present in the potable supply, and if not, should consider investigating discharges from industrial users for some of these CECs and work with the industrial users to divert these materials from entering the sewer or provide pretreatment.

Additional treatment to remove potentially harmful CECs found in the reclaimed water may be recommended at some time in the future if the City decides to further evaluate potable reuse options. An evaluation of treatment approaches should be performed to determine the appropriate treatment technology and general timeline for implementation, considering the CECs found, at what level, and the end use of the reclaimed water.

The City should also develop a public relations campaign to communicate with the public on this topic. Especially proving that the City is continuing to monitor these and future CEC's with a commitment to the public health.

If the preferred future use of reclaimed water could impact potable water supplies or aquatic environments, sampling should be performed annually. Additionally, if potable reuse is the preferred alternative, monitoring and sampling efforts should be conducted on the wastewater for source water characterization (ADEQ, 2018). The recommended duration of source water characterization is 6 months to 2 years prior to implementation of a potable reuse program. Thereafter, sampling should occur at least once every 5 years and the list of analytes should be updated to reflect the current CCL and UCMR lists or other newly identified CECs.

Section 4: . Stakeholder Engagement

A key and unique element of this scope was to engage a community stakeholder group to gain perspective from community representatives on the highest and best use of reclaimed water and better understand community preferences and values around the use of excess reclaimed water. This section describes the approach, findings, and recommendations for next steps with the community stakeholder group.

4.1 Approach

The stakeholder group was selected by the City and BC based on applications completed by individuals within the community. The application was open to the public, with a request that each applicant have an interest in reclaimed water use in the community. The goal of the group was to represent a diverse set of perspectives around the community on reclaimed water use, with a request from City Council to include an informal group of concerned citizens, the "Flagstaff Water Group". Additional applications were received from individuals representing Friends of the Rio de Flag, Friends of Flagstaff's Future, and the Sierra Club. The other nine citizens were members of the public. A group of 13 community members was selected for participation in a number of workshops developed by BC to inform and understand community preferences toward reclaimed water uses. The following alternatives for use of uncommitted reclaimed water were presented to the group for evaluation.

- Expand Purple Pipe
- Streambed Recharge without Advanced Treatment
- Streambed Recharge with Advanced Treatment
- Recharge Wells without Advanced Treatment
- Recharge Wells with Advanced Treatment
- Augmentation of Upper Lake Mary with Advanced Treatment
- Direct Potable Reuse

An initial survey was developed and shared with the group to understand some of the top concerns, values, and preferences around reclaimed water use to get a sense of where to focus. The survey revealed that the top values around reclaimed water use included sustainability/sustainable uses, water quality, and education. It also revealed that the top concern regarding reclaimed water use was water quality, followed by suitable uses and quantity of supply. This feedback helped tailor the group approach.

Figure 4-1 below shows the approach developed for informing stakeholders, gaining perspectives and gathering feedback from the group.

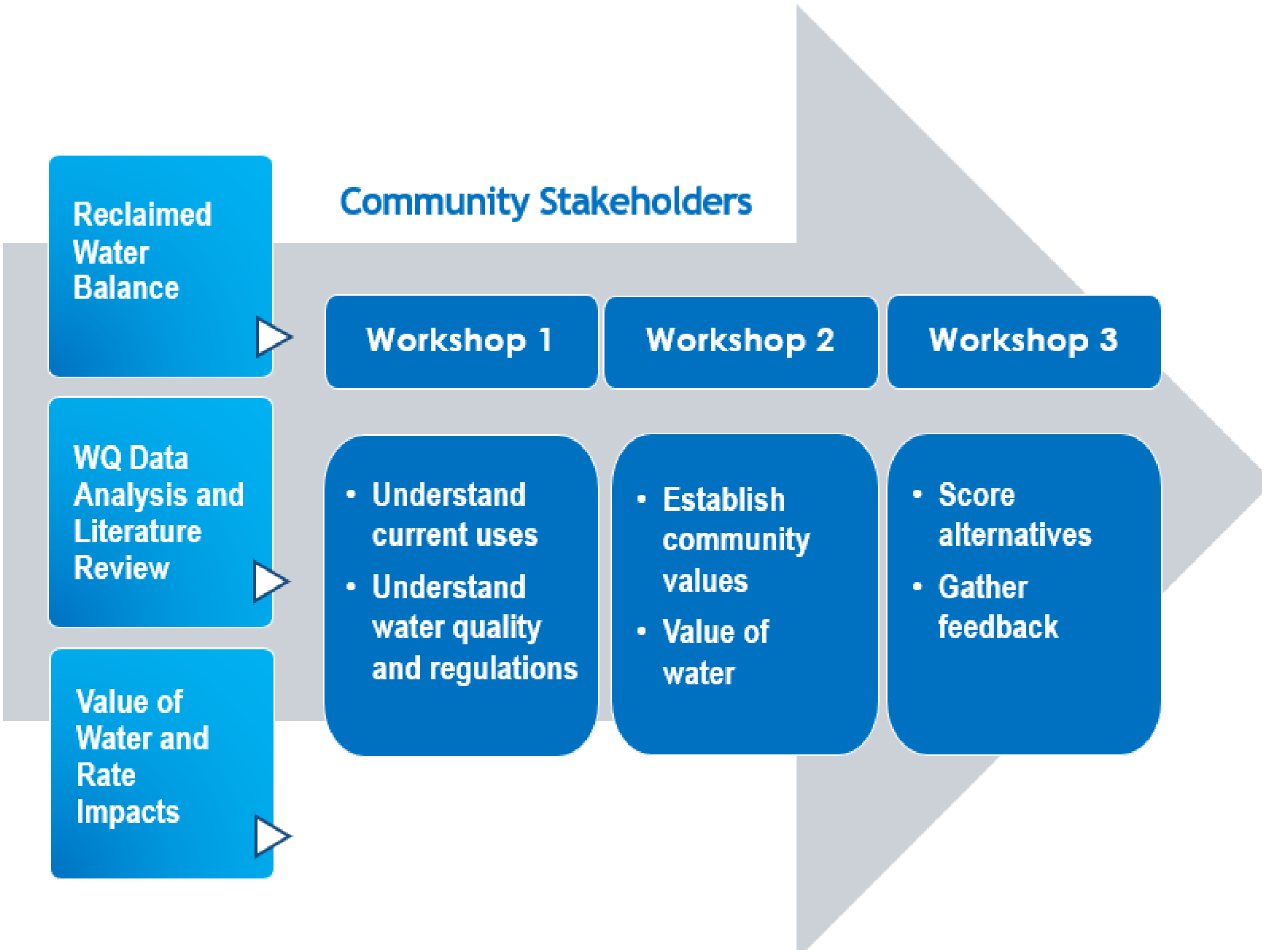

Figure 4-1. Stakeholder approach

As shown in Figure 4-1 above, findings from the three major technical tasks outlined in the scope of work were used to inform the stakeholder group in the workshops. The first workshop was designed to set the stage for the project including group introductions, in which each committee member introduced themselves and answer the question “what do you value most with regard to reclaimed water?” these initial responses were used to develop a list of community values regarding the use of reclaimed water to fine-tune throughout the engagement effort. The goals of workshop 1 were to inform the group on current reclaimed water uses within the community, present the reclaimed water balance to understand current and future availability of reclaimed water, and educate the group on Flagstaff’s water quality.

Workshop 2 introduced some of the finding from WWR’s work on reclaimed water policy pricing and the excess reclaimed water use alternatives the City is looking at. A significant portion of the workshop was also used to create values statements the stakeholder group could use as a tool for evaluating the reclaimed water alternatives.

Workshop 3 focused on gaining consensus from the stakeholder group on their preferred alternative for excess reclaimed water use. Prior to the workshop, the stakeholder group completed a scoring matrix of the alternatives against the values the group developed. During the workshop, these scores were presented and the group was encouraged to provide feedback on their scoring. The goal was to identify information gaps and determine what additional information was needed for the members to make an informed decision.

4.2 Findings

Findings and key takeaways from the stakeholder effort include the following:

- A draft list of values was developed
- Engage community tribal members in future reclaimed water planning efforts
- Some common goals among members were identified
- Additional information is needed

The draft list of values was developed with the group to use as a guide in identifying their preferred alternatives. The top alternatives selected would ideally align with the community values established. The values statements were developed by a small breakout group and vetted by the remaining group members. At this time, the values statements are in draft format and further discussion and vetting is required with the stakeholder group. Table 4-1 below shows the draft values. The values statements gained general agreement, although revisiting some of these statements with the group, and the public was requested by the stakeholder group.

Table 4-1. Draft Values Statements

Value	Application to Reclaimed Water Management Decisions
Health, Quality	a. Make decisions that protect the long-term health and safety of people and other living organisms b. Ensure that our water practices don't degrade the quality of our potable water supplies (Coconino Aquifer, Lake Mary, Inner Basin) c. Rely on best available science d. Recognize limits to our knowledge and take a precautionary principal approach to future actions
Water Sustainability	a. Make decisions to minimize our ongoing net consumption of water in order to maximize our long-term water use choices
Energy Efficiency	a. Work to maximize the energy efficiency of the system in support of city climate action goals
Aesthetics/Amenity	a. Operate the water system to improve the local quality of life, including aquatic and riparian habitats and their associated native plants and animals
Respect	a. Acknowledge and respect the needs of neighboring water users, especially tribal communities and those using the Coconino Aquifer downstream of Flagstaff
Equity	a. Ensure that the benefits of reclaimed water are accessible and/or accrue to all residents

Through the values exercise, the City and stakeholder group identified a need for input from community tribal members to gain perspectives from indigenous people in the community. A small group conversation with community members part of various tribes represented in the City was held to shed light on their perspectives and determine how they could be represented in the stakeholder values. Ultimately, the City and the group determined that in order to reflect these voices in the community, at least one or many of these tribal members need to be included in further stakeholder workshops and engagements going forward.

Through the workshops, values development, and scoring it was clear that the group had a common goal of defining and determining the highest and best use of reclaimed water, and additional information was needed to help make that determination.

Key considerations for the stakeholder group going forward include:

- Water quality – are there any chemicals of concern present in the reclaimed water effluent, and what effects will those have on the various uses

- Highest and best use – How will these alternatives provide supply resilience through climate change and other challenges
- Energy use – which of the alternatives require the lowest energy use
- Cost – who pays and what are the rate impacts
- Gain understanding on which of the alternatives are supported or preferred by the various communities living in Flagstaff

4.3 Next Steps

Engagement with the community stakeholder group is an ongoing task throughout the City's reclaimed water master plan effort. The stakeholder group identified the following next steps to provide more refined context and clarity on preferred alternatives for the future reclaimed water management:

- Big Picture – a focus on where we are trying to get to with the group – which is identify the best and highest use of the resource
- Provide more information on the range of costs for each alternative and how those costs will be distributed to the consumer in each of the alternatives
- Energy demand and efficiency for each of the alternatives
- Cultural/Other Community Perspectives
- Water quality goals and treatment technologies. The water quality goals and appropriate treatment technologies will be based on the findings from the reclaimed water sampling effort described in Section 3.

Section 5: Recommendations

The reclaimed water study was intended to evaluate critical components needed for an overall reclaimed water master plan, which is the next step for the City.

The following items should be completed as part of the next phase of work for the reclaimed water master plan:

- Undergo scenario planning effort to develop strategies for managing uncertainties and risk in the City's water resources portfolio to provide systemwide resilience;
- Solicit input from Water Commission and City Council to gain their thoughts on how to continue the stakeholder engagement, including tribal community members and other cultural perspectives. Section 4 above identifies the next steps recommended for the stakeholder group effort. Additional and broader public input will also be needed once the stakeholder group has identified their preferred alternatives;
- Reclaimed water sampling results from the list provided in Attachment C, including a report of what, if any, CECs were found in the reclaimed water that should be addressed and/or monitored. The results from this effort can be combined with the results from the CEC Panel Report from 2019 for an even broader picture of the reclaimed water quality;
- Evaluation of treatment technologies to address chemicals of concern, and recommendations for when to consider implementing additional treatment;
- Evaluate costs for the preferred alternatives for reclaimed water, up to three or four total, at an American Association of Cost Engineers (AACE) Class 4 Estimate. A Class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate. Class 4 estimates are used to prepare planning-level cost scopes or to evaluate alternatives in design conditions. Class 4 estimate require a 1 to 15 percent design effort to properly define the project. The greater the level of design, the less uncertainty of the estimate.

The Advanced Water Reclamation Feasibility study includes class 4 cost estimates for two alternative direct potable reuse treatment trains. We recommended bringing other reclaimed water alternative costs to this level of cost estimate for an equivalent comparison among the various options. Operation and maintenance (O&M) costs should also be developed for each of the preferred alternatives. These costs will be used to evaluate the alternatives against each other and develop rate impacts to customers;

- An evaluation of the economic value of reclaimed water generated by land use types to help inform planning and allocation;
- Evaluate each of the management strategies to understand the financial impact on the consumer water bill;
- In addition to considering the economic value of reclaimed water resources in rate setting, reclaimed water agreements should be prioritized based on uses that generate the most overall value for the City. This could include an analysis of whether to expand the reclaimed system at all. Although system expansion allows for new reclaimed water purchase agreements, consideration of the economic, community, and environmental benefits generated from different uses of reclaimed water in the City needs to be evaluated further; and
- Evaluate the preferred alternatives from a “big picture” perspective, including how each of the alternatives fits into the City’s water resources portfolio, provide system resilience, satisfy community preferences, and result in the overall best and highest use of the resource.

References

Reports

Recycled Water Work Groups Final Report, Section 2, Arizona Department of Environmental Quality, 2018, pg 11.

Guidance Framework for Direct Potable Reuse in Arizona, Chapter 3 Recommendations, National Water Research Institute, 2018, pg 46

Internet Document

Tiffani Cáñez, Mark Brusseau, Bo Guo, Dick Thompson, and Jennifer McIntosh, "PFAS in Groundwater at a Reclaimed Water Recharge Facility" *UA Science Hydrology & Atmospheric Sciences April 2020*, https://has.arizona.edu/pfas-groundwater-reclaimed-water-recharge-facility (August 19, 2021).

Attachment A: Reclaimed Water Pricing Policy and Economic Value of Water Memorandum

Attachment B: Recommended Sampling for Potable Reuse

Attachment C: Initial Supplemental Sampling for Flagstaff Reclaimed Water

Includes a list of constituents to be sampled and tested prior to help inform the decision process for future reclaimed water use