Water Master Plan
2023

Engineering Division

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Acronyms and Abbreviations

AF	acre-feet
AF/yr	acre-feet per year
aka	also known as
ADD	Average Day Demand
AMI	Advanced Metering Infrastructure
ANSI	American National Standards Institute
ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BEC	Box Elder Creek
BMR	Bell Mountain Ranch
CCPWA	Cherry Creek Project Water Authority
CDPHE	Colorado Department of Public Health and Environment
CEC	Contaminant of Emerging Concern
CIP	Capital Improvement Plan/Project
cfs	cubic feet per second
CO	Colorado
COS	Cost-of-service
CPMD	Castle Pines Metropolitan District
CPNMD	Castle Pines North Metropolitan District
CRW	Castle Rock Water
CWCB	Colorado Water Conservation Board
CWLI	Colorado Water Loss Initiative
DOC	Dissolved Organic Carbon
DOIT	Division of Innovation and Technology
Dominion	Dominion Water and Sanitation District
DWSD	Dominion Water and Sanitation District
ECCV	East Cherry Creek Valley
EMMP	Energy Management Master Plan
ENRCCI	Engineering News Record Construction Cost Index
EPA	United States Environmental Protection Agency
°F	degrees Fahrenheit
FMP	Financial Management Plan
FWTP	Founders Water Treatment Plant
GIS	Geographic Information System
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GWDUI	groundwater directly under the influence
HAA5s	Haloacetic Acids
HID	Henrylyn Irrigation District
HOA	Homeowner’s Association
HVAC	Heating, Ventilation, Air Conditioning
IREA	Intermountain Rural Electric Association
KPI	Key Performance Indicator

lf	linear feet
LIRFs	Lawn Irrigation Return Flows
MG, Mgal	million gallons
MGD	million gallons per day
MS4	Municipal Separate Storm Sewer System
MWTP	Meadows Water Treatment Plant
NEPA	National Environmental Protection Act
O&M	Operations and Maintenance
PCWPF	Plum Creek Water Purification Facility
PCWRA	Plum Creek Water Reclamation Authority
PFAS	Per- and Polyfluoroalkyl Substances
PWWD	Pinery Water and Wastewater District (Pinery)
Plan	Water Master Plan
PMP	Preventive Maintenance Program
PRV	Pressure Reducing Valve
PW	Public Works
PWP	Aurora's Prairie Waters Project
PWSD	Parker Water and Sanitation District
QMRA	Quantitative Microbial Risk Assessment
RWRWTC	Ray Waterman Regional Water Treatment Center
RHR	Rueter-Hess Reservoir
RHWPF	Rueter-Hess Water Purification Facility
RO	Reverse Osmosis
SCADA	Supervisory Control and Data Acquisition
SDF	System Development Fee
SEO	State Engineer's Office
sf	square feet
SFE	Single Family Equivalent
SMWSA	South Metro Water Supply Authority
SWPP	Source Water Protection Plan
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOU	Time of Use
Town	Town of Castle Rock
TTHMs	Total Trihalomethanes
UCMR	Unregulated Contaminant Monitoring Rule
UDFCD	Urban Drainage and Flood Control District
UV	Ultraviolet
VFD	Variable Frequency Drive
w/	with
w/o	without
WEMP	Water Efficiency Master Plan
WFMP	Water Facilities Master Plan
WISE	Water Infrastructure and Supply Efficiency
WQCD	Water Quality Control Division
WRIP	Water Resources Implementation Plan

WRMP	Water Resources Master Plan
WROS	Water Resources Optimization Plan
WRSMP	Water Resources Strategic Master Plan
WTP	Water Treatment Plant
Yr/YR	Year
ZOP	zinc orthophosphate

Executive Summary

The 2023 Water Master Plan (WMP) presents findings and recommendations resulting from a reassessment of water program needs for the Town of Castle Rock through 2065, with a focus on near term needs through 2027. This 2023 plan builds on the previous master planning efforts, but is also a stand-alone document.

This document outlines **general planning** for **expansion** and **optimization** of the **Castle Rock Water System** necessary to meet the **evolving water needs of the local community**.

- **General planning** identifies previously completed programs and projects, as well as proposed future programs and projects needed for short-term and long-term planning horizons. Cost estimates for various programs and projects have been outlined as well as funding strategies to cover these costs.

- **Expansion** of the Castle Rock Water System is necessary due to anticipated population growth from both infill development and future Town annexations and expansion of the overall water service area. Timely construction of new capital projects in close coordination with infrastructure projects by local developers, other Town departments, and regional water providers, is integral to intelligent expansion of the water system.

- **Optimization** of the Castle Rock Water System is needed to ensure assets are maintained at the lowest possible life cycle costs. Various operations and maintenance programs, hydraulic modeling programs, and asset management programs are utilized to accomplish this goal. Capital projects to rehabilitate and replace existing infrastructure, completed in coordination with projects by local developers, other Town departments, and regional water providers, are also crucial to optimization of the water system.

- **Castle Rock Water System** is the local infrastructure directly utilized for supply, treatment, storage, pumping, transmission, and distribution of water. It does not include items such as water rights, shared regional infrastructure, and personnel staffing.

- **Evolving water needs of the local community** are the driving force behind the overall plan. Population growth, per capita water demand changes, development activities, drinking water regulatory changes, climate change and drought, and water supply source changes are some of the factors impacting these evolving needs. These factors are in a continuous state of change, thus necessitating regular updates to the Water Master Plan.

Currently the Town of Castle Rock's potable water distribution system, which serves a population of over 82,000, has more than 14,800 system valves, more than 4,720 active fire hydrants, is over 439 miles in total length, and distributes (on average) in excess of 9.38 million gallons of potable water each day to the customers of Castle Rock. The 2022 peak day demand was 19.22 million gallons per day (MGD). At an estimated build-out population that accounts for future annexations of potential infill areas and extraterritorial services, the

distribution system could serve more than 155,000 residents. For planning purposes, we estimate high-case and low-case scenarios to encompass a range of possibilities. In order to plan for varying scenarios, CRW has identified that projected demands could be as low as 12,546 AF under the high water conservation scenario of 100 gpcd, and 112,000 people versus 23,439 AF under a low water conservation scenario of 135 gpcd with 155,000 people. The base scenario is 118 gpcd at a population of 122,000, and corresponds to a projected demand of 16,126 AF by 2050 (note the assumption that once a built-out population is reached, no more population growth is planned)

The following principles serve as the basis for the Town's water programs:

- **Principle 1:** Protect People, Property and the Environment
- **Principle 2:** Plan for the Future
- **Principle 3:** Encourage Coordination of Infrastructure Needs
- **Principle 4:** Operate the Water Enterprise Fund as a business, balancing revenue and expenses
- **Principle 5:** Provide for effective long-term operation and maintenance of water system facilities
- **Principle 6:** Ensure water planning is consistent with, and considered part of, a fully integrated total water management approach
- **Principle 7:** Identify and implement changes to the Water System which will improve long term sustainability through resource recovery and net zero energy use

Much of the effort to revise the Water Master Plan for 2023 was to revisit the hydraulic planning model based on future and evolving water supply and demand models, and to update the Capital Improvement Plan to incorporate WISE and other regional components into the Castle Rock Water system. After changes to the landscape and irrigation criteria for new development were adopted in November 2022 (very limited turf for new development), the modeling was revisited. The landscape and irrigation criteria changes resulted in the changed timing of many capital projects consistent with the updated water supply and demand model as well as availability of capital reserves, and also eliminated and / or reduced the scope of projects consistent with the expected reduction in total water supply needs and peak demand infrastructure (i.e., reduced the size of future pipes and other infrastructure consistent with revised lower future demand).

Collateral to that effort was revisiting future near-term and long-term capital plans and the cost estimates used. The capital plan is used to identify needed improvements to the supply, treatment, storage, pumping, transmission and distribution systems to handle growth and meet future system demands, but also identifies capital rehabilitation and replacement projects for existing assets. Rehabilitation and replacement of aging infrastructure will take a higher priority in future years, especially as the Town approaches build out. With respect to capital plans, there were some significant changes to the five-year capital plans, but there were also several major changes to the long term (>5 years out) capital plan which were made for this study year. Additional requirements for desalination related to the Water Infrastructure Supply Efficiency (WISE) project as well as increases in capacity in the Plum Creek Water Purification

Facility (PCWPF) expansion were incorporated into the Water Resources capital plan and account for a large increase in near term spending.

Long term planning was impacted by upcoming proposed changes to turf restrictions on new homes and non-residential development which will reduce the future capacity needs as consumption and peak demands in new development will be significantly less than current areas of Town. In the Water fund, additional funds were allocated for future deep groundwater well redrills, new wells, and associated raw waterlines because groundwater resources will still be a component of CRW's water portfolio even as we continue the transition to more renewable and reusable supplies. The total water capital plan for the years 2024-2066 is estimated at $416,388,796, with over $86 Million dedicated to rehabilitation and replacement, an increase of over $113 Million to the previous plan that covered 2021-2060. This does include $50 Million planned for a new water treatment plant in the Crystal Valley Ranch area.

Annually, Castle Rock Water conducts a rates and fees study and revises the cost of the service model in order to recommend changes, if any, to the rates and fees schedule. Further, the capital plan is devised to try to spread out capital costs in order to minimize any unexpected jump in rates or fees in any one year.

Increases in system development fees (SDF's) primarily affect new development, and support the expansion of facilities or development of new infrastructure to accommodate the increase in demand that comes from growth. System development fees (SDFs) are a function of year-end 2021 fixed assets, 2022 year-end estimates of capital improvement project costs, 2023 through 2065 capital improvement project plans, and system capacity for water, water resources, and wastewater and developable acres for stormwater. For 2023 the adopted increase in SDFs for the water fund was 10%. Several factors are driving the recommended increases in SDFs identified in the SDF model and financial model. First, Castle Rock continues to see strong growth in both residential and non-residential customers from existing entitlements in Town. While growth has slowed in the current year due to external economic factors, projections still indicate continued strong growth in the coming years.

To keep pace with this population increase, additional projects have been added to the long term plan over the last several years and the infrastructure and capital costs for these projects are now better defined. Additional infrastructure and the costs for that infrastructure have also been identified to meet the increased peak demands from a larger customer base. Next, the pace of growth has exceeded projections. This drives the need to build projects sooner to meet annual water supply needs creating the need to generate more revenue sooner. It also requires building peak demand capacity sooner than expected. For example, recent growth has driven the need for additional water SDFs for new wells to help fill the supply needs until longer term renewable water projects can be completed. If growth was occurring more slowly, these wells might not have been needed.

For the monthly water user charges and volumetric fees, there are planned increases of 3.0 to 4.5 percent from 2022 rates for 2023 through 2027. Increases in water user charges reflect fixed operations and maintenance costs, variable operational costs such as electricity (CRW's second largest operating cost) and the costs of capital rehabilitation and replacement. Several

items in particular contributed to increases of 37% in O&M costs over the five-year study period for rates and fees, and are reflected in the proposed increases in rates:

- Meter costs under supplies are going up significantly as we transition to advanced metering infrastructure (AMI);
- Operating costs for WISE will continue to increase as the full quota of Castle Rock's WISE water is delivered with that occurring in 2026;
- Personnel costs have risen significantly in response to staffing shortages and competition for labor across the region with Castle Rock Water and the Town as a whole taking action on this issue in 2022;
- CORE (the electrical service provider) has increased rates for electricity by 6% across the board in 2022.

Increases in volumetric rate fees reflect variable costs and affect those who may not use water wisely, do not practice conservation within the household, or simply use more water because of a larger household.

In addition to the capital component, the plan lays out programs for the long-term, cost-effective operation and maintenance of the system. These programs include:

- An extensive valve exercising and flushing program to maintain water quality;
- Investment in asset management software and development of the Asset Management Program, that works integrally with the inspection, operations and maintenance programs, and capital planning efforts;
- In-house staff hydraulic modeling and data collection to analyze and optimize the distribution system and forecast future requirements;
- Regularly scheduled maintenance at all water treatment plants, pump stations, pressure reducing valves, and storage tanks;
- Adequate manpower and staffing, and an investment in training, safety, and career development;
- Appropriate investment in equipment and maintenance of facilities;
- Responsible replacement of aged infrastructure;
- Energy demand management and optimization.

Going forward, CRW plans the following to implement the following components of the water master plan:

- Investigate whether the migration to direct potable reuse (DPR) from the current indirect potable reuse (IPR) scenario is the right path forward for CRW, looking at the cost, regulatory, technical and water quality implications to make an informed decision for its customers;
- Evaluate water quality continuously, health advisories and maximum contaminant levels and continue to optimize water treatment to address these items as science and regulation develop;
- Monitor our drinking water reservoirs and develop programs to ensure raw water quality in these reservoirs is maintained;
- Complete Advanced Metering Infrastructure (AMI);

- Execute the SCADA Master Plan with a focus on continuing to improve our cybersecurity;
- Full incorporate the service area to include the existing Bell Mountain Ranch system;
- Ramp up the Rehab and Replacement Plan;
- Support state and local efforts to reduce phosphorus in the local watersheds through its participation with the Chatfield Watershed Authority (CWA) and the Cherry Creek Basin Water Quality Authority (CCBWQA);
- Work with partnering agencies to expand our capabilities to store and/or bring reusable water supplies back to the Town;
- Advance regional projects that position CRW for the future. Projects to construct infrastructure such as reservoirs, pipelines, and treatment facilities are occurring and Castle Rock will continue to support and participate in these projects where it makes sense. This infrastructure helps bring water to the area and, through economies of scale by partnering with other entities, reduces the cost impact to our customers for long-term renewable water supply;
- Defend our groundwater rights against harmful changes to management of those rights by the State, constructing new wells, acquiring additional groundwater rights, and adding new groundwater sources to our groundwater treatment plants that have available capacity as well as constructing new plant capacity where it makes sense;
- Utilize the interconnect with the Pinery to bring CCPWA renewable water back to RWRWTC for retreatment and distribution;
- Identify and implement projects to improve long term sustainability through resource recovery and reducing net energy use.

1. Introduction

This 2023 Water Master Plan update highlights critical findings and recommendations resulting from a reassessment of water infrastructure needs for the Town from current conditions through build out of the community. In 2006, the Town prepared a Water Facilities Master Plan (WFMP) that examined the existing water system infrastructure and identified water supply, treatment, storage, transmission and distribution system capital improvement projects required to provide service to existing and future development through build out of the Town's service area boundary. Specifically, the WFMP included examining the following components of the water supply system:

- Existing water supply, treatment, storage, transmission and distribution system capacity;
- Potable water demands and finished water production capacity;
- Water treatment requirements for meeting existing and future demands;
- Water distribution system modeling for both existing and future conditions;
- Recommended capital improvements for maintaining a safe and reliable drinking water system.

A significant change in 2006 from previous master plans was to migrate towards centralized water treatment facilities rather than provide multiple water treatment plants to serve localized demands or to rely on groundwater without treatment beyond chlorination. This transition was logical given the Town's decision at that time to route the majority of renewable water sources, such as reclaimed water, alluvial water, and imported surface water, from one location, the Rueter-Hess Reservoir (RHR).

Since preparing the 2006 WFMP, water supply strategies have evolved and the Town has modified the approach to supply, treatment, storage, transmission, and distribution of drinking water. Namely, the Town's reliance on nonrenewable groundwater was projected to continue to require new deep aquifer well facilities to be constructed. In 2010 this approach was modified and only replacement wells were to be drilled to maintain the current deep well production capacity. Instead of investing more capital into new non-tributary groundwater, the Town embarked on delivering the first renewable water facility in 2013. The Plum Creek Water Purification Facility, PCWPF, an advanced surface water purification facility, was initially brought online in May of 2013 with a treatment capacity of four MGD. Additional alluvial wells at the South and Central Well fields were also completed to provide renewable water to the facility. The Town also successfully converted all of its water treatment facilities to secondary disinfection with chloramines in 2013, concurrent with the introduction of the PCWPF as the backbone of the system's treatment facilities.

PCWPF remains the backbone of the water system. Treatment was expanded to 6 MGD with the addition of new membrane racks in 2017. In early 2021, the completion of advanced treatment processes at the facility positioned the facility for future DPR, while enhancing the IPR capability. The theme of centralized water treatment facilities still remains and many of the capital improvements related to water storage, transmission and distribution remain vital parts of the updated master plan. Due to a continued reliance on deep groundwater, particularly during peak summer demands, the Town still relies heavily on its groundwater

treatment plants, therefore continues to invest in existing and future wells, and is evaluating the need for a new water treatment plant in the southern part of Town.

In 2016, renewable water sources accounted for roughly 11% of all raw water supply. In 2022, renewable water sources accounted for 35.1% of all raw water supply. The overarching goal is to continue to develop a water supply portfolio that consists of 75% renewable water sources and 25% non-renewable sources by 2050. After 2050, CRW will continue the development of renewable sources working towards a 100% renewable supply in normal or wet hydrologic years by 2065 to complement the existing non-renewable supply. To this end, CRW updated the Water Resources Strategic Master Plan (WRSMP) in 2021 that lays out how we are going to meet that goal over the next thirty-plus years. Additional alluvial water supplies are being developed, and plans to expand the PCWPF to 12 MGD are progressing sooner rather than later in the capital plan.

Imported surface water from the WISE partnership was realized in 2018, bringing the Town closer to its future goal of 75 percent renewable water supplies. The PCWPF was expanded and advanced treatment processes for indirect potable reuse (IPR) were added to treat six MGD, with future expansion to twelve MGD. Two planned diversion structures on Plum Creek, pipelines and pump stations were constructed which allow the Town to capture up to one hundred percent of its reusable effluent, return flows and other water rights, another huge step in meeting the goal of 75 percent renewable water sources and 25% non-renewable sources by 2050. The first diversion, named CR-1, was in operation by July 2017, while the second diversion was acquired with the purchase of the United Water assets near Sedalia in late 2017. Completion of the Plum Creek Diversion Pump Station and Plum Creek Raw Water Return Pipeline in early 2021 allowed CRW to capture almost 100% of its reusable effluent, return flows and other water rights.

Early delays in bringing renewable water supplies to Town, coupled with a vigorous economy from 2017 to 2020, and an uptick in new development, prompted CRW to revisit the supply and demand model and make the hard choice to continue to invest in new deep groundwater wells to supplement near-term water supplies. New wells were constructed in Castlewood Ranch and Lanterns and future wells are planned for the Crystal Valley Ranch area. The Town acquired water rights, deep wells, and a water treatment facility in Bell Mountain Ranch (BMR) in return for assuming the water service needs of that community. CRW is evaluating whether improvements to the BMR WTP, and/or constructing a new WTP in the south part of Town, are needed to supplement treatment capacity, especially to meet peak summer demand.

In 2010 when the original version of this master plan was created, development of the community had slowed considerably due to the economic downturn and a slow and steady growth was projected for the foreseeable future. Since the 2017 update, the Town has seen a dramatic uptick in commercial and residential development, such that the timing and scope of projects has changed, prompting annual rates and fees evaluation to provide for a steady revenue stream to support short and long term capital improvements. Capital improvement plans, typically in five-year planning periods, have been updated based on new patterns and expectations for growth, changes to landscape and irrigation criteria, and evolving along with

the Water Resources Strategic Master Plan. This water master plan update is intended to provide a high level overview of the water system infrastructure and highlight future planned capital improvements.

This water master plan has been developed with consideration to seven guiding principles that reflect the vision and mission of Castle Rock Water. The seventh principle is new since the last master plan update. That principle reflects CRW's vision of forward thinking to continue to be a national leader, and CRW's mission to balance social, environmental and fiscal responsibilities in a sustainable manner.

- **Our Vision:** Castle Rock Water will be a national leader among water utilities, focused on customer satisfaction and delivering outstanding quality and value.

- **Our Mission:** We provide our community with exceptional service that protects public health and balances social, environmental and fiscal responsibilities in a sustainable manner.

Principle 1- Protect People, Property and the Environment

Community drinking water systems have been around for a long time, primarily developing from recognition by public health officials that many infectious diseases were caused by drinking contaminated water supplies that were not adequately managed and treated. Similarly, as community water treatment systems developed, responsible parties came to better understand the need for protecting their source water, both for domestic and recreational uses. Along the way, the Safe Drinking Water Act was passed by Congress to protect drinking water and its sources from naturally occurring and man-made contaminants. Castle Rock Water is transitioning from a groundwater based system to a system using mainly renewable surface water. In line with the principle of protecting people, property and the environment, Castle Rock Water has and will continue to implement projects and programs to ensure we are good stewards.

- **Capital Improvement Program** - Castle Rock Water manages over $622.6 million dollars in total water/water resources assets including six water treatment plants, 454 miles of potable water mains, 53 miles of raw water mains, 9 pump stations, 16 active water storage tanks (two more nearing completions in 2023), 119 active wells, 79 active pressure reducing valves, and other infrastructure. Reliability of the overall water system (current and future facilities) is a primary focus. Castle Rock Water shall construct and maintain facilities which meet or exceed all water quality standards, in the most cost effective manner possible. Castle Rock Water Engineering and Operations staff coordinate to insure efficient project delivery (from project initiation through closeout) of infrastructure that improves the reliability of the overall water system.

- **Design and Construction Standards** – Castle Rock Water staff collaborate on regular updates of design and construction criteria for use in the expansion and optimization of the Castle Rock Water system. These criteria and standards are utilized for both capital improvement projects and developer projects to insure that safe and fiscally responsible

services are provided for all customers. Standards and criteria are revised to keep pace with regulations (for example, state requirements in 2020 related to tracer wire for locating utilities) or with standard construction techniques.

- **Water Quality Focus** – CRW maintains an internationally recognized consulting firm on retainer to help ensure that we are addressing the most up-to-date science on water quality, health advisories and maximum contaminant levels. Castle Rock Water executed an on-call services agreement with CDM Smith in May 2019 (renewable for up to three years) to provide expertise in water quality consulting with emphasis on reuse water and contaminants of emerging concern, and mixing of different water supplies (imported, surface water, reuse water, groundwater, etc.) and the resulting impacts on corrosion control, process control, regulatory limits and aesthetics. The focus of the work will assist CRW with system optimization and the planned integration of new water sources to increase water supply resiliency and meet future projected water demand needs by integrating indirect and direct potable reuse sources. Task orders are issued defining the scope of work requested, and results are generally provided in the form of a final technical memorandum with conclusions and action-item recommendations, depending on the task at hand. Typical tasks to be accomplished include:

    - Plum Creek Water Purification Facility (PCWPF) Treatment Process and Water Quality Review;
    - Water Infrastructure and Supply Efficiency (WISE) Water Quality Review;
    - Denver Basin Groundwater Quality Review;
    - Summarize Raw Water Quality;
    - Monitoring Plan Review;
    - Operations and Treatment Process Review;
    - Distribution Mixing System Model and Review

  Annually, the environmental health and safety group produce an annual report that is a review of the regulatory landscape as it relates to water quality. The study outlines the regulatory changes from previous years, and identifies pending regulation in the coming year, and then comment on the potential impacts to water quality, particularly as they relate to PCWPF, to operations, or even to capital projects.

- **Conservation Focused Projects** - Efficient water use is a key element of living in the semi-arid high desert climate, receiving less than 15 inches of precipitation each year, and is a critical part of the Town of Castle Rock's (Town) water resource strategy. Additionally, the State of Colorado requires that water providers who sell 2,000 AF/yr of water or more annually have a State approved water efficiency plan. Castle Rock Water completed a 2015 Water Efficiency Master Plan (WEMP) that met or exceeded requirements of the Colorado Water Conservation Board Municipal Water Efficiency Plan Guidance Document. This document was updated for 2023. This Plan focuses on demand-side activities, such as education, rates, rebates, audits, and regulations. This Plan also solidifies the Town's commitment to efficient water use and conservation. The WEMP outlines a goal-oriented, performance based, and cost-effective strategy that

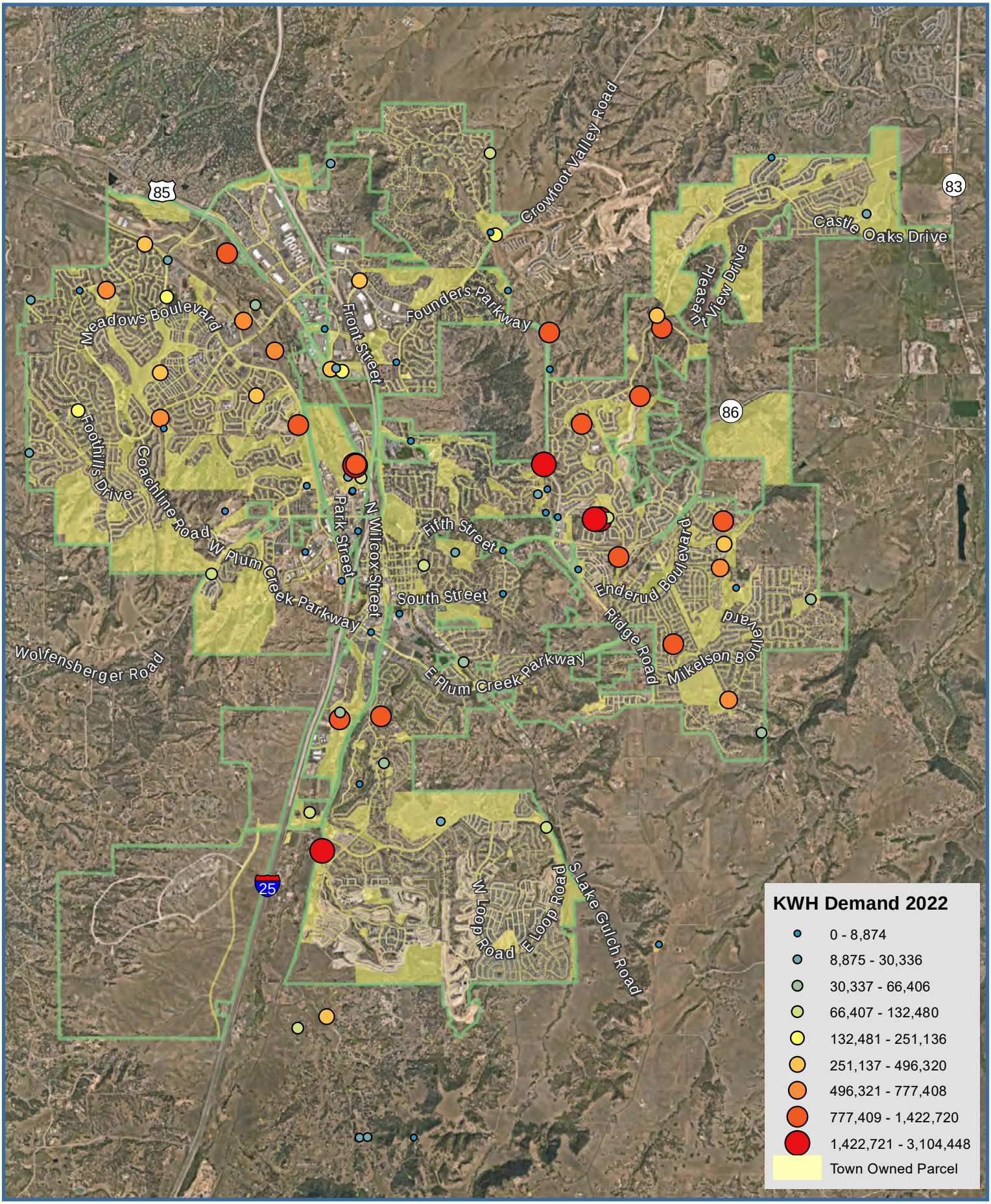
delineates our current conservation programs and identifies the Town's plans for other conservation programs that will result in water savings to our community.

CRW continues to emphasize conservation in order to achieve a per capita demand of 100 gallons per person per day by 2050. This would account for an additional 14.5% savings in water use and essentially would act as a new source of supply. If the Town's existing customers (approximately 82,000 people) are able to reduce water consumption from 118 gallons per person per day to 100 gallons per person per day, the water use savings would represent approximately 1,610 AF/yr. This kind of savings would reduce the need to develop new water supplies potentially avoiding $70 million to over $110 million in future investments. Key initiatives related to conservation that are in progress include reducing the amount of irrigated turf in the community (new landscape and irrigation regulations were adopted in 2022), installing advanced metering infrastructure to allow residents to better manage their water use (underway in 2022 for completion system-wide by 2026), and expansion of greywater systems in new development (a pilot program is underway in Red Hawk for 26 homes).

- **Energy Management** - The second largest operating cost, electricity, reflects full operation of the Plum Creek Water Purification Facility and other treatment plants, alluvial and groundwater well operations and pumping associated with water and wastewater service. As such, the cost of energy used is a significant part of Castle Rock Water's operational budget. CRW is taking multiple approaches to improve operational efficiencies that will in turn reduce energy needs and associated costs. Using less energy will also lessen the environmental impact of daily operations (environmental pollutants are generated in production of energies used). Existing operations are frequently reviewed for opportunities to reduce energy use and new capital infrastructure is designed and constructed with the latest technologies in energy efficiency. CRW is also looking proactively at the use of renewable energy sources to reduce the cost of energy for the provision of water service. A test system of solar power was installed at the new administrative building and is actively being monitored for performance. A heat map (see Figure 1.1) of energy use by CRW in Town has also been developed as well as an identification of property where renewable energies might be appropriate.

- **Comply with all Environmental Regulations –** CRW programs and projects meet or exceed water quality regulations established by the USEPA (Safe Drinking Water Act), the CDPHE and other applicable regulatory agencies. In November of 2017, CRW purchased the United Water and Sanitation District's infrastructure, which included the Plum Creek Diversion structure in Sedalia. In 2020, CRW constructed the Plum Creek Diversion Pump Station at the diversion site, and the 5.87-mile-long Plum Creek Raw Water Return Pipeline from the pump station/CRR1 reservoir to the CRW raw water system to bring renewable water supplies located downstream of the confluence of East and West Plum Creek back to the PCWPF, where the addition of advanced treatment processes was completed in late 2020. The Advanced Treatment (AT) processes at PCWPF provide for a multiple barrier, advanced treatment approach to treat this water in an Indirect Potable Reuse (IPR) scenario. The multiple barrier approach used

existing infrastructure to its fullest extent while adding advanced treatment processes to enhance removal of pathogens, organics, regulated drinking water contaminants, and contaminants of emerging concern. Since the AT expansion came online in early 2021, the PCWPF has been in compliance with all state and federal standards for water quality. CDPHE will be promulgating final rules for DPR in 2023. CRW is evaluating whether the conversion to DPR, versus the current successful operating scenario of IPR, will be in the best interests of the Town.



CASTLE ROCK Qwater
Securing our future drop by drop

0 0.5 1 2 3 Miles

Date: 3/16/2023 1 inch = 6,000 feet

Document Path: J:\GIS\Projects\Energy_Analysis\Town_Prop_Color.mxd

CASTLE ROCK WATER MASTER PLAN FIGURE 1.1

Principle 2- Plan for the Future

Central to any master plan is that it has to be a plan for the future, and fundamental to good planning is having the right people and tools to develop, analyze and understand the model results. In 2010 Castle Rock Water purchased modeling software and trained staff to develop a water hydraulic model that could be used and updated as growth conditions change. Key components of the Castle Rock Water planning process include:

- **Smart Service Area Expansion** – CRW staff evaluates expansion of service area boundaries where it makes sense to provide maximum economies of scale for our customers or to safeguard our interests in the locally available water supplies, particularly in the aquifers. Service areas may expand as more private unincorporated lands in Douglas County plan to incorporate within the Town boundaries, or where service might be extended by means of an extraterritorial service agreement. In each case our customer base would increase and a priority of Castle Rock Water would be to evaluate the development plan so there is an overall reduction in operating costs to each customer.
    - **Bell Mountain Ranch (BMR**) – in 2022 CRW acquired the water assets of the Bell Mountain subdivision, located just south of the Lanterns subdivision in Crystal Valley Ranch and the payment of system development fees in exchange for a commitment to serve through an extraterritorial agreement. The community of 321 homes had a water treatment plant that needed substantial upgrades to be in compliance, lacked sufficient water storage for its fire flow requirements, and lacked a renewable water strategy for the future. CRW had acquired wells in the BMR subdivision as part of the acquisition of the United Water assets in 2017, but lacked a way to efficiently and beneficially use the wells. The Ridge Estates (lower part of Crystal Valley Ranch) developer needed water storage in the Tan pressure zone of Town, of which none existed, but could be served by a tank in the Bell Mountain area, which the developer is constructing and which will provide for the Ridge Estates storage needs and the additional needed fire flow storage for BMR. This expansion of the service area benefited existing residents and was an example of smart service area expansion.
    - **Macanta (Canyons South)** – CRW agreed to serve the planned development of 968 single family homes back in 2005. At the time, one of the main reasons for extending service was that the project entailed a major ground water acquisition – approximately 2,700 AF of Denver Basin ground water in an area of good yields that would be under CRW control and production. The water rights available exceeded the water rights dedication requirement by 1,400 AF. By serving the community, CRW also ensured that another entity did not develop deep aquifer groundwater wells in that area. The community was also very close to backbone infrastructure of the Town, realizing maximum economies of scale from the Town's infrastructure investment, and generating over $14 million in system development fees. Further, the Town could also ensure conservation oriented landscape and irrigation.

- **Maximize Renewable Water Use** - The Town's water supply strategy is detailed in the Water Resources Strategic Master Plan approved updated in 2021. In short, CRW plans to fully develop and utilize the Town's current renewable water rights which include surface water rights, lawn irrigation return flows, and water reuse in both the Cherry Creek basin and Plum Creek basin. CRW also plans to acquire additional renewable water resources where those resources are cost effective and can be integrated into our existing infrastructure and future planned infrastructure. The water supply strategy will take significant capital expenditures and coordination to integrate new facilities with the Town's existing water distribution system.

- **Maximize Future Water Supplies** - A conjunctive use (or a coordinated blend) of surface water and groundwater will be implemented to balance environmental and fiscal responsibilities. Aquifer storage and recovery (ASR) is one method being implemented to replenish the Denver Basin Aquifer. Treated, renewable water will be injected directly down-hole into existing wells and stored in the aquifer for future use. A pilot program for two ASR wells in the Meadows was completed and conditionally permitted in 2014 to allow testing but issues developed with one of the downhole valves used to control flow. Repairs were made and the project received final approval from the EPA in January of 2023; plans are to begin injection operations in March of 2023. In 2022, construction began on two additional deep groundwater ASR wells at the Ray Waterman Regional Water Treatment Center (RWRWTC) to store excess WISE water. Staff believes that up to a total of 600 AF/yr of renewable water could be stored in the two existing and two new ASR wells.

  Regional water system interconnections and partnership agreements are being developed and projects executed with entities including Water Infrastructure and Supply Efficiency (WISE) Authority, Chatfield Reservoir Mitigation Company, Parker Water and Sanitation District, Dominion Water and Sanitation District, Pinery Water and Wastewater District, Castle Pines Metropolitan District and Cherry Creek Project Water Authority. These interconnections and agreements will allow for import of additional water supplies which will result in reduced cost impact to our customers as well as resiliency in water supply during potential emergencies.

  Water storage expansion programs and projects are being implemented. Operations programs to fully utilize treated water storage are helping increase capacity to meet peak day and fire flow demands without unnecessarily ramping up raw water supplies and treatment plants. Proper water storage management also ensures that water quality is maintained throughout the distribution system. Options for increasing storage of future raw water supplies are also being pursued. Current storage space includes Rueter-Hess Reservoir, Chatfield Reservoir, the future Walker reservoir, expanded Castle Rock Reservoir #1, future Castle Rock Reservoir #2 and ASR facilities. CRW is developing a program to optimize the placement of supplies during periods when they aren't needed by customers.

- **Coordinate Planning –** CRW will continue to coordinate water rehabilitation projects closely with the annual pavement maintenance program managed by the Castle Rock

Public Works Department. Distribution system infrastructure improvements are planned for installation prior to roadways being repaved. Working together with the Public Works Department, Parks and Recreation department, and the development community is important to plan and execute smartly in order to minimize overall expenses and disturbances to customers.

- **Frequent Hydraulic Model Updates –** CRW staff update the hydraulic model annually to account for changes in the water system. The existing hydraulic model of the distribution system is an evolving work in progress to account for such changes as expansion of the service area, new development, revisions to the growth model, changes to landscape regulations and conservation practices, and changes to renewable water supplies being received from the various sources. Continuing updates to the model help ensure that needed improvements to existing facilities are planned and included in the appropriate budget year and are constructed and physically available before the actual demand or need arises. Updates also help ensure that development projects are accounting for potential future needs so that infrastructure can be appropriately sized from the initial planning phase.

- **Water Supply Assessment -** CRW needs to adequately project future water supply demands and secure water for the future. Based on recent and projected development activity, CRW has assumed that the Town could build out to a total future population as high as 155,000 by approximately 2050-2055. CRW is planning for the optimal mix of regulation, conservation, reuse, groundwater and renewable water sources in order to provide the Town with a long-term, sustainable water supply for the Town's future water needs.

- **Water Storage Assessment -** CRW currently has 16 active potable water storage tanks constructed of reinforced concrete and sealed for water quality protection. Two new storage tanks are under construction in 2023 and will add an additional 2.4 million gallons of storage. As the Town's boundaries and developments grow, CRW will evaluate storage needs and plan ahead for future water storage needs, to include replacement of aging tanks.

    - **Peak Demands -** One of the purposes of water storage tanks is to meet peak demands (max day and peak hour) of the water distribution system. The Town has multiple pressure zones that sometimes require more than one tank to serve each zone. The required storage volume for a particular distribution area is calculated by summing up the projected maximum day demand and the maximum fire flow demand for the area. Pump stations and pressure reducing valves (PRVs) are used to move water between pressure zones.

    - **Fire Flow Requirements –** CRW, in coordination with the Town Fire Department, establishes fire flow requirements for an area based on appropriate building codes (code sets the flow rate and duration of flow rates). Fire flow demands are documented in the approved Final Utility Reports for a residential or commercial development. The maximum fire flow demand for any particular

area of Town is used in the modeling and planning processes. Fire flow demands for a particular service area are not cumulative for modeling and planning purposes-only the largest fire flow demand is used. Pump stations and PRVs are used to move water between tanks to supplement storage between zones

- **Drought Tolerant Initiatives –** Droughts of varying durations and severities happen with unplanned regularity over long periods of time. CRW is working to design and construct a water supply and distribution system that will be flexible and resilient in its ability to supply potable water to customers during periods of drought.

    - **Alternate Sources of Supply -** CRW is developing infrastructure to utilize the Town's current renewable water rights, which include surface water rights, lawn irrigation return flows, and water reuse in both the Cherry Creek basin and Plum Creek basin. Development of the Town's Denver Basin groundwater supply will continue. This groundwater supply will help meet the demands of our customers in the short term and provide reliability and drought protection in the long term.

    - **Water Conservation Programs** - CRW developed the 2015 Water Efficiency Master Plan (WEMP) that met or exceeded the Colorado Water Conservation Board Municipal Water Efficiency Plan Guidance Document. The WEMP was updated in early 2023. Effective management of the community's resources is good environmental and financial stewardship. Conservation programs such as installation of advanced metering infrastructure (AMI), a formal meter testing program, and Water Wiser courses are planned to continue and change as needs arise. Effective conservation measures (including AMI) reduce overall water consumption and allow CRW to more accurately determine water use demand patterns for various periods of time. Effective conservation programs allow existing infrastructure to be utilized more efficiently and potentially reduces overall costs of future capital infrastructure expansion. Accurately determining water demand patterns as part of the annual rates and fees analysis and hydraulic modeling allows staff to more effectively plan for raw source water supplies and treatment facilities to meet demands. System leaks and water theft situations are also more readily identified and addressed with a robust metering capability in place.

    - **Landscape Regulations:** In 2022 CRW updated Landscape regulations for all new development, both residential and nonresidential, to be effective January 1, 2023. CRW had determined that the changes were needed in order to meet the strategic goal of 100 gallons per capita per day by 2050. Half of all water consumed by customers was used outdoors. Peak summer demands, primarily due to irrigation, are 4 to 5 times average winter demands. Most turf grass in Castle Rock is considered "non-functional"; non-functional turf is areas of turf where play or recreational activities cannot or do not take place. Turf reductions for new development had the greatest usage reduction benefit. The residential changes adopted included:

- No turf in front yards for new homes;
- Backyards for new homes no more than 500 square feet of irrigated turf (equivalent to a 20' by 25' area);
- ColoradoScape design instead;
- Swimming pools and water features will reduce total allowed turf;
- Incentivized front yard and backyard landscapes to be installed by home builder.

For nonresidential properties, the goal is to eliminate non-functional turf.

CRW acknowledged that the changes would mean lower revenues from system development fees and reduced usage, but noted that the changes would reduce the size of future infrastructure, reduce future O&M costs, and translated into savings of $56 - $72 million in future CIP costs.

Principle 3 - Encourage Coordination of Infrastructure Needs

CRW strives to coordinate with other departments, the development community, and our regional partners to ensure that the financial resources of the department are used judiciously. Timely coordination helps ensure that duplication of efforts does not occur, and also often offers economies of scale.

- **Local Coordination with Public Works -** Public Works has an annual program which identifies Town roadways for maintenance. CRW coordinates with Public Works to ensure that any necessary infrastructure improvements are completed prior to roadway maintenance (and demolition of new pavement is not needed shortly after installation). Several projects were completed in the last five years in close coordination with Public Works:
  - Gordon Drive Improvements – replaced water and sewer pipes, service laterals, and added storm infrastructure, with complete roadway restoration following utilities work.
  - Downtown Alley Improvement Project – replaced some of the oldest sewer pipe in the downtown area before PW reconstructed the alley.
  - Glovers Waterline Replacement Project – replaced all old 6" DIP water pipe with new 8" PVC, replaced all water and sewer laterals within the project area, with roadway reconstruction to follow.

  CRW will continue to coordinate projects with PW to ensure best value for the Town.

- **Local coordination with Parks and Recreation (PR)** – CRW has completed several priority projects with PR in the last five years:
  - Notable was the PCWRA reuse project that brought a reliable source of renewable reuse water to the Red Hawk Golf Course for irrigation, replacing the reliance on a deep, groundwater well. In 2019, CRW completed a 3.5 mile, 8-inch diameter reclaimed water pipeline from the Plum Creek Water Reclamation Authority's treatment facility to the Town's Red Hawk Ridge Golf Course for irrigation use. The golf course had been using a dedicated deep groundwater well to pump untreated raw water to the golf course pond for use in turf irrigation.

Peak summer irrigation demand at the golf course can exceed 600,000 gallons per day and this demand exceeded the golf course's available supply by approximately 200,000 gallons per day. Frequently, in high demand season, CRW staff would supplement the golf course with raw water from the municipal supply system to meet the additional irrigation demand. With the implementation of this project, CRW is able to provide reuse water to Red Hawk Ridge for irrigation and free up Denver Basin groundwater and treated potable water for higher beneficial use. The new source supply is the Town's treated effluent water from the Plum Creek Water Reclamation Authority (PCWRA) that has historically been discharged from PCWRA directly to Plum Creek, or sent to other golf courses.

On average, over 4.5 million gallons per day of the Town's wastewater is reclaimed at the PCWRA, which can be beneficially reused for irrigation and other uses. The Red Hawk reuse system was designed to deliver more than 650,000 gallons per day to the golf course. In 2022, 238.7 acre-feet (AF) of reusable water was sent to the golf course; that is enough water to cover 238.7 acres of land with water one foot deep! The Castle Rock Parks and Recreation Department pays a reuse rate for the water, and also is repaying CRW for the capital costs involved with the pipeline and pump station improvements. The golf course is a valued amenity to the community. The reuse supply water ensures that sufficient water is available to maintain the golf course, especially in times of drought. The project helped the Town maximize reuse water rights, reduce demands on the municipal water system, supply sustainable irrigation water for the golf course and additional nutrients for the turf, reduce irrigation pumping costs, and increase community familiarity with reuse.

Red Hawk Ridge golf course reservoir storage lake

- Another project was the replacement of irrigated turf with artificial turf at several parks. All four of the existing baseball fields at the Metzler Park were converted from natural bluegrass turf to synthetic turf, saving over six million gallons of water annually. The project enabled year-round use of the Town's signature lighted ballfield complex. The synthetic turf will significantly reduce maintenance and will also provide a public demonstration of water conservation. Academy Sports Turf was awarded the construction contract, in the amount of $2,104,500. Construction began in November 2018 and the conversion was completed by March 2019, before irrigation season and in time to accommodate spring baseball. Another conversion was underway in late 2022 to change over the athletic fields in Paintbrush Park to synthetic turf as well. This project will be complete in early 2023.

Installation of the artificial turf at the ballfields

- **Local Coordination with Developers -** CRW works closely with the Town's Development Services Department to help ensure that infrastructure planned for new development will work with existing systems and accommodate future growth. CRW has internal staff that reviews proposed development plans.

  - **Waterline Looping -** Water distribution piping that ends, for example at a dead-end street, is considered a dead-end pipeline. Undesirable water aesthetics (such as taste and odor issues) can result from dead-end pipeline arrangements. Frequent flushing can help to keep the water in these lines fresher. To avoid aesthetic water issues and minimize flushing requirements, and ensure adequate fire flows can be met, CRW will (where reasonably possible) require construction of new water piping from a dead-end line to another pipeline section and essentially loop the distribution system. Looped systems can also more reliably handle a high flow demand situation (such as the need to supply fire flows) in a specific area. Development standards require a minimum 8-inch diameter sized mains to ensure capacity for a 1,500 gpm fire flow, limit the length of dead end

mains, and also limit the number of houses that can be on a dead end main. Developers must model the hydraulics of their proposed water systems to ensure development criteria are met and are required to loop their systems if certain criteria can't be met. Currently, as shown on Figure 1.2, there are about 300 dead end water mains with either air release or blowoff valves at the end, which facilitate flushing operations, and about 90 mains more that are capped, for future potential extension into a new service area.

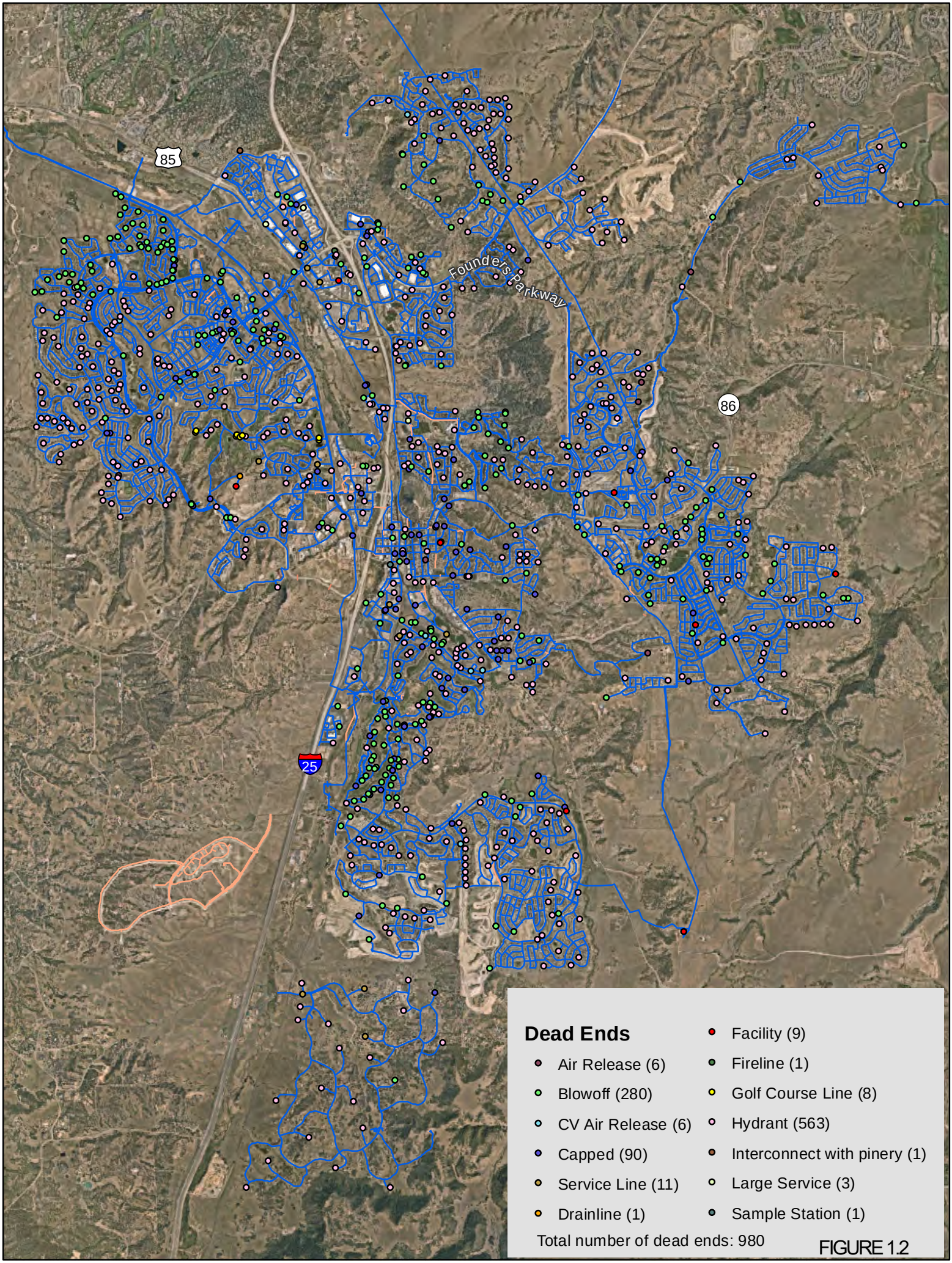

85
Founders Parkway
86
25
Dead Ends
Air Release (6)
Blowoff (280)
CV Air Release (6)
Capped (90)
Service Line (11)
Drainline (1)
Facility (9)
Fireline (1)
Golf Course Line (8)
Hydrant (563)
Interconnect with pinery (1)
Large Service (3)
Sample Station (1)
Total number of dead ends: 980

FIGURE 1.2

- **Waterline Oversizing –** At times CRW may need to increase the size of a new pipeline proposed by a developer if the increased size may benefit the overall distribution system. The hydraulic model is used to forecast and determine supply needs, and resultant pipe sizes, to the various Town pressure zones.

- **Acquisition of Parcels, Right of Way and Easements -** During the development review process, staff help ensure that CRW acquires required corridors and/or dedicated parcels and/or easements for future required infrastructure. Identifying future projects in the Master Plans help plan reviewers and development staff recognize our future needs and ensure that our interests are taken into account. For example, CRW routinely requests parcels for future facilities such as wells, pump stations and water treatment plants. Easements for future raw and potable water lines are also often identified during the planning process.

- **Regional Coordination with Other Communities** - CRW is actively engaged in partnerships and agreements with surrounding communities in regards to regional projects, shared infrastructure and water system interconnections.

  - **Extraterritorial Service Agreements** – CRW has executed extraterritorial service agreements with Bell Mountain Ranch (water service) and Macanta (water and wastewater collections service). In these two cases, CRW as the principal water supplier made sense due to the proximity to the Town's water system, but also ensured CRW managed the access and use to the water rights and reusable water, provided additional entities to share in the cost of future renewable water projects, and, in the case of Macanta, ensured CRW had input into landscape and irrigation criteria used.

  - **Infrastructure Sharing** - CRW is partnering with other entities to share infrastructure and ensure resiliency in the Town's water supply.

    - **WISE** - Partnerships established with entities such as the Water Infrastructure and Supply Efficiency (WISE) Authority, Chatfield Reservoir Mitigation Company, Parker Water and Sanitation District, and Dominion Water and Sanitation District to allow for import of additional supplies.
    - **Parker WSD/RHR** - The Town currently owns storage space in the Rueter-Hess Reservoir (8,000 acre-feet) and is partnering on future infrastructure such as pipelines, pump stations, water treatment plant expansion, and future desalination projects.
    - **Chatfield Reservoir Storage Project** (719 acre-feet with future plans to 2,000 acre-feet). - The Town diverts reuse water at the Plum Creek Diversion near Sedalia and sends this water back to PCWPF for treatment. Reuse supplies that cannot be used directly either are stored in Castle Rock Reservoir No. 1 (CRR1) or captured in Chatfield

Reservoir for storage and future use. CRW is looking at ways to return these supplies back to Town for treatment, or otherwise beneficially exchange them with a partner agency.

- **Pinery Water and Wastewater District (PWWD) and Castle Pines Metro District (CPMD)** - CRW has established emergency interconnects with both the PWWD (constructed in 2013) and CPMD (constructed in 2015). Connecting with neighboring systems and infrastructure helps provide resilience during potential emergencies, and potential future avenues for exchange of water supplies. CRW will continue to work with these and other local water providers on future regional opportunities.
- **Dominion Water and Sanitation District (DWSD**) – DWSD is a partner in the WISE program. CRW has an agreement to wheel DWDS's WISE water though the CRW system to a point of delivery in the Meadows. The delivery point has been ready to serve since late 2020. To date, DWSD has not exercised their WISE option and required CRW to wheel the water. CRW coordinates closely with DWSD to ensure infrastructure is in place to support the agreement.
- **Cherry Creek Project Water Authority (CCPWA)/Walker Reservoir -** Walker Reservoir is a water storage facility located approximately ½-mile northwest of Franktown, Colorado and is currently being constructed by the CCPWA, of which CRW is a member agency. When completed, Walker Reservoir will have a 650 AF capacity and CRW will own 150 AF, or approximately 23% of the capacity. Walker Reservoir will serve multiple functions by being able to store tributary and non-tributary water and to release water for direct use, augmentation and release and re-diversion downstream to RHR.

Principle 4 - Operate the Water Enterprise Fund as a Business

Our Vision is that we will be a national leader among water utilities focused on customer satisfaction and delivering outstanding quality and value. In so doing, our team works diligently to develop capital improvement plans (short and long term planning) that will guide our priorities as we continue to serve our growing community. Operations staff work hard to keep our systems performing optimally, our infrastructure in top condition, and to ensure outstanding water quality at a cost commensurate with neighboring utilities.

- **Key Performance Indicators (KPIs) and Industry Benchmarks** - CRW developed KPIs for use in measuring success and progress against goals and objectives. For example, KPIs of water system integrity measure the number of leaks and line breaks we experience relative to other utilities nationally. For 2022, our KPI for water distribution system integrity (a measure of the number of leaks and line breaks per 100 miles of pipe) was 0.8, placing CRW in the top ten percentile among surveyed participants. Many of the KPIs used are standardized (The American Water Works Association is a source of benchmark KPIs) that will allow us to benchmark our progress against other similar utilities (regionally as well as on a national basis).

- **Minimize Water Quality Complaints** - CRW employs multiple programs to remain in the top quartile nationally each year in regards to minimizing water quality complaints. In 2021, our KPI was 0.2 and placed CRW in the top quartile for water quality.

    - **Water Line Looping -** CRW will plan to construct new water piping from dead-end lines to other pipeline sections and essentially loop the distribution system where needed to ensure outstanding water quality to all customers. For example, early in 2017, Castle Rock Water installed a new waterline along Prairie Hawk Drive, between Atchison Way and Topeka Way. The cost of the project was $163,800, which included design and construction. The blue pressure zone had been extended down to Prairie Hawk along Topeka a few years prior. This created a long dead-end pipe in Topeka. This project created a looped water system for the blue pressure zone. The project consisted of installing approximately 500 linear feet of twelve-inch PVC pipe. The project also included a new water quality sample station.

    - **Storage Tank Mixing** - Water in storage tanks without mixers can stratify in different layers within the tank based on differing temperatures. It is possible for water layers to not turn-over for longer periods of time especially in the winter months when demand is lower but fire flow storage must be adequate. Lack of turn-over can result in water quality issues. Tank mixers have been installed in several Town potable water storage tanks and have been effective in mixing stored water, promoting turn-over, and achieving better water qualities.

    - **Ensure Disinfection Residual** - CRW staff inspect and monitor water distribution system facilities to ensure systems are in prime operating conditions. Strategies implemented on a regular basis to ensure adequate disinfection residual include, but aren't limited to: testing for disinfectant residuals at multiple locations within the distribution system; ensuring water in storage tanks is turned-over; conducting line flushing; and optimizing systems to minimize water age in the system. CRW switched to chloramination in 2013 as it has lower levels of chlorine and the disinfectant protects the water for a longer period of time as the water goes through the distribution system. CRW made the switch to chloramines to have water quality consistent with the Water Infrastructure Supply Efficiency (WISE) water and also due to the introduction of surface water once the PCWPF came online in 2013. Chloramines (a combination of chlorine and ammonia) are the preferred disinfection practice because they produce less disinfection byproducts than chlorine alone.

      Tanks 17A & 17B, completed in 2005 and 2008, respectively, are located on the mesa South of Red Hawk Golf Course. These tanks store approximately four million gallons of water for the red zone pressure

system. Due to low demand in the red pressure zone, these tanks experience water quality issues yearly.

Current operational management strategies to counter water quality issues at these tanks have consisted of keeping the water levels low or taking one tank completely offline. Mixers have also been added to keep the water well-mixed, but has not eliminated issues with low disinfection residual. CRW has to utilize significant labor resources to monitor and sometimes drain the tanks when chlorine residuals fall too low. This wastes labor resources and precious water resources. The timing of the water resources being wasted is a problem as this issue arises primarily in the middle of irrigation season.

In order to maintain the tanks near capacity for CRW's strategic water storage initiative and for firefighting, a chloramination booster station is being added to the tanks to monitor water quality and adjust/boost chemical addition as needed. The Monoclor® Residual Control System, placed in each tank with the adjacent support infrastructure, will monitor the chloramine residual and add chemicals as needed to maintain a residual in the tank, reducing labor costs and the wasting of water and ensuring ongoing water quality compliance.

- **Minimize Waterline Breaks** – Various CRW programs such as leak detecting and pipeline replacement help keep us in the top quartile nationally each year with respect to minimizing the number of waterline breaks per mile of piping. The Waterline Rehab and Replacement program takes into consideration the history of water lines breaks in an area as an indicator that the pipes need to be evaluated for replacement. An example is the Glovers Waterline Replacement project. The project replaced all the waterlines and service lines in the neighborhood, in two phases over three years, primarily due to a history of water line breaks and a lack of mainline valves that greatly inconvenienced the neighborhood each time. A 10-year plan for rehab and replacement of waterlines has been developed that focuses on pre-1980 distribution pipe. Refer to Figure 5.1 in Section 5.

- **Cross Connection Program and Backflow Testing -** Public drinking water systems may become polluted or contaminated through uncontrolled cross-connections. A cross-connection is an actual or potential connection between the public water system and any other system that could accidentally introduce a contaminant into the public water system. This is known as a backflow event. Water normally flows in one direction, from the public water system through the customer's plumbing to a sink tap or other plumbing fixture. Under certain conditions, backflow can occur.

Backflow could be caused by a backsiphonage, or a backpressure condition. Backsiphonage is due to a loss of pressure in the public water system during a high withdrawal of water for fire protection, a water main or plumbing system break, or a shutdown of a water main or plumbing system for repair. Backpressure is due to any condition in the customer's system that would increase their system pressure above the public water supply pressure, causing a reversal of flow.

Annual backflow testing is required on all fire suppression system backflows, all commercial and multifamily domestic/potable backflows, all irrigation if it's a dedicated irrigation line, and single family residential if they have fire suppression systems or recycled water systems in the home.

- **Asset Management -** CRW has implemented a GIS based asset management system to help maintain distribution system infrastructure. Operations staff have an active leak detection program in place that monitors for leaks in the distribution system and especially those areas that have experienced past leaks. Information gathered from such activities, coupled with other feature information such as pipe material and age, can be uploaded in the asset management software to help identify future pipeline replacement projects.

- **Design/Construction Standard Updates** - Construction details and standards are updated on a regular basis to make adjustments as needed to allow for new materials or techniques that improve upon previous design standards. New methods and materials help reduce the likelihood of waterline breaks.

- **Minimize Non-Revenue Water** – Non-revenue water is water loss that adds to system costs and can lead to operational problems in the distribution system. Various CRW programs have been established to reduce non-revenue water to a level that keeps us in the top quartile nationally each year.

    - **Colorado Water Loss Initiative (CWLI) -** Water loss was identified in the Statewide Water Supply Initiative (SWSI) 2010 as a significant factor in the Municipal and Industrial water supply-demand gap[1]. For that purpose, the Colorado Water Conservation Board (CWCB) created the Colorado Water Loss Initiative (CWLI) - a 24-month program designed to teach water utilities and assist them with the implementation of best practices for the management of water losses. Castle Rock Water is a participating utility in the program. The American Water Works Association (AWWA) water audit methodology, described in detail in the AWWA Manual of Water Supply Practices M36 Water Audits and Loss Control Programs, is a recommended best practice and is the industry standard approach for water loss management. This methodology allows for informed decision

[1] Colorado Water Conservation Board, Statewide Water Supply Initiative 2010 (Denver, 2011).

making for water loss control and management activities to reduce losses. CRW has been performing a water loss audit each year since 2012.

The scope of the CWLI comprised a comprehensive program of training and technical review and assistance for water systems across Colorado to attain a basic level of competency with the AWWA water balance and audit concepts and the AWWA Free Water Audit Software (FWAS). The program kicked off in August 2018, and was completed in five stages over the course of two years. This scope included, at a minimum, Level 1 validation of the water audit prepared by CRW.

CRW's report for the audit period of calendar year 2019 was validated in 2020. Key metrics from that audit were a data validity score of 56, an ILI of 0.96, and a real loss of 24.38 gallons per connection per day (gal/conn/day). For comparison, our metrics for the latest completed report, for calendar year 2022, are a data validity score of 50, real losses of 21.6 gal/conn/day, and an ILI of 0.8. For 2022 (the latest year that a number has been calculated for), CRW was just above the lowest quartile for unit real losses, with a data validity score of 50 (recommended value is greater than 71), indicating that we have room for improvement. Actions suggested include: analyzing our business practices and billing functions to identify data gaps; conduct loss assessment investigations on a sample portion of the system; begin long-term assessment of meter replacement, water main replacement and robust billing systems such as AMI (which we are doing).

- **Leak Detection Program** - CRW implements an annual leak detection program. Waterline leak surveys are completed working with a contractor using specialized smart electronic noise correlating equipment. If a leak is found the appropriate repairs are completed. CRW will look to improve this program by evaluating new methods for leak detection.
- **Bulk Water Program** - CRW operates a bulk water station where contractors and county residents can fill approved water trucks after receiving the required permits. Contractors (typically) may use fire hydrants for bulk water usage on a construction site. A permit is also required and an approved hydrant meter and backflow assembly is required before water may be used from the hydrant. The meter assemblies on this equipment are calibrated on a regular basis to accurately account for water used.

- **Reduce Operational Costs** - Develop projects which minimize the operational costs of facilities in accordance with the KPIs, or achieve payback in less than 5 years: Operation of a water and wastewater utility requires the use of a significant amount of energy. For example, deep groundwater wells require electricity to pump water from over 1,000 feet below the ground surface to water treatment facilities. New facilities are being designed and built with an eye towards implementing energy-efficient

technologies. When existing facilities require retrofitting, the life cycle cost of equipment is an important consideration in selecting new systems.

- **Life Cycle Cost Minimization** - New proposed CRW infrastructure is evaluated on the basis of life cycle cost minimization. The life cycle cost of a facility and/or equipment includes all costs of the unit during the life cycle period. These costs include design, construction, operating and maintenance costs.

- **Reduce Energy Costs** - CRW programs incorporate water operations into the energy management plan to minimize energy costs. Next to labor costs, electricity is the second largest operating expense for CRW and optimizing energy use is a responsible practice for an energy-intensive utility. An Energy Team made up from staff has been established and will be evaluating such items as how to maximize operating efficiency of pumping operations. Other energy savings may be achieved elsewhere in operations and consideration of energy cost-saving measures will be included across the utility.
  - **Time of Use Rate Reduction** - Energy providers such as CORE offer a time of use (TOU) program. Customers who can reduce electric usage during peak times are eligible for a reduced rate. CRW subscribes to this program to reduce electrical costs.
  - **Demand Charge Planning** -The CORE demand charge is on top of the electric usage billing. A demand charge is a specified rate multiplied by the peak Kilowatt demand used by CRW per month. Timing of when pumps start (creating a peak usage) is a factor in how facilities are operated during the month. For example, if pumps can be used at night to fill storage tanks, the demand charge may be lower. New and replacement equipment is evaluated for all around energy efficiency including the reduction in demand charges.
  - **Solar** – CRW will look for opportunities to incorporate solar power into our facilities. CRW added photovoltaic solar panels to the new Administration building that was completed in 2021. The system is averaging 1,300 Kwh per month of solar generated power. The system also allows any excess electricity generated by the panels on sunny days to be metered back to the electric utility as a credit.

- **Optimize Chemical Usage and Costs** – Chemical costs are a significant component of CRW's operational costs to treat both water and wastewater. CRW staff use chemical monitoring, SCADA and water quality monitoring to ensure optimal chemical dosing.

- **Advanced Metering Infrastructure (AMI) –** The AMI program has the potential to reduce energy costs for CRW by reducing fuel consumption and carbon emissions. Not only does the AMI program eliminate the need for rolling a truck to obtain a meter read, it also provides customers with up-to-

date water usage with multiple reads daily, encourages water conservation, and can help identify leaks.

An AMI system uses transmitters and signal receiving equipment to remotely read meters, eliminating drive-by technology in which staff in trucks must drive by a meter's physical location to take a read. The frequency at which meter information is received is completely adjustable. AMI will replace the current drive by technology with tower technology which eliminates the need to roll a truck to obtain monthly meter reads. It not only eliminates the need for rolling a truck to get a meter read, it also provides up-to-date water usage with multiple reads daily, encourages water conservation, helps identify leaks, and provides the utility and the customer useful usage alerts in a timely manner, and reduces emissions from vehicles doing drive-bys.

One of the benefits of using AMI is not having to visit individual meter locations to complete a final read (for example, if a home is sold or an apartment tenant is moving, a final read is usually completed for billing purposes). In 2022, final meter reads totaled over 4,600 for the year. This work item requires a staff visit per final read; AMI completes this activity remotely with no site visit required, reducing labor costs.

AMI is a key component of Castle Rock Water's (CRW's) Water Efficiency Master Plan and will not only improve service to our customers but also help encourage water efficiency and conservation, supporting our long term goal of an 14.5% reduction in per capita water use over the next 10 to 20 years. In a recent 2021 residential Town survey, 71% felt that "smart" water metering would be a valuable service. A multi-year AMI program was approved by Council as part of the 2022 budget and the five-year financial plan for 2022 to 2026. The first step in the program was to install four bases stations (aka "towers") around the town that serve as the data collection and routing centers. The four towers were installed in 2022 at Tanks 11, 15, 16 and 17. The program is a multi-year project expected to take 3-4 years to complete. Meters and MXUs that are not AMI compatible have to be replaced. Supply chain issues with getting enough new meters has slowed progress on using a contractor for some of the meter installation work because there is not enough material to keep them busy. The overall cost of the AMI project is roughly $11 Million.

- **Hydropower –** CRW has a demonstration project for downhole electrical generation at its aquifer storage and recovery wells (ASR) at the Ray Waterman Water Treatment Center. Those wells should come on line in 2023.

- **Receive Perfect Sanitary Survey Scores** - CRW programs strive to achieve perfect scores on sanitary surveys through optimal maintenance of the water system. Colorado Department of Public Health and Environment (CDPHE) notes

that a sanitary survey is an on-site review of utility elements including water source, facilities, equipment, operation, and maintenance of a public water system for the purpose of evaluating the adequacy of the facilities for producing and distributing safe drinking water. The sanitary survey is required by the Colorado Primary Drinking Water Regulations and occurs every three to five years. CRW works closely with CDPHE staff throughout the survey period. The expectation is a perfect score from the CDPHE inspector; should any deficiencies be identified they are immediately corrected.

- In September of 2021 a sanitary survey of the water system was conducted by the field services section of the CDPHE Water Quality Control Division. No significant deficiencies or violations were found. Inspectors had six observations with recommendations for correction, mostly concerning updated requirements related to configuration of vents and screening of vents, and storage tanks inspections standard operating procedures. Staff addressed all recommendations to the satisfaction of the CDPHE.

  In between sanitary surveys, CRW started a program in 2018-2019 where we bring in a third party consultant to perform an independent sanitary survey like review of our records and systems. The reason for this program is to ensure that CRW is always ready for a sanitary survey and is also always working to ensure all elements of our facilities are working properly and meeting all regulatory requirements. The next third party evaluation will occur in 2023.

- **Provide Fiscal Responsibility -** Our mission statement includes that we will provide our community with exceptional service that protects public health and balances social, environmental and fiscal responsibilities in a sustainable manner.

    - **Growth pays for Growth** - Every year, Castle Rock Water conducts a rates and fees study that looks closely at the projects we must do to meet the demands of our existing and growing population and maintain a high level of customer service. With that, we adjust the amounts that our customers pay for water availability, water service, usage, and system development (tap) fees. This system has allowed us to be self-sustaining and requires that new growth pays its share for water and related services.
    - **Annual Rates and Fee Studies** - An annual rates and fees study is conducted to analyze future growth and costs and adjust rates for residential, commercial and development, accordingly.
    - **CIP Planning -** The Town has developed a Financial Management Plan which outlines Castle Rock Water's main financial policies, procedures, and outlays for the future. The plan also establishes the goals and the principles to guide Castle Rock Water. The goals are compared to key performance indicators to determine if Castle Rock Water is meeting the goals of the FMP. Each year, the Town does a Cost of Service model

using updated CIP cost estimates and CIP schedules to ensure that the rates and fees increases are smooth and affordable for the customers.

- **Balance Revenue and Expenses** - CRW uses a cost-of-service (COS) model to determine rates and fees for water, wastewater, stormwater, and water resources. The basic philosophy behind a COS methodology is that utilities should be self-sustaining enterprises that are adequately financed with rates and fees that are based on sound engineering and economic principles. Guidelines of water ratemaking are established by the AWWA in Manual M1 – Principles of Water Rates, Fees and Charges. As a result of the most recent COS study for the Town, our consultant developed projected revenue requirements from 2023-2027 that will recover the Town's revenue requirements for operating expenses and capital improvements associated with our plan for meeting future needs.
    - **Annual Budget** - In accordance with the FMP goals, CRW works to keep costs at or under budget for capital and operational budgets each year and continuously strives towards more efficient operations.
    - **Manage Debt Financing and Portfolio** - Capital improvements are funded through a variety of sources, including debt financing. Debt financing may be used only when specific conditions (listed in the Town Charter) are met.
    - **CIP Planning** - CRW planning documents, such as our five-year Strategic Plan, the FMP, the Rehab and Replacement Plan (RRP, draft 2022) and the Capital Improvement Plan allow us to identify key capital projects in the upcoming years. The Town's five-year Capital Improvement Plan is reviewed and prioritized each year as a key task in the budget preparation process.

Principle 5 - Provide for Effective Long Term Operation and Maintenance

Castle Rock Water manages over $622.6 million dollars in total water/water resources assets, and more infrastructure is planned for the future. Such significant investment requires CRW to be good stewards and owners, and that entails comprehensive planning and design, competitive construction, predictive and responsive operations and maintenance, and seamless integration with assets constructed by others.

- **Promote Good Design and Construction** - Design and construction of CRW facilities is completed as a CRW Team effort where various groups have the opportunity to review and comment on proposed facilities. A goal of the design and construction process is for the resulting project to be able to meet the needs of the expanding distribution system, to provide a safe and friendly operating environment, and to have the lowest possible life cycle cost. Requiring projects be developed with adherence to the criteria manuals and the standard details helps ensure product reliability, system functionality and integration with other assets.

    - **Criteria Manuals** - CRW has developed criteria manuals for the Water Distribution, Sanitary Sewer Collection, and Storm Sewer Collection systems.

Criteria manuals may reference standards developed by other agencies such as CDPHE, the EPA, the American Water Works Association (AWWA), the American National Standards Institute (ANSI), and the American Society for Testing and Materials (ASTM).

- **Standard Details** - Standard construction details for the water, sanitary, storm sewer, landscape, and irrigation systems are on the Town's web site. These details are reviewed and revised as new methods and/or technologies are approved.

- **Approved Materials List** - A list of approved materials that can be used in water, sanitary, and storm sewer applications is in the development stage. When completed, this document will be a reference for developers and others to consult when preparing their plans for Town permitting review. Town projects would also be held to these same approved materials. Currently, approved materials can often be found on the applicable standard detail.

- **PW Manual of Construction - The Public Works Department (PW) has a Standard** Special Provisions Document on the Town's web site that is mostly specific to roadway type projects (Colorado Department of Transportation is referenced). CRW standards and details will be coordinated to work with the PW Standard Special Provisions.

- **Maintain our infrastructure** - CRW has more than $622.6 million worth of water infrastructure assets to be managed, operated, optimized, and maintained. This includes 6 water treatment plants, 810 miles of water pipes, 53 miles of raw water mains, 9 dedicated pump stations, 16 water storage tanks (two more coming online in 2023), 65 well facilities, 73 active PRVs, and other infrastructure. It is imperative that once we invest in assets, we maintain them for their expected service life, and further, plan for their retirement.

    - **CIP Planning** - An asset management program enables CRW to plan for future major repairs and their costs, utility costs, and other operating costs. Capital rehabilitation and replacement projects are identified in the Water Rehab and Replacement Plan (draft, 2022) and included in the short and long term CIP budgets.

    - **Hydraulic modeling** - CRW has a working hydraulic model of the overall distribution system. The model is updated on a regular basis as facilities in the system change or new infrastructure is added (such as new developments pipelines). The model is essential for use in planning for new developments and/or upgrading existing facilities. Modeling can also help to optimize how water is moved around Town through the various tanks, pressure zones and pumping stations, enabling facilities to operate more efficiently, reducing operating and maintenance costs.

- **Rehabilitation Programs** - CRW runs multiple capital programs for planned rehabilitation and replacement of existing water system infrastructure. These programs are focused on achieving the lowest life cycle costs for these assets.

    - **Tank Rehab** - Tank rehabilitation projects facilitate structural and/or site modifications to existing tanks to ensure reliability and tank integrity.
    - **Distribution System Upgrades** - Planned distribution system upgrades projects ensure system reliability. System valves, pressure reducing valves and vaults, and other appurtenances often require repair and/or replacement before water main pipes do. Such items must be maintained in good operating condition to ensure reliable water transmission and distribution.
    - **Waterline Rehab and Replacement Program** - A significant portion of CRW's water system infrastructure was constructed within the past 50 years. However, there are areas of Town with older pipes that may be approaching the end of their useful lives (for example, 50 years for pipelines). CRW has a replacement program in place that identifies which pipeline sections need replacing and prioritizes which pipelines are critical and need to be at the top of list for replacement. Where applicable, these activities are coordinated with PW and their roadway repaving projects.

- **Asset Management Programs -** CRW has incorporated information management and GIS to become more proactive in terms of planning, operations, and asset maintenance management. Maintaining accurate and up-to-date infrastructure data is a major priority, along with implementing technologies that provide a significant return on investment in cost, business functions and improved customer level-of-service

    - **Condition Assessment Tools** - CRW is developing and improving tools to identify water infrastructure that has reached the end of its useful life and a plan for replacement. A preventive maintenance program associated with asset management will be used to determine replacement schedules based on the type of asset, material, age, service duty and operating costs. As a formal asset management program develops, capital replacements and timing will become better defined.

    - **Life Cycle Cost Evaluation** - CRW will continue to employ methods to evaluate capital improvements and capital replacement projects based on minimizing life cycle costs: Documenting costs over the life of an asset can help identify when an asset has reached the end of its effective life (also from the perspective of its economic life). Tracking life cycle costs has many advantages such as identifying operating and maintenance support required, the real costs of downtime and lost production, and cost of repairs just to name several.

    - **Intelligent Maintenance Plans** - CRW is utilizing asset management programs and SCADA to maximize the life of assets and assess rehabilitation requirements. As the program develops, the asset management program will help to identify how best to maintain equipment and keep it operating most

efficiently within its life expectancy (equipment life can be maximized with ideal maintenance schedules being observed). For example, pump run times can be monitored via SCADA to anticipate when critical parts should be replaced to prevent a failure.

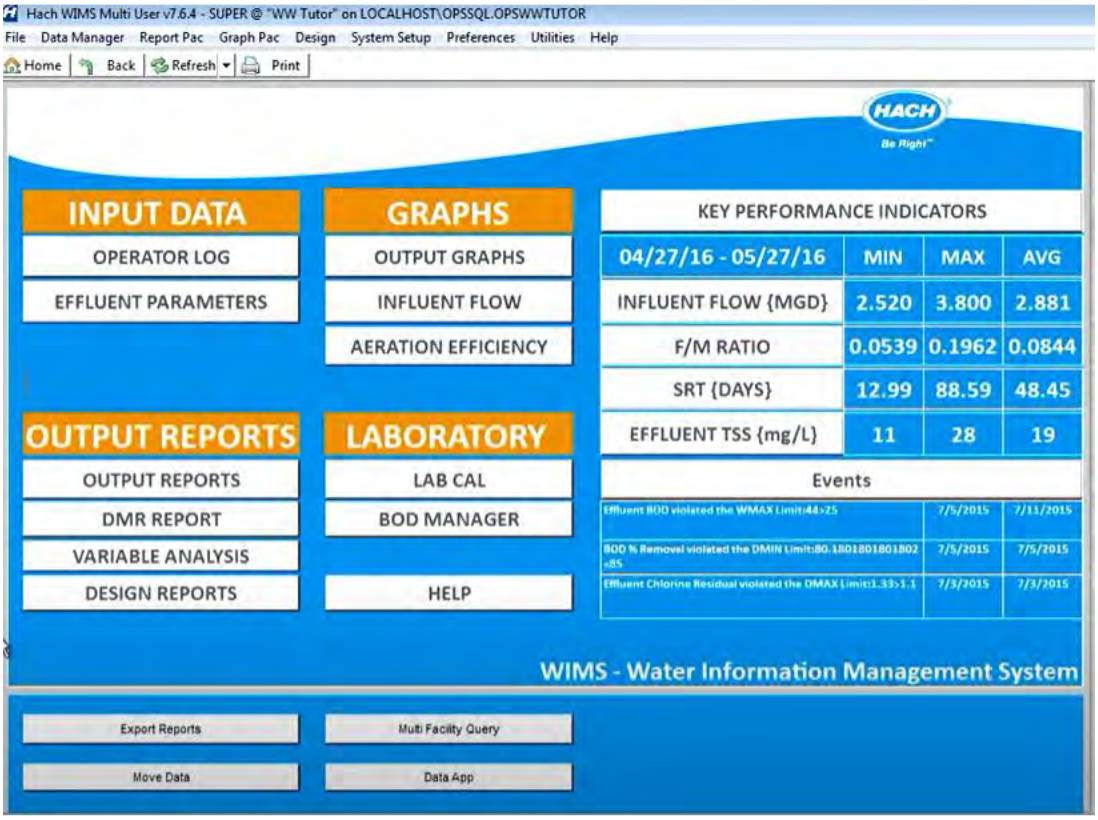
- **Operations and Maintenance Programs –** Day to day operations and maintenance programs are fundamental to ensuring quality water is reliably delivered to CRW customers, but also that our return on investment in facilities and infrastructure is maximized.

    - **Water Treatment Chemical Cost Minimization** - Drinking water produced from the water treatment facilities is constantly being monitored for various water quality parameters. Monitoring water quality after a treatment chemical is added allows operators to make adjustments so the optimum amount of treatment chemical is added to obtain desired results. This operating data is stored in the SCADA system and can be retrieved for evaluation by operators.

    - **Technology Utilization for Operating Optimization** - CRW is working to fully utilize technology to monitor and operate the system in the most efficient manner.

        - **SCADA -** All of the CRW facilities are currently monitored via the SCADA system and data is saved for later evaluation (or real time, as needed). Stored operating data in the SCADA system allows operators to fine tune system settings, establishing the most efficient operational arrangement. Facilities can be monitored and certain parameters changed from remote stations 24 hours a day, seven days a week. The SCADA team maintains the current system and stays on top of the industry, evaluating new equipment and acquiring assets when they improve reliability or system functionality. The SCADA Master Plan was updated in 2019 and identifies future requirements. Planned improvements include cyber security controls, the addition of electronic access control at all new water facilities, the automation of key pressure reducing valve stations, installation of surveillance equipment to improve facility security, strengthening of the communications network, and the replacement of obsolete equipment.
        - **Water Information Management System (WIMS)** – CR Water collects a significant amount of water quality and advanced treatment operational data, and we will increase our data collection in the future. The quantity of regulatory and operational water quality data has been ever-increasing over the past five years. CR Water staff recognized the need to “clean-up” the records, but the time required to effectively collate and manage the data, and to set up action level systems within spreadsheets was restrictive. The necessity of a data management system was becoming obviously apparent to the staff. In 2020, the CR Water On-Call Water Quality Consultant, CDM Smith, began to strongly recommend a Laboratory Information Management System (LIMS) software that could hold and manage a large amount of data, directly connect to and report

the data collected by the SCADA system, and to provide reporting and action level warning capabilities. In 2021, CDM Smith assisted with the qualitative evaluation and selection of a LIMS that would be suitable to the needs of CR Water. The Water Information Management System (WIMS) software developed by HACH was selected because it is tailored to the water and wastewater industries and it meets the criteria that CDM Smith recommended. The software will provide a central and secure database to efficiently manage large amounts of data, and to help streamline advanced treatment operations. The WIMS software is also used by PCWRA, allowing seamless integration of data with PCWPF, which will be of great value if CR Water transitions to DPR in the future. The CRW WIMS is under development and integration into the CRW system for full-scale usage in early 2023.



Screen Shot of Sample WIMS Dashboard

- **Web-based Denver Basin Groundwater Wells Study** - It is important that staff understand the hydrogeologic characteristics and the long-term sustainability of the aquifers and to be able to efficiently use the available well and aquifer data to make more informed decisions about how to develop and access the Town's water resources. In 2022 CRW contracted with a water resources consultant Leonard Rice Engineers (LRE) for a Denver Basin Sustainability Study. Phase 1 of the study is to

create dashboards that utilize a centralized database of water level, aquifer elevations, pumping rate, and volume data. The dashboard will utilize these databases to graphically display the water level data through time compared to the top and bottom of the aquifers, display how the pumping rates and volume have changed over time, calculate and graphically display linear water level trends illustrating those trends, and calculate and display rolling pumping and water level averages. Having this information easily accessible will allow staff to effectively make decisions on how to manage the Town's well fields and use of the groundwater resources. This data will also be used to update assumptions in CRW's water supply and demand model, determine the timing of new well facilities, and evaluate the success of our rehabilitation and replacement program.

- **Preventive Maintenance Programs (PMPs)** - Operations staff employs multiple preventive maintenance programs for various components of the water system. Staff will continue to implement and improve these programs to meet and exceed the program objectives.

    - **Tank Inspections and Cleaning** - Regular tank inspections and cleanings are critical to ensure optimum water quality of water stored in these tanks. Clean tanks prevent dirty water complaints, help minimize chlorine demand in the distribution system, and help prolong the life of tanks. During inspections defects are identified and corrective steps taken immediately. The tank inspection operating procedures were updated after the last CDPHE sanitary survey in September 2021 to ensure compliance with CDPHE expectations and to be proactive in identifying and responding to potential tank defects that could compromise water quality.
    - **Valve and Hydrant Inspection** - CRW staff inspect water valves and hydrants on a regular basis to ensure proper functionality which can be critical in certain situations, such as a main line break or a fire.
    - **Leak Detection** - An annual leak detection program is implemented by CRW staff. A contractor with specialized leak detection equipment is employed to evaluate specific areas, with the goal of leak detecting 1/3 of the distribution system annually. Identified leaks are repaired or sections of piping replaced as needed.
    - **Flushing** - CRW maintains an annual water main flushing program. Mainlines, particularly dead-end lines, are flushed to maintain optimal water quality and to ensure that fire hydrants work properly.
    - **Cartegraph OMS** – Operations staff utilize the Cartegraph OMS asset management program to keep track of the many tasks required at the various water facilities in order to ensure system performance. Routine and special tasks are identified, scheduled and tracked in the OMS program, which allows multi-platform access (tablets, PCs, web) and cloud-based, real-time updates.

- **Energy Management -** CRW has developed an Energy Management Master Plan (EMMP) – Phase I (November, 2013). As noted in the plan, energy consumption represents a significant operating expense for CRW. In fact, it is our largest operating cost behind labor. Pumping water for drinking water supply represents the highest use of electricity for the utility. Some of the potential projects identified by CRW to realize energy and cost savings include the following: facility projects (headquarters, well facilities, etc.) with consideration of IREA Time of Use (TOU) rates; program operation of wells to optimize energy consumption; replacement of HVAC equipment with high efficiency units; conduct water treatment backwashes during off peak hours; and improvements in lighting system efficiency. Development and implementation of the EMMP is an ongoing work activity that can result in energy and cost savings. The EMMP will be updated in the coming year.

Principle 6: Ensure Water Planning is Consistent with, and Considered Part of, a Fully Integrated Total Water Management Approach

Castle Rock Water's goal is to provide a sustainable, reliable and renewable water supply, now and into the future, for all of Castle Rock's citizens and businesses, when and where they want it, and at prices that remain reasonable, viable and competitive with surrounding communities. Securing adequate water supplies for the Town's current population base and our projected future demands is critical for our residents. Water is the life-blood of any community and it is incumbent upon Castle Rock Water to meet the mission of having affordable water available when customers turn on the tap. The 2021 Water Resources Strategic Master Plan (WRSPM) lays out how Castle Rock Water is going to meet that goal over the next 20-30 years. In addition to laying out the projects and programs to achieve our renewable water goals and adequate water supply in general, this WRSMP identifies the investments needed from the community to meet Castle Rock's long-term water goals. CRW is an enterprise of the Town and CRW's customers pay rates and fees to cover utility services, including renewable water. The money to pay for renewable water comes from existing customers and new developments. The current plan estimates long-term investments of $523 million will be needed from existing and future customers through 2060. Key components of the Town's water supply strategy include:

- **Supply Transition** - Continue to develop a water supply portfolio that consists of 75 percent renewable water sources and 25 percent non-renewable sources by 2050. After 2050, continue development of renewable sources working towards a one hundred percent renewable supply to complement the existing non-renewable supply. To this end, in 2021 CRW updated the Water Resources Strategic Master Plan (WRSMP) that lays out how we are going to meet that goal over the next thirty-plus years.

- **Conservation** - Implement the ideas that are delineated in the 2023 Water Efficiency Master Plan, such as reducing the amount of irrigated turf in the community, installing

advance metering infrastructure (AMI), retrofitting the landscaping in public rights of way and parks to more water efficient, and expanding the use of graywater systems in new development. Refer to the WEMP for more information on current and future water conservation initiatives.

By way of example, if the Town does not allow turf for any new front yards; limits backyards to no more than 500 square feet (sf) of irrigated turf; and the assumption is made that 155,000 people will be the ultimate population served then the Town could see a reduction of 64% of future outdoor water use (based on what the outdoor water use would be without further turf limitations than today). This would translate to a usage of approximately 100 gpcd at build-out. Without imposing strict turf limitations, it will be very challenging to achieve our usage rate goal of 100 gpcd.

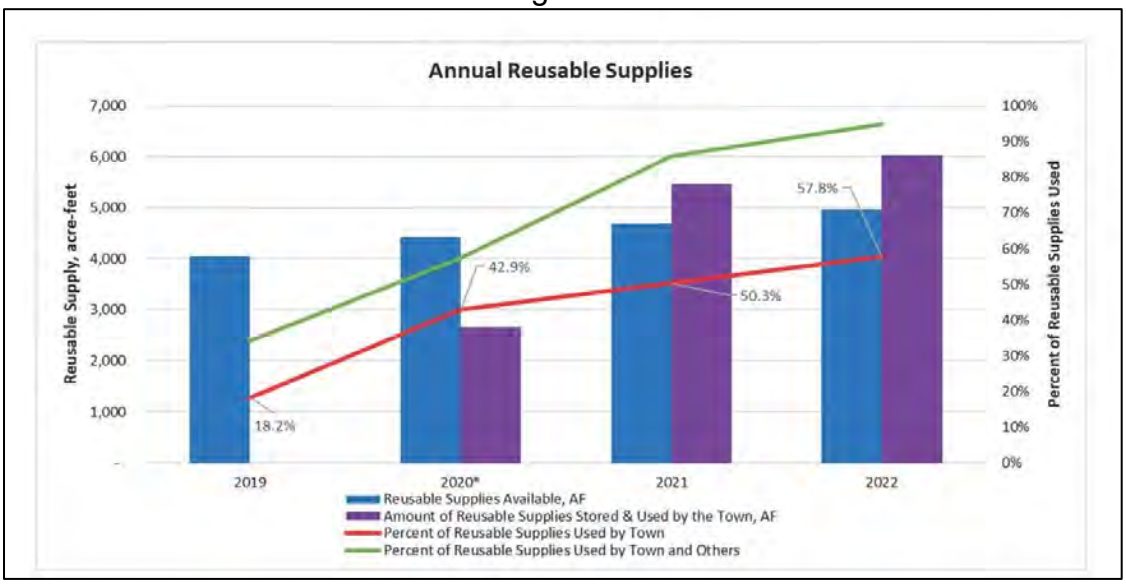
If the Town's existing customers (approximately 82,000 people) are able to reduce water consumption from 118 gallons per person per day to 100 gallons per person per day, the water use savings would represent more than 1,610 AF/yr. This kind of savings would reduce the need to develop new water supplies potentially avoiding $70 million to over $110 million in future investments.

- **Renewable Water Rights** - Fully develop and utilize the Town's current renewable water rights which include senior and junior native surface water rights, lawn irrigation return flows (LIRF), and water reuse in both the Cherry Creek basin and Plum Creek basin. The Town currently has approximately 900 AF of firm yield from the alluvial well system along East Plum Creek which utilizes native rights and reuse water, 8,650 acre-feet of additional junior or highly variable water, and an additional 5,350 acre-feet of reliable supplies which include LIRFs and reuse water. Water that the Town pumps and uses from the Denver Basin aquifer, WISE supplies and future imported supplies can be reused to extinction. The Town diverts reuse water at the Plum Creek Diversion near Sedalia and sends this water back to PCWPF for treatment. Reuse supplies that cannot be used directly either are stored in Castle Rock Reservoir No. 1 (CRR1) or captured in Chatfield Reservoir for storage and future use. Our reuse water represents around one-third of our future projected water supply. Key initiatives in local renewable water include potentially implementing direct potable reuse over the next five years (i.e. taking water directly from the treated end of the water reclamation facility to the front end of the water purification facility), developing a project to pump water stored in Chatfield Reservoir back to Castle Rock, and completing a new pipeline (under design) from our Plum Creek Raw Water Return Pipeline to Rueter-Hess Reservoir.

- **Reuse Supplies** - Fully utilize our reusable water: Water that the Town pumps and uses from the Denver Basin aquifer, WISE supplies and future imported supplies can be reused to extinction. CRW acquired the United Water diversion structure assets in Sedalia on Plum Creek that gave us the ability to re-capture some of these supplies. Usage of these supplies represents approximately 35 percent of our future projected water supply. In 2022, CRW used, allowed to use, or stored almost 100% of its current reusable water supply, as shown in Figure 1.3. Future projects are to expand reservoir

storage in Sedalia, store reusable supplies in existing reservoirs or using ASR, and accelerate reuse supply treatment by expanding the PCWPF facility to 12 MGD.

Figure 1.3



- **Import Renewable Water** - Work in partnership with other entities to import additional supplies and to reduce the cost impact to our customers. The Town has been a member of the South Metro Water Supply Authority since 2004 and has worked in partnership with them to develop the WISE Authority and project. The WISE project has been operating since 2018 but there is more infrastructure to complete for the long term and full scale operation of the project. Significant progress has also been made on the Box Elder project with a water rights case proceeding and most of the needed water rights purchased. Going forward, key actions on imported renewable water include completing remaining WISE infrastructure, designing and constructing Box Elder project infrastructure, developing a collaborative water agreement with agricultural stakeholders for the Box Elder project, and evaluating and determining our level of participation in the Platte Valley Water Partnership with Parker Water.

  In February 2021, CRW became a member of the Cherry Creek Project Water Authority (CCPWA). Other members include the Pinery, Inverness and Cottonwood Sanitation Districts. The CCPWA project can provide an average of 250 acre feet (AF) of renewable water per year for CRW. CRW is working on a project to use the interconnect with the Pinery to bring renewable water supplies (0.25 MGD initially, but up to 1.0 MGD in the future) back to the CRW raw water supply system, retreat it at the Ray Waterman Regional Water Treatment Center (RWRWTC) and send it to distribution. The Pinery treats wastewater from Macanta and Cobblestone which are reusable supplies that the Town has rights to.

- **Reservoir Storage** - Manage our reservoir storage program to optimize the placement of supplies during periods when they are not needed by our customers. CRW is planning for enough storage to satisfy a full year's worth of demand by 2050, or

approximately 20,000 AF. Current storage space includes Rueter-Hess Reservoir (8,000 AF), Chatfield Reservoir (719 AF, expandable to 2,000 AF under an option agreement with the State), Castle Rock Reservoir No. 1 (240 AF), and aquifer storage (430 AF/yr) within the Denver Basin. Additional key storage projects over the coming years include constructing Castle Rock Reservoir No. 2 (790 AF), expanding Castle Rock Reservoir No. 1 (to 560 AF), completing construction of Walker Reservoir (150 AF of storage for Castle Rock), evaluating ASR in the Box Elder Creek and Lost Creek basins, and purchasing additional storage options in Chatfield Reservoir (1,410 AF remaining).

- **Source Water Protection** - CRW developed a Source Water Protection Plan (SWPP) in 2017 as a collaborative effort with multiple stakeholders including local citizens and landowners, private businesses, water operators, local and state governments, and agency representatives and with technical assistance from the Colorado Rural Water Association. In 2022, CRW is updating the SWPP to incorporate the portion of East Plum Creek from the Meadows Parkway Bridge downstream to the confluence with West Plum Creek, as well as West Plum Creek in its entirety.

  Management of watersheds is important because the surface water features and stormwater runoff within a watershed may enter aquifers or other bodies of water and management can impact water quality. Currently, the Town operates fourteen wells that are located in the alluvium of East Plum Creek and two surface water diversions, one on East Plum Creek near the PCWPF (the CR-1 Diversion) and the Plum Creek Diversion located on the main stem on Plum Creek near Sedalia, Colorado. The Town also owns alluvial wells in the Cherry Creek basin (the Converse Wells and other alluvial wells as part of the CCPWA). Watershed management is important to protect water quality for all of these water sources. Further, watershed management and groundwater protection are closely related to measures that have been developed by CRW's Stormwater Division.

  The following are general examples of goals for a watershed management and groundwater protection program:
  - Avoid erosion and sediment loss in susceptible areas to the extent practicable;
  - Preserve areas that provide important water quality benefits (e.g. wetlands) and/or are necessary to maintain riparian and aquatic biota;
  - Protect, to the extent practicable, the natural integrity of water bodies and natural drainage systems (e.g. seeps and springs) associated with site development; and
  - Identify the priority local watershed pollutant reduction opportunities (e.g. improve existing urban and runoff control structures; support legislation to reduce phosphorus in fertilizers and other products to protect the watershed).

  Each of the above management measures is to encourage land use and development planning on a watershed scale that takes into consideration sensitive areas that, by being protected, will maintain and improve water quality.
  Some practices include:

- Protect areas that provide water quality benefits, including wetlands, riparian vegetation and wildlife. This can be accomplished through buffers, easements, deed restrictions and covenants. Developers can be encouraged to protect the water resources as a selling point (aesthetic and ecological amenity).
- Protect the integrity of water resources from the effects of site development and infrastructure. This can be accomplished by establishing setbacks from natural drainage areas including seeps, springs, and groundwater recharge zones. Protecting or promoting vegetated buffers around natural drainage areas to provide additional protection.

As part of protecting the Town's watershed and groundwater, CRW identified eleven potential risks and the best management measures that are used for protection. The risks are identified as construction, development, landscaping, natural disasters, pet waste, roads / deicing practices, soil erosion, solid waste, storage tanks, stormwater runoff, and wastewater treatment plants. Refer to the SWPP for more information.

- **Groundwater Supplies** - Continue to maintain, develop and protect the Town's Denver Basin groundwater supply as a drought supply. The Town currently has approximately 13,500 AF of firm yield from the existing Denver Basin well system. The 2021 WRSMP outlines that the Town will use Denver Basin groundwater to meet 25% of the Town's water demand through 2050, and will continue to utilize it in times of drought. This supply will help meet the demands of our customers in the short term and provide reliability and drought protection in the long term. Availability of deep groundwater, which the Town has been reliant upon for decades, will continue to decrease in the future and ultimately not meet the Town's long-term water needs. Regulatory pressure is also a risk if the State were to impose limits on the total volume of water that can be withdrawn from permitted Denver Basin wells. Areas of focus in the next five years include defending our groundwater rights against harmful changes to management of those rights by the State, full development of the groundwater management model, constructing new wells, acquiring additional groundwater rights, completing the Denver Basin Sustainability study, and adding new groundwater sources to our groundwater treatment plans that have available capacity.

- **Alluvial and Surface Water Supplies** - Continue to maintain, develop and protect the Town's alluvial and surface water supplies. Updating the Town's source water protection plan is a key component of this strategy, as is the Stormwater Municipal Separate Storm Sewer System (MS4) program.

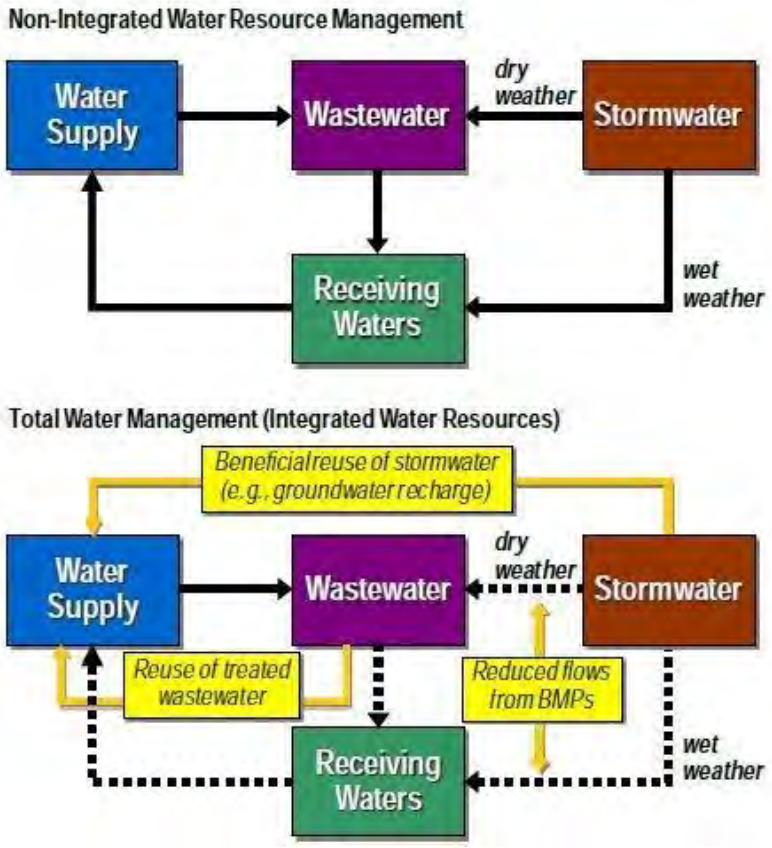


Figure 1.4 Non-integrated water resources management vs. total water management
(Total Water Management, EPA/600/R-12/551; July 2012)

Principle 7: Identify and implement changes to the Water System which will improve long term sustainability through resource recovery and net zero energy use

The most precious resource in wastewater is water. Around 99% by weight of the matter in wastewater is water, a renewable/reusable resource. Large scale centralized Waste Water Treatment Plants (WWTPs) like Plum Creek Water Reclamation Authority (PCWRA) also represent potential collection points for the resources contained in wastewater, namely water, PCWRA is not just a wastewater treatment plant - it is a water reclamation facility (WRF) as the name intends. Water reuse from WRFs, either through IPR or DPR to the water treatment plant, or to irrigation reuse, can significantly reduce a municipality's freshwater demand. It can also be much less energy intensive than relying on deep groundwater extraction wells for non-renewable water with high energy demand pumping. CRW strives to optimize water recovery and reuse and to develop other environmentally responsible options for energy optimization.

- **Water Recovery and Reuse** - Since early 2021 Castle Rock Water (CRW) has practiced, as planned, IPR utilizing water captured from Plum Creek which contains treated wastewater from the PCWRA effluent outfall. The IPR source water is captured

through the Plum Creek Diversion, stored in CRR1 and pumped back to the PCWPF for advanced treatment. When designing the advanced treatment train at PCWPF, CRW had intended to eventually transition from IPR to direct potable reuse (DPR). Now that the Colorado Department of Public Health and Environment (CDPHE) has finalized the Direct Potable Reuse Rule (11.14) and associated Division policies within Regulation 11 Colorado Primary Drinking Water Regulations 5 CCR 1002-11, the Town is investigating whether the shift to DPR is in the best interest of the Town and its customers, or if continuing with existing IPR practices is preferable. As such, CDM Smith, an engineering firm, has been tasked by CRW to assess the costs and benefits of implementing DPR.

Two primary objectives were defined to achieve this goal:

- Performing a qualitative and quantitative alternatives analysis comparing IPR to DPR;
- Conducting a cost-benefit and risk assessment study for DPR.

This work is in process. CRW also plans to proceed with at least the first step of the application to the State for DPR which is to do a full year's worth of analytical testing on the effluent from the water reclamation facility.

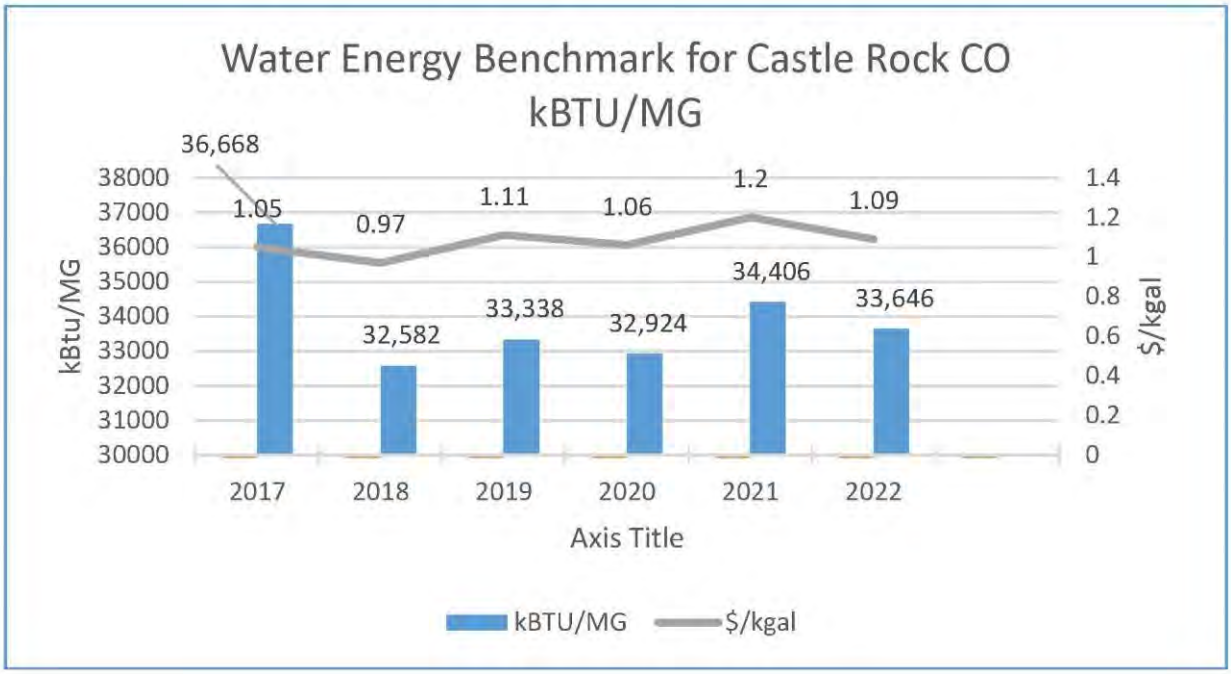
CRW intends to maximize its reuse of water. In the next 5 years, CRW will expand the PCWPF from 6 MGD to 12 MGD.

- **Irrigation Reuse** - Since late 2019 CRW has been providing reusable effluent to the Red Hawk Reuse Golf Course for irrigation. Before the project, the golf course had a deep groundwater well they relied on for irrigation. During dry months, CRW had supplemented the golf course's groundwater well with raw water from other deep groundwater wells and alluvial wells, or at times even treated, potable water. The Town's treated effluent water from the Plum Creek Water Reclamation Authority (PCWRA) had historically been discharged from PCWRA directly to Plum Creek, or sent to other golf courses. On average, over four million gallons per day of the Town's wastewater is reclaimed at the PCWRA, all of which can be beneficially reused for irrigation and other uses. The Red Hawk reuse system was designed to deliver more than 650,000 gallons per day to the golf course. Using reclaimed water for irrigation reduced demands on the aquifer, eliminated a reliance on supplemental, treated, potable water, provided an ideal end-user for reuse, and ensured a reliable source of irrigation water for a valued Town amenity.

- **Energy Management -** The second largest operating cost for CRW, electricity, reflects full operation of the Plum Creek Water Purification Facility and other treatment plants, alluvial and groundwater well operations and pumping associated with water and wastewater service. CORE, Castle Rock Water's electricity provider, increased rates in August 2022 by 6%. Castle Rock Water has implemented an energy management and system optimization plan to maximize the efficiency of electrical usage. This plan will be updated in the near future. Water reuse is actually a key component of energy management. Water reuse from WRFs, either through IPR or DPR to the water

treatment plant, or irrigation reuse, can significantly reduce a municipality's electrical demand because it is much less energy intensive than relying on deep groundwater extraction wells with high energy demand pumping. As shown in Figure 1.5 below, CRW's total energy demand per million gallons has dropped since 2021, despite five percent higher overall water demand in 2022 over 2021. The transition in late 2021 to using the available reuse supplies from Plum Creek versus a higher dependence on deep groundwater wells may explain this.

Figure 1.5 Water Energy Benchmark



- **Solar -** In 2021 CRW constructed a new 12,188 square foot (sf) Administration and Customer Service building equipped with a 1,400 sf photovoltaic solar system capable of generating 25 kW of power. The system is averaging 1,300 Kwh per month of solar generated power. The system also allows any excess electricity generated by the panels on sunny days to be metered back to the electric utility as a credit. CRW is evaluating the performance of the system at the Administration Building and depending on results will be looking for more opportunities to install solar systems. Much of the pumping at well sites and process systems at the water treatment plants are too energy intensive to rely solely on solar, but solar may be used to offset the energy requirements of these facilities and of administrative offices, kitchens and laboratories.

The new Administration & Customer Service Building

CRW may partner with PCWRA on using available land to install a solar array to gather the power of the sun as a way to reduce the overall energy demand at the WRF facility. CRW will also partner with PCWRA on future initiatives to reduce and/or offset energy demand. As part of the next PCWRA utility plan update in 2023, energy efficiency and resource recovery at the WRF will be key topics to be explored.

- **Hydropower** - Potential and kinetic energy recovery from moving water is possible with hydropower technologies. Moving water (raw, treated, or wastewater) has the potential to run a turbine and generate electricity. However, generally a way to use the generated electricity nearby is required. Net metering may be possible to return generated electricity to the supplier's grid. CRW has a demonstration project for downhole electrical generation at its aquifer storage and recovery wells (ASR) at the Ray Waterman Water Treatment Center. Those wells should come on line in 2023.

- **LED Lighting** – CRW has changed out the lighting in several of its facilities to energy efficient LEDs. While the savings are small compared to the overall electrical demand of the facilities, it is a practical way to make our facilities, especially older facilities, more energy efficient. For example, in 2017, operations preventive maintenance staff replaced the older fluorescent lights in the Meadows WTP with new energy efficient LED bulbs. The lights are typically on 24 hours a day, 7 days a week. The new LED lights are longer lasting (reducing manpower costs to replace), energy efficient, and produce a softer light. The project was expected to pay for itself in 4 years in reduced electric bills.

Meadows WTP after lights were replaced with energy efficient LEDs

- **Variable Frequency Drives (VFDs) –** CRW looks for opportunities to add VFDs to pumps and motors during retrofit or replacement projects. A variable frequency drive (VFD) is a type of motor controller that drives an electric motor by varying the frequency and voltage of its power supply. The VFD also has the capacity to control ramp-up and ramp-down of the motor during start or stop, respectively. Benefits to using a VFD include reductions in peak energy demands, reduction in power when not needed, self-diagnostics and communications, and PLC-like functionality and software programming. Adding new VFDs, and replacing older VFDs, is also a goal of the updated 2019 SCADA Master Plan to ensure integral system-wide control and communications. In 2020, plant mechanics and SCADA staff replaced three failing and obsolete VFDs at the Crystal Valley Ranch pump station with new Allen Bradley Power Flex VFDs. The Crystal Valley Ranch pump station pumps water from Tank 15 Red Zone to Tank 6 Green Zone tanks. Originally installed in 2002, the original VFDs had reached the end of their useful service life. A goal of the project was to improve electrical efficiency and move to standardization on a uniform SCADA platform across facilities.

Upgraded Crystal Valley Pump Station Motor Control Center (MCC) and VFDs

2. Master Plan Elements

Water Supply

The Town's source of water supply currently consists of sixty deep groundwater wells drilled within Denver Basin aquifers, fourteen alluvial wells, two surface water diversions, and imported water from the WISE project supplying a total average production capacity of approximately 24 MGD. Annual production of the Denver Basin aquifer has averaged around 2.17 billion gallons per year over the past five years and conservation efforts have continued to reduce the per capita demand from a high of 175 gallons per capita per day (gpcd) in 1990 to a 2022 five-year rolling average of 116.9 gpcd. However, water levels in the aquifers continue to decline and well yields have decreased steadily over the past five years. The average rate of well yield decline for all Denver Basin wells in Castle Rock's water supply portfolio for the period 2018 through 2022 is approximately four percent per year.

Therefore, the Town has been working on developing renewable water supplies from various sources. The long-term goal for water supply is to have a portfolio consisting of 75 percent renewable water comprised of imported surface water, alluvial water and reclaimed water, and 25 percent non-renewable groundwater by 2050, and 100% renewable water usage (in average and wet water years) by 2065. The Town still has the potential to develop more Denver Basin groundwater wells; however, the goal is to limit this resource to the extent possible and focus most of our financial resources toward renewable supplies. The timing of planned development relative to renewable water projects, however, may make additional Denver Basin groundwater wells necessary in the near term. Ultimately, the demand for non-renewable groundwater is targeted for ten MGD with an annual production volume of 3,850 acre-feet per year. This represents approximately half of the annual production capacity required today.

The rolling five-year average per capita demand of 116.9 gpcd is consistent with the long-term goal of 135 gpcd or 400 gpd/SFE. The 2006 WFMP was based on a 400 gpd/SFE demand and this demand remains valid for existing customers in this master plan update, but future demands of 265 gpd/SFE reflect the changes in landscape regulations approved in 2022. The Town's current population is approximately 82,000 people and the high build out population projection is potentially 155,000. To meet this ultimate demand, additional water supplies would have to be developed. These new water supplies fall under the renewable category and are being developed under the Water Resources business enterprise. For planning purposes, we estimate high-case and low-case scenarios to encompass a range of possibilities. In order to plan for varying scenarios, CRW has identified that projected demands could be as low as 12,546 AF under the high water conservation scenario of 100 gpcd, and 112,000 people versus 23,439 AF under a low water conservation scenario of 135 gpcd with 155,000 people. These two scenarios demonstrate the challenges of trying to plan for the future. More information regarding renewable water supply strategies can be found in the Water Resources Strategic Master Plan (WRSMP) 2022 Update.

Raw Water Storage

Reservoir Storage

Castle Rock Water's long-term goal is to provide a sustainable, reliable and renewable water supply for all of Castle Rock's citizens and businesses. Reservoir storage plays a primary role in Castle Rock Water's long term renewable water plan.

- **Rueter-Hess Reservoir Pipeline and Pump Station**
  The Town of Castle Rock secured 8,000 AF of raw water storage in Rueter-Hess Reservoir in 2008. To date, the Town has approximately 20 AF of treated effluent flows from the Cherry Creek Basin stored in the Rueter-Hess Reservoir. Beginning in 2016, unused WISE water deliveries could also be stored in the Rueter-Hess Reservoir. CRW is designing a pipeline and booster pump station to transfer renewable water supplies from the PCRWRP to the Reuter-Hess Reservoir. The 7-mile-long, 16" pipeline will divert up to 4 MGD of renewable water supplies to the reservoir for storage during times when available supplies may exceed what CRW can treat/use/store to meet demands, probably just in winter months. Pipeline construction may start in 2024, and will likely take 12-18 months to complete. The current cost estimate exceeds $16 Million.
- **Castle Rock Reservoir 1 (CRR1) and Castle Rock Reservoir 2 (CRR2)**
  As part of the water supply plan, in 2017 the Town of Castle Rock purchased the United Water assets in Sedalia which included a surface water diversion, pumping and raw water storage facilities located on Plum Creek near the Town of Sedalia. The diversion point is downstream from the confluence of East and West Plum Creek, which will allow the Town to maximize the use of its water rights, including reusable supplies and native supplies owned in East and West Plum Creek. Existing facilities included a diversion structure, two pump stations and a raw water storage reservoir, Castle Rock Water Reservoir No. 1 (CRR1-240 acre-feet capacity). The diversion structure provides for controlled diversion of water from Plum Creek to the Plum Creek Pump Station, which delivers water to CRR1 and to the Ravenna Pump Station (RPS). Construction of the new Plum Creek Diversion Pump Station (PCDPS) was completed in 2021, replacing the existing Plum Creek Pump Station, and was designed to pump raw water from Plum Creek to CRR1 and from CRR1 to the Plum Creek Water Purification Facility (PCWPF) through the nearly 8-mile-long Plum Creek Raw Water Return Pipeline. In accordance with the Water Resources Strategic Master Plan, Castle Rock Water is planning to construct Castle Rock Reservoir No. 2 (CRR2-1,130 acre-feet capacity) immediately east of CRR1. This new reservoir will help Castle Rock Water to accommodate daily high demands during summer months in the coming years and is an additional storage vessel for those times when Castle Rock's junior surface water rights are in priority, or when free river conditions exist. Construction on the CRR2 and the expansion of CRR1 is expected to begin in 2023, taking several years to complete.
- **Chatfield Reservoir Reallocation Project**
  The Chatfield Reservoir Reallocation Project (Project) is a water storage project to reallocate flood storage space in the existing Chatfield Reservoir located in northwest Douglas County to space that can be used for storing renewable water supplies. The Town of Castle Rock is currently, and has been since 2004, a participant in this Project. On June 7, 2014, Town Council approved a resolution to reduce the Town's participation in the Chatfield Storage Reallocation Project from 1,500 AF to 200 AF based on staff's recommendations of the then current need for storage in Chatfield by

the Town and for the need to allocate funding to other renewable water projects. CRW secured 200 AF of raw water storage space in Chatfield Reservoir in 2014. The Town entered into a multi-year agreement with the CWCB in July 2015 to purchase shares in the Chatfield Reservoir Reallocation Project. This agreement has allowed the Town to spread out the project costs over time while the Project was undergoing design and construction activities. The following year CRW entered into an option agreement with the Colorado Water Conservation Board (CWCF) for acquisition of additional storage shares over a multi-year period. Since then, CRW has acquired additional firm storage space that currently totals 719 AF. As the Town continues to develop and firm its renewable water rights on Plum Creek and the South Platte River, in addition to its fully reusable return flows, additional storage in Chatfield becomes beneficial.

- **Walker Reservoir Project**
  Walker Reservoir is a proposed CCPWA water storage project and is located northwest of Franktown. The project will provide 650 AF of storage which will be filled from a combination of future alluvial and deep wells near the reservoir and is to be stored for use during high demand periods. CRW's portion of the storage capacity is 150 AF. The water that is stored in the reservoir will be discharged into Cherry Creek by the project pump station to be picked up downstream by project members.

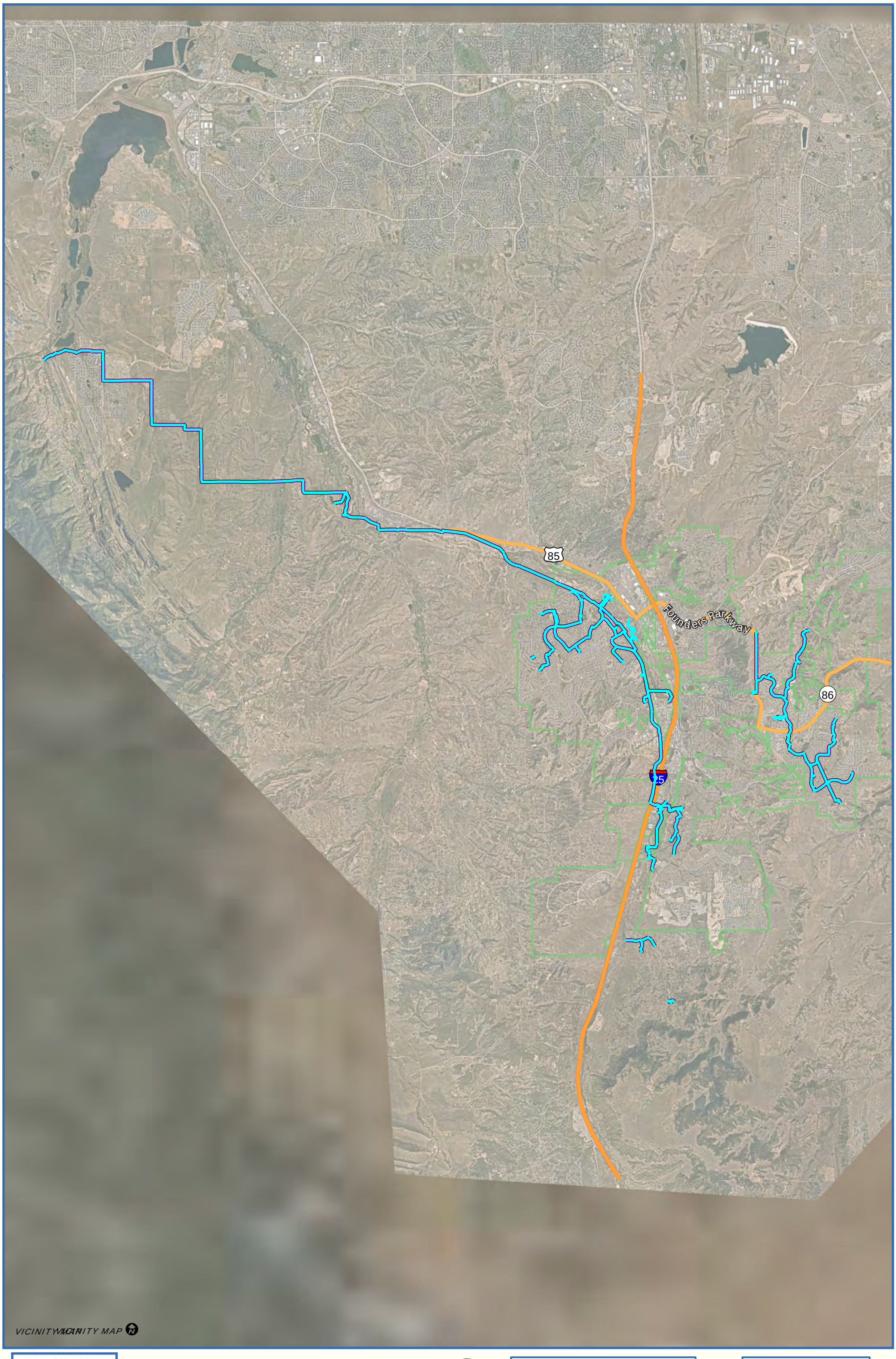
Aquifer Storage and Recovery (ASR)
Aquifer storage and recovery (ASR) is one method being implemented to replenish the Denver Basin Aquifer. Treated, renewable water will be injected directly down-hole into existing wells and stored in the aquifer for future use. A pilot program for two ASR wells in the Meadows was completed and conditionally permitted in 2014 to allow testing but issues developed with one of the downhole valves used to control flow. Repairs were made and the project received final approval from the EPA in January of 2023; plans are to begin injection operations in March of 2023. In 2022, construction began on two additional deep groundwater ASR wells at the Ray Waterman Regional Water Treatment Center (RWRWTC) to store excess WISE water. Supply chain issues have delayed completion of those wells, and final EPA approval is expected in 2023. Various programs and projects are underway to maximize the use of future water supplies. Typical ASR wells have a maximum injection rate of 80% of the average pumping rate. Based on the information available, staff believes that up to a total of 600 AF/yr of renewable water could be stored in the two existing and two new ASR wells.

Raw Water Pipes

CRW has over 51 miles of raw water piping that conveys raw water from the various alluvial and deep groundwater wells, the diversions, and the raw water storage facilities to the various water treatment plants. With the acquisition of the United Water Assets in 2017, CRW acquired the 16" Ravenna pipeline from our CRR1 reservoir in Sedalia up to Roxborough. In 2021, CRW completed the almost 6 mile-long 30" Plum Creek Raw Water Return Pipeline from the CRR1 reservoir/diversion/pump station back to a connection to the raw water pipeline to PCWPF. At some point, the wells and/or the pipes will reach the end of their useful life, have been replaced or repurposed, or CRW will have transitioned to alternate supplies. Meanwhile, the raw water pipelines are maintained and rehabilitated when necessary. Table 2.1 shows the active, raw water pipes by size and length. See Figure 2.1 for the location of CRW's raw water pipes

Table 2.1 Raw Water Pipes

Dia	Length, LF	Miles	Percent of total
<=6	35,134	6.65	12.9%
8	14,916	2.83	5.5%
10	9,245	1.75	3.4%
12	52,061	9.86	19.1%
14	2,309	0.44	0.8%
16	83,530	15.82	30.6%
18	14,600	2.77	5.3%
20	23,637	4.48	8.7%
24	4,272	0.81	1.6%
30	31,015	5.87	11.4%
36	2,354	0.45	0.9%
54	120	0.02	0.04%
Total	273193	51.74	100.0%



CASTLE ROCK Qwater
Securing our future drop by drop

0 4,625 9,250 18,500 27,750 Feet

1 inch = 9,175 feet

Disclaimer: The data presented has been compiled from various sources, each of which introduces varying degrees of inaccuracies or inconsistencies. Such discrepancies in data are inherent and in supplying this product the Town of Castle Rock assumes no liability for it's use or accuracy. Questions or comments regarding the cartographic composition of this map including, but not limited to, errors, omissions, corrections, and/or updates, should be directed to the Utilities Department, Town of Castle Rock, (720) 733-6056. Copyright 2022, Town of Castle Rock Utilities Mapping.

CASTLE ROCK WATER
FIGURE 2.1
RAW WATER PIPES

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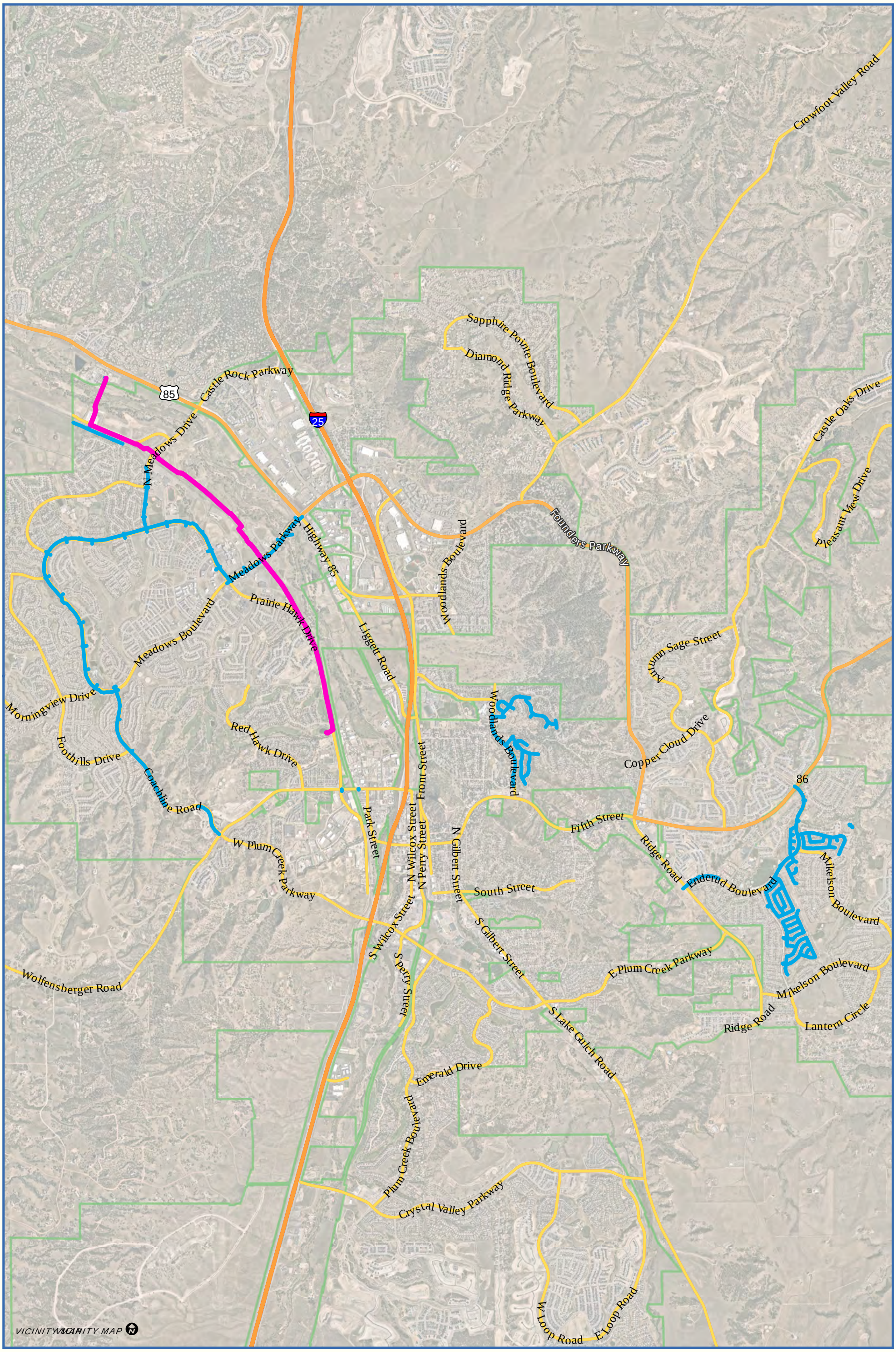
Reuse and Reclaimed Water Pipes

CRW has almost 19 miles of reuse and reclaimed water pipes, as shown in Table 2.2. Much of the pipe was installed in the 1980s when the Town began to grow and was considering a dual pipe system where reclaimed water and dedicated pipes would serve irrigation demands and potable demands would be on a separate pipe system. Much of the original Founders, Woodlands, and some of the Meadows early neighborhoods had dual pipe systems. However, as centralized wastewater treatment was too far away to be practical, and dedicated storage required also, CRW has historically charged much of the reuse/reclaimed water pipes with potable water each spring. The Red Hawk Reuse pipe, almost 3.5 miles of 8" pipe, was installed in 2019 to serve the Red Hawk golf course, and is a truly reuse system; reclaimed water from the PCWRA is pumped directly to the golf course reservoir for direct reuse. In the future, much of the reuse pipes in the neighborhoods will probably have to be rehabilitated and/or replaced due to age and condition, or the existing potable systems may have to be upsized to meet daily demands and irrigation demands. Replacing existing potable lines of the dual systems and upsizing them instead of replacing and maintaining the dual pipes may be the more economical approach and will be evaluated in the future as part of the rehab and replacement program. Refer to Figure 2.2 for the locations or reuse and reclaimed pipes.

Table 2.2 Reuse/Reclaimed Pipes

Diameter (in)	Length (miles)	Linear Feet	% of total
4, 6	5.08	26800	26.8%
8	9.82	51857	51.9%
12	2.85	15072	15.1%
16	1.05	5548	5.6%
18	0.12	621	0.6%
Total	18.92	99898	1.00



CASTLE ROCK water
Securing our future drop by drop

0 1,650 3,300 6,600 9,900 Feet

1 inch = 3,332 feet

CASTLE ROCK WATER
FIGURE 2.2
REUSE/RECLAIMED WATER PIPES

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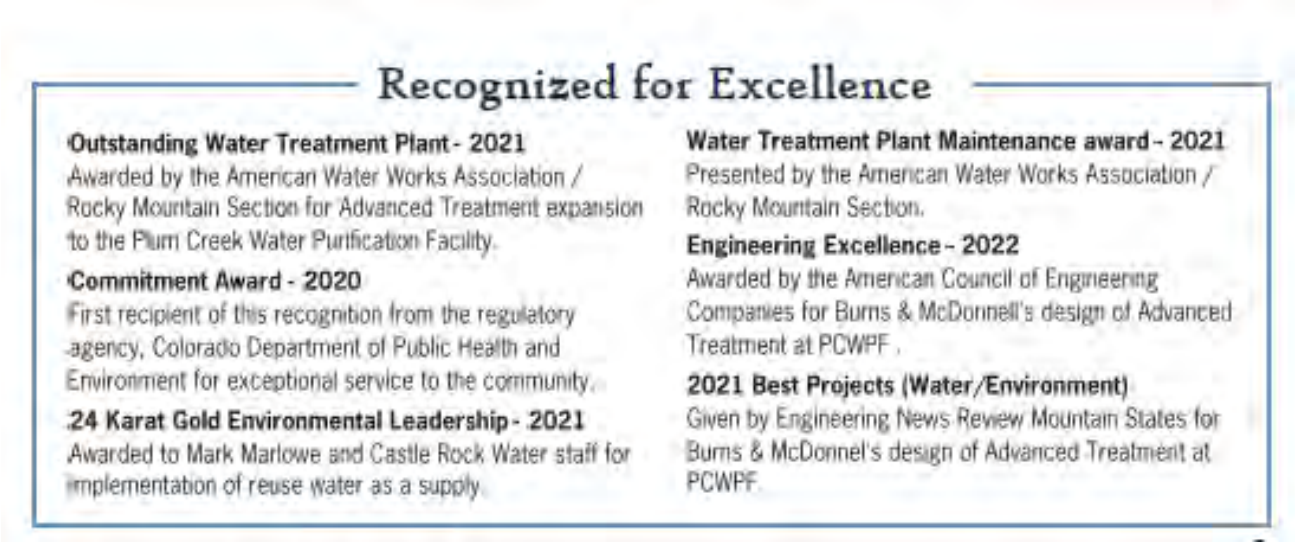
Water Treatment

Five groundwater filtration plants and one surface water advanced treatment plant (PCWPF) currently serve the Town and have a combined treatment capacity of 27.92 MGD. The Town acquired the Bell Mountain WTP and other assets in 2022 when it agreed to absorb their infrastructure and provide water service to the community under the terms of an extraterritorial service agreement. Table 2-3 lists the six plants and their capacities. Treatment capacity currently exceeds the available water supply for all of the groundwater plants except the BMR plant. At the time of the 2017 WMP, there were no firm plans to add groundwater treatment capacity since the groundwater supply is limited to 14.5 MGD and the long-term future demand for groundwater is projected to be less than four MGD (WRSMP, 2021). However, the timing of demand and the supply for renewable water, the aging of existing plants, and where growth will occur, prompted CRW to investigate the potential for a new WTP in the southern part of town or a potential rehab/upsize of the BMR WTP. Currently, the plan is to construct up to an 8 MGD WTP in a site in Crystal Valley Ranch; $50 Million has been included in the future CIP plan for the construction. Wells facilities and raw water lines will also be constructed. The project capacity might be phased to spread out capital construction costs.

The Town currently owns all of the Denver Basin groundwater rights underneath the Town, as well as some renewable water rights. The Town has more than 40,000 acre-feet of groundwater rights, but the Town does not have the necessary infrastructure in place to access all of these water rights. Groundwater is considered a non-renewable resource, and therefore, it is imperative that we continue transitioning to the Town's ultimate water portfolio goal of 75% renewable and 25% non-renewable by 2050.

The Plum Creek Water Purification Facility (surface water treatment) was completed in 2013, and was expanded to six MGD firm treatment capacity in 2017 with the addition of two MGD of additional membrane filtration equipment racks. The PCWPF was expanded in 2021 to include Advanced Treatment (AT) processes, up to 12 MGD for some of the unit processes to accommodate future expansion. While treatment processes at PCWPF already met local, State and Federal regulations for safe drinking water, AT processes were added to treat reusable surface water sources in a potential future DPR scenario. The additional AT processes provide redundancies, focus on contaminants of emerging concern (CECs), and add to the new standards being established by systems utilizing reuse water. The project and CRW staff received various accolades:



Concurrent with the expansion of PCWPF to include AT processes, CRW was completing several other high priority projects to expand the capability to capture and treat reusable supplies. These projects (see Section 4 for discussion) included:

- Upgrades to the Plum Creek Diversion facility
- Plum Creek Raw Water Return Pipeline
- Plum Creek Diversion Pump Station

Indirect Potable Reuse and Direct Potable Reuse

The Advanced Treatment (AT) processes at PCWPF provide for a multiple barrier, advanced treatment approach to treat this water in an Indirect Potable Reuse (IPR) scenario. The multiple barrier approach added advanced treatment processes to enhance removal of pathogens, organics, regulated drinking water contaminants, and contaminants of emerging concern. Since the AT expansion came online in early 2021, the PCWPF has been in compliance with all state and federal standards for water quality. CDPHE should be promulgating final rules for DPR in 2023. CRW is evaluating whether the conversion to DPR, versus the current successful operating scenario of IPR, will be in the best interests of the Town.

Raw water quality to PCWPF is generally improved via blending with surface water in the natural stream environment, and the distance involved promotes additional time for natural microbial and chemical attenuation processes in the Plum Creek and CRR1. However, there are water quality considerations for either the IPR or the DPR strategy. The environmental buffers (Plum Creek and CRR1) are susceptible to deterioration of water quality due to natural processes such as harmful algal blooms, TDS spikes, and wildfire impacts. PCWPF does not have treatment technology for TDS removal, therefore strategies for TDS management will need to be established regardless of IPR or DPR source alternatives.

Diurnal fluctuations in ammonia and nitrates in PCWRA treated wastewater will warrant increased operator attention at PCWPF in a DPR scenario. Contaminants of Emerging Concern (CECs), such as perfluoroalkyl substances (PFAS), could be higher in concentration in a DPR scenario due to absence of the environmental buffer that the Plum Creek natural

flows afford. PCWPF is designed to handle the removal of these contaminants to minimize risk, but there may be increased O&M requirements and/or treatment modifications and optimization necessary.

The DPR scenario requires purchase of multiple online analyzers for treated wastewater and advanced treated water monitoring. With DPR, there is a potential necessity for additional treatment requirements for pathogen reduction dependent upon the results of a site-specific Quantitative Microbial Risk Assessment (QMRA) that CDPHE will require. CRW is planning to do this QMRA in the current planning period. Disinfection byproduct (DBPs) precursor concentrations such as bromide could increase in the PCWPF influent due to higher percentages of PCWRA treated wastewater, necessitating adjustments to existing DBP management strategies (e.g., bromate control as related to ozone dose). In the event of an upset condition at the PCWRA, or a spill or discharge that adversely impacts the Plum Creek, the current IPR scenario affords more time to respond than the DPR scenario. Future use of DPR will require strategies for managing any upsets.

Advanced Treatment GAC filters at the PCWPF

Advanced Treatment Ozone Contact Time Piping at the PCWPF

Current plans for full expansion of PCWPF will follow a three phase schedule of construction to reach ultimate treatment, pumping and distribution capacity of 12 MGD by 2031. Phase 1 will increase the treatment and distribution capacity to 8 MGD by early 2026. Included in Phase 1 is the replacement of 12,500 linear feet of existing 16-inch potable pipeline with new 30-inch pipe, to include a 1,500 linear feet horizontal directional bore under Plum Creek to minimize impacts to endangered Prebles Mouse Habitat. Phase 2 will increase treatment and pumping capacity to 10 MGD, for completion in 2028. The final phase to reach 12 MGD of treatment and pumping is planned to be completed by early 2031. Current estimated opinion of costs (in 2021 dollars) for the three-phased expansion to 12 MGD is about $56.5 Million. Phase 1 design should occur in 2023, with a two-year construction phase in 2024-2025, with processes online to meet demand in 2026.

Engineering will continue to work with Operations to make minor modifications to the treatment processes and building infrastructure to increase efficiency and safety. The Ray Waterman Regional Water Treatment Center (RWRWTC) was evaluated for these types of improvements in 2009 and several potential improvements were identified. In 2015 the underdrains and filter media at RWRWTC were removed and replaced. The upgrades may support a rerating of the facility from eight MGD to ten MGD, with additional modifications to chemical dosing and pump capacity, however, this would have to be approved by CDPHE, and may be worth pursuing at such time as additional water sources become available. Currently the RWRWTC is supply-

limited; however, treatment capacity is being used to retreat WISE water to a finished water quality that is more consistent with CRW's existing water quality from the facility, then the comingled treated water is sent to customers. Plans are being formulated to use the interconnect with the Pinery to bring 0.25 MGD, initially, of CCPWA fully treated renewable water supplies to the Town's raw water system, to be retreated at RWRWTC for distribution. In the future, up to 1.0 MGD may be available through the Pinery interconnect,

As shown in the Table 2.3 below, the Town's ability to provide treated water is limited by available water supplies, but in combination with water storage, is sufficient to meet max day demands. However, acquiring additional raw water supplies, particularly renewable water supplies, is a high priority and will be driving the capital investment program in the near future. Nevertheless, CRW will continue to invest in deep groundwater wells, either new and/or rehabbed wells, because they are a long-term part of our water portfolio and provide some backup system reliability in times of drought. For example, the WISE supplies are interruptible supplies, so there must be a backup supply to replace those waters if necessary.

Table 2-3 Water Treatment System Capacity

Water Treatment System	Treatment Capacity (MGD)	Raw Water Capacity (MGD)	Treatment or Raw Water Limited?	Firm Pumping Capacity (MGD)[1]
RWRWTC	8.0	6.0	Raw Water	12.0
Founders	3.2	2.7	Raw Water	2.4
Meadows	8.0	4.4	Raw Water	7.0
P.S. Miller	2.0	1.27	Raw Water	1.5
PCWPF	6.0	6.0	Treatment	6.0
Bell Mountain	0.72	0.72	Treatment	1.2
Total	27.92	21.09	**Total Firm Water Pumping Capacity**	30.1

[1]Firm pumping capacity represents the total pump station capacity with the largest pump out of service.

Bell Mountain Water Treatment Plant and/or Crystal Valley Ranch WTP:
In November 2022, the Town entered into an Extraterritorial Services Agreement with the Bell Mountain Ranch subdivision. The 321 home subdivision is in Douglas County, just south of but contiguous to the Town, was a separate community water system that relied 100% on nonrenewable groundwater. BMR had their own WTP, wells, raw and potable water lines, and storage tanks. The subdivision, is however, completely on septic tanks with no sewer collection system. WTP residuals had been discharged to a nearby dry gulch. However, with new regulations, the community system was unable to comply with State water quality requirements for discharge from the WTP. The community needed a long-term renewable water supply solution in addition to significant rehabilitation of its WTP and/or a method to deal with the treatment residuals. CRW has long been cognizant that long-term water solutions

require regional partnerships, and that expansion of the service area, even outside the Town's incorporated boundaries, is sometimes the right thing to do.

Under the terms of the agreement, BMR would pay for capital buy-in and connection costs, and would become CRW customers, similar to the Macanta (Canyons South) subdivision, also in Douglas County. For the purpose of serving BMR, the Town has purchased 1,000 acre-feet of additional WISE renewable water, part of which was previously reserved for other areas of unincorporated Douglas County, which water will be supplied, subject to availability, to help meet the BMR Subdivisions' annual water demand of approximately 144 acre-feet. The Town acquired all BMR water infrastructure, wells and water rights, and will provide service in the same manner as to other CRW customers.

In 2022 CRW initiated a study to evaluate options for either modifications at the existing Bell Mountain WTP or construction of a new 8.0 MGD WTP in the Crystal Valley Ranch (CVR) Loop Road area, with the intent to decommission the BMR WTP when/if a new CVR WTP was constructed. The existing BMR WTP needs significant capital expenditures just to remain in service as a 0.75 MGD plant; capital dollars may be better spent on a new larger plant in CVR that can help meet peak summer irrigation season water demands in CVR and Heckendorf/Lanterns, maybe replace the Miller Water Treatment Plant in the future, and also meet the demands of BMR and the future Dawson Trails development.

The Ridge Estates development in lower CVR needed water storage in a zone higher than existing pressure zones within the CRW service area and needed storage within the Bell Mountain service area. BMR was also short on fire flow storage for its 321 residences within their service area. The developer, BMR and the Town are jointly constructing an additional 0.40 MG storage tank within BMR, and also a pump station and potable water interconnect between CVR and BMR. This interconnect and pump station will allow CRW to provide service to BMR in the future to either make improvements at the BMR WTP for continued service or to decommission the plant altogether once a CVR WTP is constructed.

Construction of a new WTP in the CVR or BMR area has several advantages. Current Lanterns deep groundwater wells could be redirected to the new WTP, making additional capacity available at the PCWPF for surface water supplies that can only be treated at the PCWPF. Wells in the southern part of Town have traditionally been very good producers. CVR, Lanterns, Heckendorf and Dawson Trails will be where much of new growth in the next decade to twenty years is expected to occur. The CVR site is a large parcel, with good road access, and close to distribution piping and available storage in the Tank 15 nearby. An alternatives study completed in Feb 2023 recommended construction of a new WTP in the CVR area over a new facility in BMR; $50 Million has been included in the CIP planning budget for construction of this new WTP.

Corrosion Control

Prompted by the Flint, Michigan water issues (specifically lead leaching from private plumbing), in February 2016 the EPA informed states to enhance the oversight of implementation and enforcement of drinking water regulations such as the Lead and Copper Rule. The Town of Castle Rock had seen rapid growth with a population estimated to be over

62,000 people in 2016. That population number triggered large system requirements in the Lead and Copper Rule and required that a corrosion control study be completed unless the water system could demonstrate that they met criteria to be deemed a system having optimal corrosion control. Based on tap and source water quality laboratory testing completed in 2017, CRW was deemed as having optimal corrosion control treatment by the CDPHE and a corrosion control study was not required.

Water quality within the Town's distribution network has been historically stable, with no action level exceedances of lead or copper since the Town began testing for these compounds in 1992. The Colorado Primary Drinking Water Regulations (5 CCR 1002-11) allows an exemption from completing the corrosion control study for water systems that already meet specific water quality parameters (currently have optimal corrosion control). CRW met those requirements and submitted a request to CDPHE seeking the exemption from completing the study. CDPHE approved CRW's request to be deemed a system having optimal corrosion control (not having to complete the corrosion control study). CRW chose to perform a CCS proactively to evaluate their current treatment processes and to review other potential corrosion control technologies (CCTs), not as a requirement issued by EPA or CDPHE.

In early 2019 CRW was proactive and started a CCS in accordance with the EPA and CDPHE guidelines. Completing a CCS provided CRW with data to assist CRW in continuing the goal of operating a potable water distribution system with optimal corrosion control treatment. In addition, completion of the CCS at that time established a baseline for the water quality in the Town's distribution system against which the quality of future new water sources could be evaluated and compared with.

The corrosion control study included but was not limited to a system-wide water quality evaluation (samples taken at various locations throughout the system for laboratory testing), evaluation of current water treatment methods and possible future changes to treatment or water sources, a review of materials in the distribution system, and an evaluation of corrosion control treatments in the system based on further testing. Study results were used to prepare a report that evaluated potential additional corrosion control treatments (as needed) and compared their ability to reduce lead and/or copper in private plumbing that contains lead and copper. Completing the corrosion control study required additional staff time and various costs, such as those for lab testing and engineering consultant services. In February 2019, CRW contracted with Burns and McDonnell for the CCS at a cost of $84,670; the study was completed in February 2020.

Results showed that the optimal corrosion control technology (OCCT) for PCWPF was zinc orthophosphate (ZOP) addition (just marginally better than pH adjustment), while at Meadows WTP and RWRWTC either ZOP addition or pH adjustment were equally effective. Lead and copper rule requirements designate that a single CCT be used at all treatment sites. There are significant costs associated with ZOP addition at the treatment plants, with marginal additional optimization of corrosion control. Additionally, the addition of zinc orthophosphate would be adding significant amounts of phosphorus which would have implications for wastewater treatment effectiveness at the Plum Creek Water Reclamation Facility (PCWRF). Phosphorus in wastewater from urine, detergents and other cleaning agents, and from fertilizer in

stormwater runoff that infiltrates the collection system, is already a challenge for wastewater treatment without unduly adding it to the potable water. Phosphorus is also a finite resource (worldwide, sources are expected to be exhausted in the next 100 years). At a recommended baseline dose of 3 mg/L as phosphate, the equivalent loading to the wastewater system would be almost 25 pounds per MGD of effluent (currently that would be over 100 pounds per day). The addition to the potable water used for lawns could also impact stream water quality due to runoff, when phosphorus in the Plum Creek and Cherry Creek watersheds is already a huge concern.

In August 2022, the CDPHE reconfirmed CRW's status as having OCCT and revised the water quality monitoring schedule for the CRW. If the Town were required to perform a CCS due to an action level exceedance or other scenario, a new study would probably need to be performed since the water quality sources have changed with the addition of reuse water to PCWPF in 2021 and the treatment processes at PCWPF have changed with the addition of AT processes. CRW will continue to monitor system water quality and report those results to CDPHE and to the public in the annual Consumer Confidence Report (CCR), and will complete a new CCS if so required by the EPA or CDPHE.

Finished Water Storage

Finished water storage is critical for meeting peak demands and fire flow requirements. The Town has sixteen active water storage tanks, with two new tanks under construction for completion in 2023, located in the various pressure zones with a total storage capacity of 38.31 million gallons (MG). Table 2-4 provides an inventory of existing water storage tanks. The Town plans to maintain these existing tanks and add several more as the Town continues to grow. Tank 3, the Town's oldest storage tank, was rehabilitated in 2016, and a replacement tank (Tank 3B) is in the CIP plan. The Town acquired BMR Tanks 20A and 20B in 2022, and began construction of BMR Tank 20C in 2022, for completion in 2023. BMR Tank 20C will provide tan zone storage for Ridge Estates and Planning Area #15 in Crystal Valley Ranch, and will provide for additional fire flow storage for the Bell Mountain Subdivision. Tank 18 (yellow zone) in Cobblestone Ranch is under construction in 2022-2023 and will add an additional 2.0 MG of storage. Other future tanks include a new purple zone tank (Tank 11B) and a new red zone Tank, either collocated at the Tank 14 or Tank 16 site (Tank 16B). Tank 6B has deteriorated to the point that it has been removed from service and will be demolished, and a future tank (Tank 6B Rep) constructed on the site in the future build-out timeline. The Dawson Trails development will need to construct a new Red Zone tank (future Tank 19), and potentially a future Green Zone tank (future Tank 21). See Figure 2.3 for locations of existing and future tanks.

Table 2-4 Finished Water Storage Tank Inventory

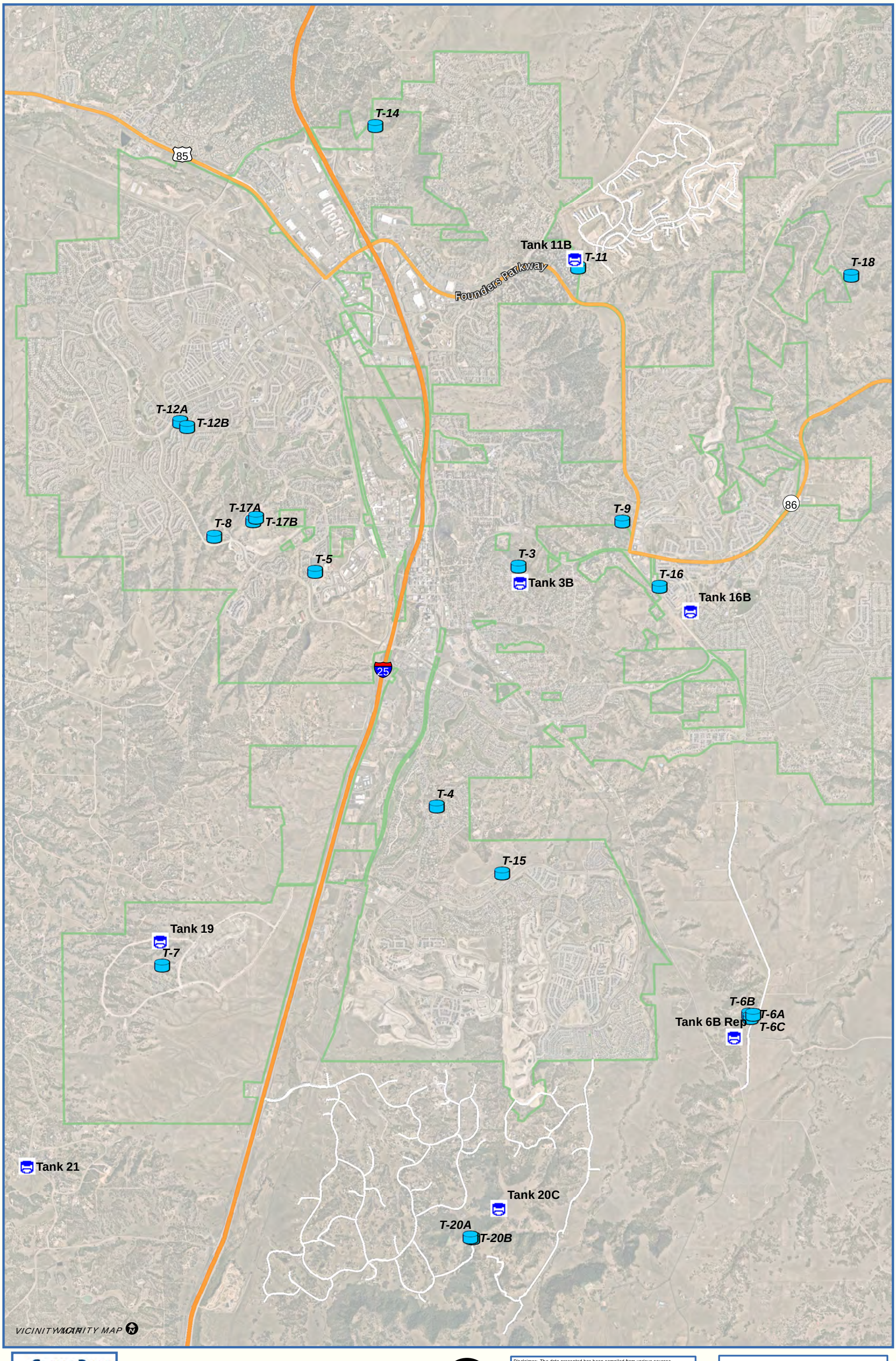
Tank ID	Year Built	Capacity (MG)	Dia (ft)	Height (ft)	Zone	Fire Flow Volume	Fire Vol in Tank	Tank with More Fire Vol	Status
T- 3	1969	1.04	92.6	19.1	Purple	360,000	360,000		A
T- 4	1984	1.51	118.0	18.6	Blue	1,560,000	780,000	T-15	A
T- 5[1]	1984	(0.5)	66.0	19.4	Yellow	390,000	0	T- 8	NIS
T- 6A	1986	2.0	120.0	23.5	Green	960000	480,000		A
T- 6B[2]	1997	(2.0)	120.0	23.5	Green				NIS
T- 6C	2010	2.22	120.0	23.5	Green		480,000		A
T- 7[3]	1986	(2.0)	122.0	22.7	Red	NA	NA	NA	NIS
T- 8	1987	3.13	147.0	24.8	Blue	1,620,000	1,815,000		A
T- 9	1989	1.0	96.0	19.3	Purple	1,200,000	600,000	T -16	A
T- 11	1998	1.0	92.5	24.0	Purple	1,080,000	540,000	T -14	A
T- 12A	1999	3.94	172.0	22.8	Yellow	1,440,000	720,000		A
T- 12B	2007	6.13	172.0	22.8	Yellow		720,000		A
T- 14	2001	2.0	121.0	23.3	Red	600,000	1,440,000		A
T- 15	2002	4.03	174.0	22.7	Red	360,000	1,140,000		A
T- 16	2004	3.11	140.0	27.0	Red	300,000	900,000		A
T- 17A	2005	2.24	136.0	20.6	Red	180,000	90,000		A
T- 17B	2009	2.26	136.0	20.6	Red		90,000		A
T- 18	2022-2023	2.0	132.0	20.5	Yellow	600,000		T -16	UC
BMR 20A	1996	0.21			Tan	240,000	180,000 (current deficit)	20-C	A
BMR 20B	1996	0.09			Tan			20-C	A
BMR 20C	2022-2023	0.40	78.0	11.3	Tan				UC
Total Active Storage Capacity		38.31							

1 Tank 5 is located in Citadel Station and currently is not in service. It has been physically disconnected from the distribution system and its future use will be evaluated.

2 Tank 6B has been removed from service due to a structural failure. This tank is scheduled for demolition in the 5-year CIP.

3 Tank 7 is located in Dawson Trails and currently is not in service. This tank is not intended for future use by CRW.

A = Active; NIS = Not in Service; UC = Under Construction



CASTLE ROCK Qwater
Securing our future drop by drop

0 1,850 3,700 7,400 11,100 Feet

1 inch = 3,667 feet

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CASTLE ROCK WATER
FIGURE 2.3
WATER STORAGE TANKS

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Water Pumping

The Town's water system includes eight booster pump stations and finished water pumps located at each of the WTPs. Water is pumped from WTPs to tanks and directly into the distribution system. Booster pumps provide the ability to move water to a higher zone for storage or distribution. The Ridge Estates pump station is under construction for completion in 2023; it will move green zone water from the Crystal Valley Ranch area up to the new tan zone water storage tank under construction in Bell Mountain Ranch. Several new pump stations are planned for the build-out condition and include a future green zone pump station at Tank 16; and future pump stations in the Dawson Trails planned development (to be built by the developer). See the capital improvements section for more information. Table 2-5 summarizes pump station capacities.

Emergency Backup Power

Generators for three major water treatment plants, capable of supplying enough power during electric service interruptions to meet average day demand, have been installed at Ray Waterman Regional Water Treatment Center (RWRWTC), the Meadows WTP and the Plum Creek Water Purification Facility (PCWPF). In addition, several critical pump stations have back-up generators. Refer to Table 2.5 for more information.

PCWPF

Construction of the original PCWPF was completed and the facility started distributing treated water in spring of 2013. Facility designs included ancillary facilities for connection to a future emergency electrical power generator. An existing 500kW, 480V diesel electric generator from an offline facility was relocated to the PCWPF in 2014. This 500kW generator can supply sufficient power to operate the PCWPF at a flow condition of 2 MGD.

With the Advanced Treatment Expansion at PCWPF in 2020, the new advanced treatment building was outfitted with a 900 kW generator that can power all AT processes up to 12 Mgd. With the next expansion, planned in the next few years, the 500 kW generator will be replaced with a generator that can power the full 12 Mgd capacity of the main treatment building processes. The 500 kW generator will be evaluated for transfer to the O&M building to keep that facility, which operates as a command center, operational during power outages.

Table 2-5 Water Pumping Stations

Pump Station	Zone	Number of Pumps	Total Pump Station Capacity	Firm Pump Station Capacity[1]	Backup Generator
Meadows Blue Zone	Blue	3	4,100 gpm	2,400 gpm	
Meadows Red Zone	Red	2	1400 gpm	700 gpm	150 kW
Citadel [2]	Blue	2	1,600 gpm	800 gpm	
Crystal Valley Ranch	Green	3	2,400 gpm	1,600 gpm	
Diamond Ridge	Green and Red	Green Zone - 5 Red Zone - 2	Green Zone – 2,440 gpm Red Zone – 1,440 gpm	Green Zone - 940 gpm Red Zone - 720 gpm	150 kW
Hillside	Blue	1	800 gpm	0 gpm	
Milestone	Purple	2	3,000 gpm	1,500 gpm	288 kW
Plum Creek South	Red	3	2,190 gpm	1,460 gpm	
RWRWTC	Green and Red	Green Zone - 3 Red Zone - 3	Green Zone – 7,670 gpm Red Zone – 7,425 gpm	Green Zone – 4,270 gpm Red Zone – 4,125 gpm	1,250 kW 1,100 kW
Meadows WTP	Yellow	4	6,550 gpm	4,900 gpm	350 kW
Founders WTP	Green	3	3,400 gpm	2,200 gpm	
PS Miller WTP	Blue	4	4,000 gpm	3,050 gpm	
PCWPF	Yellow	3	6,960 gpm	4,167 gpm	900 kW (AT) 500 kW (2 Mgd)
Bell Mtn WTP	Tan	4	1310 gpm	835	Yes
Ridge Estates (UC)	Tan	2	660 gpm	330 gpm	150 kW (natural gas)

[1]Firm pump station capacity represents the total pump station capacity with the largest pump out of service.
[2] The Citadel PS has been isolated from the distribution system, but could still be used by changing some valve settings in the distribution system.
UC – Under construction 2023

Water Transmission and Distribution

The Town's water transmission and distribution (T&D) network consists of approximately 437 miles of transmission and distribution piping (excluding raw water pipelines), ranging in size from 4 to 42 inches. The majority of the piping is 8-inch and 12-inch diameter in the distribution network. Table 2-6 summarizes the approximate lengths for each pipe size as inventoried in Castle Rock Water's GIS.

Table 2-6 Distribution System Piping

Diameter (in)	Length (miles)	Percent of total
4	1.18	0.3
6	26.0	5.9
8	256.4	58.7
10	2.69	0.6
12	83.24	19.0
16	33.20	7.6
18	5.00	1.1
20	8.61	2.0
24	7.48	1.7
30	8.18	1.9
36	5.15	1.2
Total	**437.13**	**100%**

Notes:

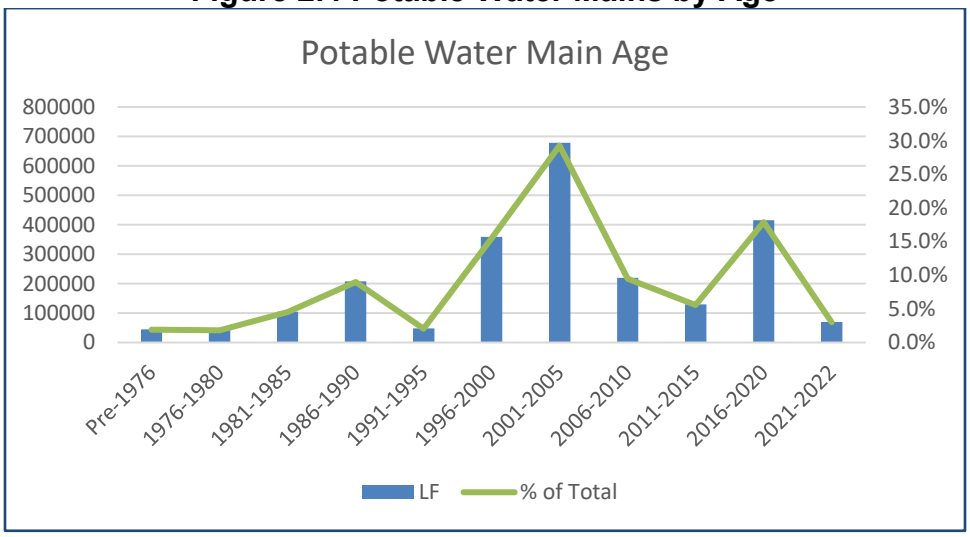
- 36" includes the WISE pipeline; while treated water already, it is retreated at RWWTC
- this does include the newly acquired BMR infrastructure

As shown in Table 2-7, there are almost sixteen miles of Ductile Iron (DI) pipe installed from before 1980 (3.7% of all T&D piping). Of that, almost 63% is smaller diameter four and six-inch pipe, which would not meet current standard criteria and is a priority for capital replacement. See Figure 2.4 for Potable Water Mains by Age and Figure 2.5 for the location of pre-1980 DI pipe.

Table 2-7 Pre-1980 DI Pipe, Potable

Diameter (in)	Length (miles)	Percent of total
4	0.60	3.76%
6	9.47	59.34%
8	3.42	21.43%
12	2.47	15.48%
Total	15.96	**100%**

Figure 2.4 Potable Water Mains by Age



Malibu St

25

VICINITY MAP

CASTLE ROCK Qwater
Securing our future drop by drop

0 470 940 1,880 2,820 Feet

1 inch = 926 feet

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CASTLE ROCK WATER 2023
PRE 1980 WATER PIPES
FIGURE 2.5

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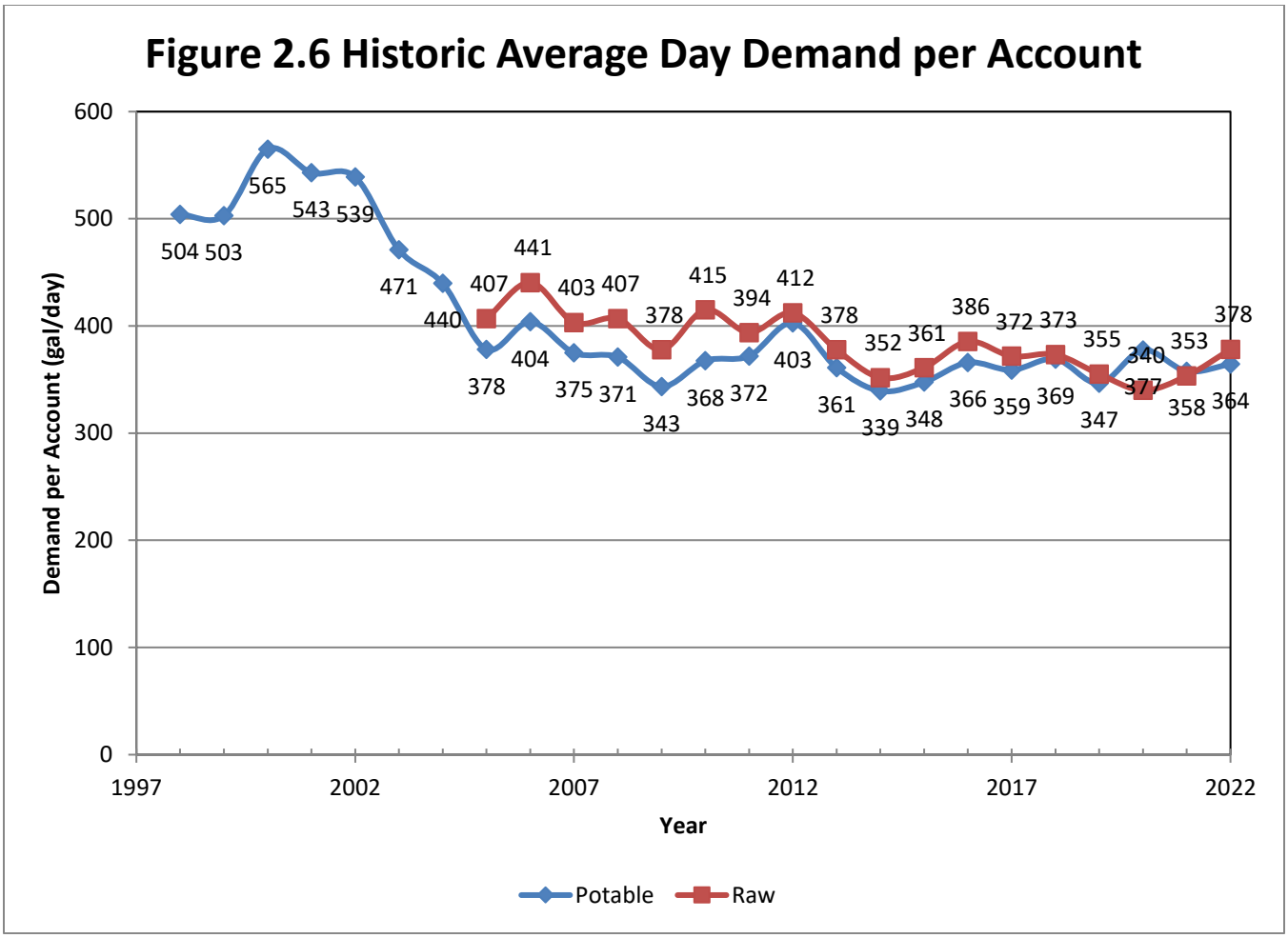
Table 2-8 shows the distributed age of distribution piping in the Town's system. Castle Rock Water's system is young by most standards – 58.2 percent has been installed since 2001. With an expected lifetime of 45-50 years, significant capital replacement will need to begin by 2040-2045.

Table 2-8 Water Mains by Install Year

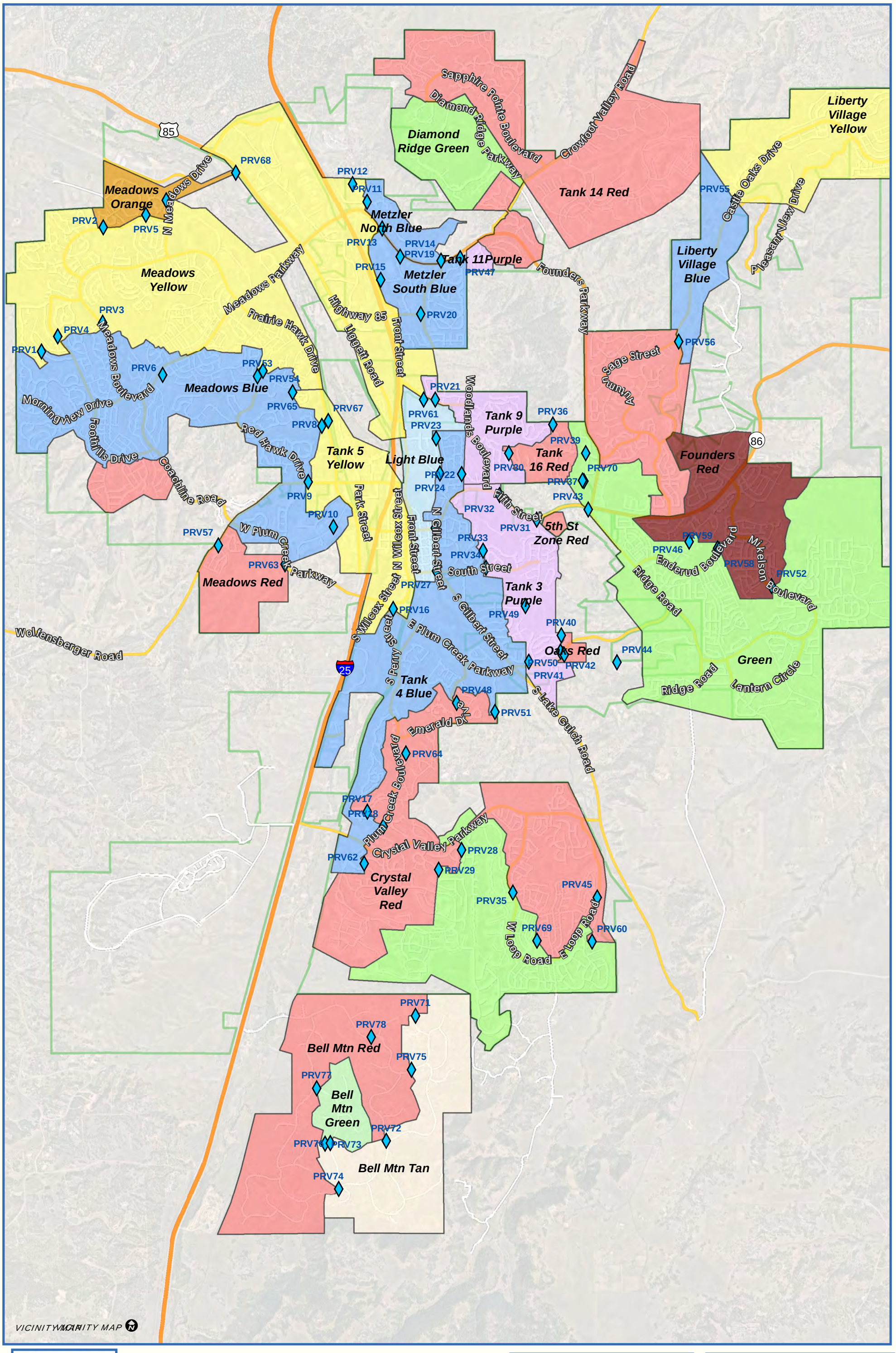
Year	LF	Miles	% of Total
Pre-1976	44666	8.46	1.93%
1976-1980	42115	7.98	1.82%
1981-1985	104764	19.84	4.52%
1986-1990	208023	39.40	8.97%
1991-1995	47873	9.07	2.06%
1996-2000	359308	68.05	15.49%
2001-2005	678630	128.53	29.26%
2006-2010	219220	41.52	9.45%
2011-2015	129077	24.45	5.57%
2016-2020	415313	78.66	17.91%
2021-2022	70038	13.26	3.02%
Total	2319027	439.21	100%

The water transmission and distribution network is sized to handle a conservative maximum peak hour day demand. See Figure 2.6 for a graphic of the historical average day demand (ADD) per account. The figure shows the impact that conservation efforts are having on decreasing average daily demands, but also the effect that dry weather (2012) and increased irrigation has on average demands. Figure 3.4 in Section 3 is an example of the daily diurnal demand chart which illustrates how peak hourly flows fluctuate over the course of the day, showing the impact that irrigation demand has on peak hourly flows.



Pressure Zones and Pressure Reducing Valves

Pressure Reducing Valve (PRV) stations are an integral component of a water distribution system. Due to varying elevations within a distribution system, the system must be divided into pressure zones. With the addition of Bell Mountain Ranch (tan zone), the system now has seven different pressure zones (orange, yellow, blue, purple, red, green, tan). Generally, the pressure within a zone is between 43 psi and 125 psi, depending on the service location relative to the storage tanks that serves the zone. The pressures within these pressure zones are regulated and maintained by tank levels, complicated pressure sensors and valve systems (PRVs, of which there are 73 active PRVs in the Town's distribution system; there may be multiple PRVs at a single location). Figure 2.7 shows the various pressure zones in the Town of Castle Rock and the location of PRVs.


Meadows Orange
Meadows Yellow
Meadows Blue
Meadows Red
Diamond Ridge Green
Tank 14 Red
Liberty Village Yellow
Liberty Village Blue
Metzler North Blue
Metzler South Blue
Tank 11Purple
Tank 9 Purple
Tank 16 Red
Tank 5 Yellow
Light Blue
Tank 3 Purple
5th St Zone Red
Oaks Red
Founders Red
Green
Tank 4 Blue
Crystal Valley Red
Bell Mtn Red
Bell Mtn Green
Bell Mtn Tan
PRV1
PRV2
PRV3
PRV4
PRV5
PRV6
PRV8
PRV9
PRV10
PRV11
PRV12
PRV13
PRV14
PRV15
PRV16
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PRV67
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PRV72
PRV73
PRV74
PRV75
PRV76
PRV77
PRV78
Sapphire Pointe Boulevard
Diamond Ridge Parkway
Crowfoot Valley Road
Castle Oaks Drive
Pleasant View Drive
N Meadows Drive
Meadows Parkway
Prairie Hawk Drive
Highway 85
Liggett Road
Front Street
Founders Parkway
Sage Street
Autumn
Woodlands Boulevard
Fifth Street
Park Street
N Wilcox Street
N Gilbert Street
South Street
S Wilcox Street
S Perry Street
S Gilbert Street
E Plum Creek Parkway
W Plum Creek Parkway
S Lake Gulch Road
Ridge Road
Enderud Boulevard
Mikelson Boulevard
Lantern Circle
Meadows Boulevard
Morningview Drive
Foothills Drive
Coachline Road
Red Hawk Drive
Plum Creek Boulevard
Crystal Valley Parkway
W Loop Road
E Loop Road
Wolfensberger Road
Emerald Dr
85
86
25
VICINITY MAP
CASTLE ROCK Qwater
Securing our future drop by drop
0 1,950 3,900 7,800 11,700
Feet
1 inch = 3,833 feet
N
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CASTLE ROCK WATER
FIGURE 2.7
PRESSURE ZONES AND PRVs
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Regional Projects:

WISE Partnership and WISE Local Infrastructure:

The Town of Castle Rock is a member of the South Metro WISE (Water Infrastructure and Supply Efficiency) Authority formed in 2013 and has a 2,000 Acre-Feet/year subscription (1,000 AF initially, and in 2018 CRW purchased 1,000 AF that had been reserved by Douglas County). The WISE project is a component of the Town's hybrid project concept that spreads out the costs over several generations but secures a renewable water supply in the near term for existing customers and development in the future. The project is based largely on the utilization of available Denver Water and Aurora Water reusable return flows available in the South Platte River downstream of Denver and excess capacity in Aurora's Prairie Waters Project. Construction began in late 2016 on 5.3 miles of 36-inch pipeline to convey WISE waters from a connection with Parker Water and Sanitation District. The project was completed in 2018. After nine years of planning and more than $50 million in infrastructure, CRW began importing WISE water on schedule in April 2018. Agreements for conveyance and cost sharing are in place with PWSD and other WISE partners. The Town plans to fully utilize WISE deliveries when they are available and minimize the use of deep groundwater wells. If WISE supplies are available that can't be put to beneficial use, the plan is to first store the excess through ASR, and then in Rueter-Hess Reservoir. Ideally, although this is treated water, the Town retreats it prior to sending to distribution to ensure outstanding water quality and disinfection residual. CRW also plans to retreat WISE waters prior to ASR storage. Castle Rock has developed partnerships with PWSD, DWSD, and Pinery WWD for design, construction and implementation of infrastructure necessary to deliver WISE water between the Western Pipeline and the Town. This additional infrastructure includes the Ridgegate Pipeline, the Canyons Pipeline, the Outter Marker Road Pipeline and the Parker Midsection Pipeline (constructed starting in 2023).

Future projected WISE investments and projects (per the 2021 WRSMP) have a current price tag of over $144 million and include:

- Expand the Parker WSD Reuter-Hess Water Purification Facility (RHWPF) with 12 MGD of reserved capacity for CRW;
- Binney Connection;
- WISE DIA connection;
- Salinity Reduction Treatment Facilities;
- PWSD Midsection Pipeline;
- WISE pump station expansion (at PWSD)
- WISE Phase 2 Pipeline - future parallel Outter Marker Road to Ray Waterman RWTC pipeline.

The WISE Pipeline during Construction

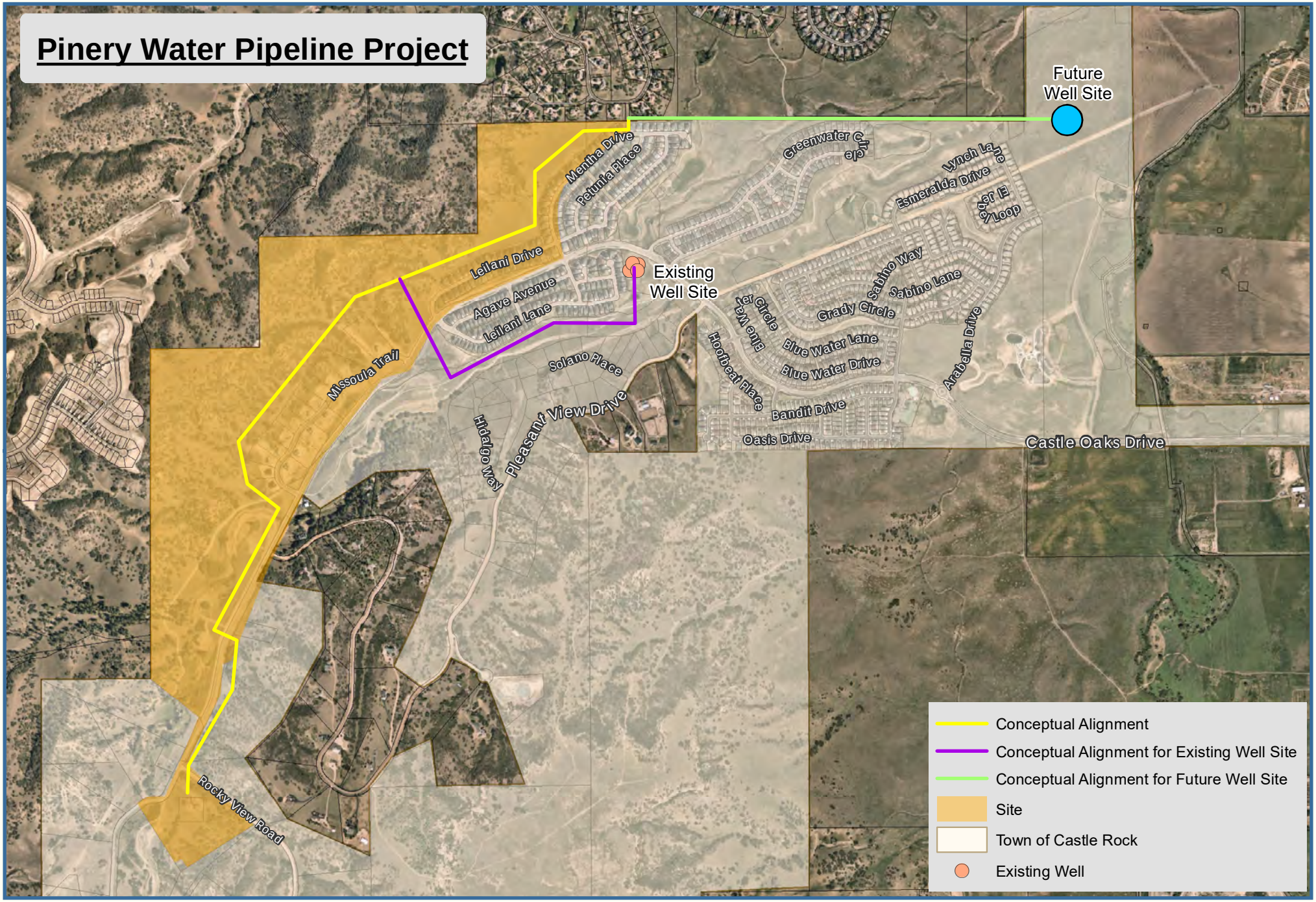
Pinery Interconnect
The Pinery Interconnect was constructed in 2013. The Town and the Denver Southeast Suburban Water and Sanitation District (the Pinery) installed a 12-inch pipeline between the two districts. The project included a flow meter and flow control valve to regulate the flow of water between the two distribution systems. The project was designed to move up to 2 MGD between the two distribution systems in the case of an emergency. CRW is planning a pipeline along the Castle Oaks Drive between The Pinery and Castle Rock's system. This pipeline will transfer from the Pinery between 0.25 to 1.0 MGD of non-groundwater directly under the influence (GWDUI) water to the Ray Waterman Regional Water Treatment Center (RWRWTC). CRW will retreat the water due to differing water quality between CRW and Pinery treated water prior to sending it to distribution.

The Pinery uses a water treatment chemical called AquaMag in their potable water distribution system. AquaMag is a blend of poly and orthophosphate used to sequester iron and manganese in the potable water. Since Pinery does not filter out iron and manganese, AquaMag helps keep these constituents in solution so they do not become an aesthetic problem. When water containing AquaMag mixes with water not treated with the product, some iron and manganese may come out of solution due to the slightly higher sequestering demand. CRW uses greensand filtration processes to remove iron and manganese down to very low levels in our treated water. There are concerns that mixing the two source waters in the distribution system could result in iron and manganese being released from their sequestered state into solution, which could cause laundry and fixture staining in customer's home. CRW would prefer to maintain the high water quality standards that its customers are used to. Rather than constructing a new treatment station in the Cobblestone Ranch neighborhood, CRW could send the Pinery water to the RWRWTF using existing raw water lines. The RWRWTF is a groundwater facility with greensand filtration. If CRW sent the Pinery water to the RWRWTC, we could better control the water quality entering the distribution system.

The Town has a few existing well sites near the proposed pipeline. The pipeline and pump station option will give the Town the flexibility to tie-in these wells in the future. See Figure 2.8 for an exhibit of the proposed Pinery Interconnect pipeline.

Castle Pines Interconnect
The Castle Pines Interconnect was constructed in 2014. The Town and the Castle Pines Metropolitan District installed a twelve-inch pipeline between the two districts. The project included a flow meter and flow control valve to regulate the flow of water between the two distribution systems. The project was designed to move up to two MGD between the two distribution systems in the case of an emergency. To date, an emergency situation has not required activation of the interconnect.

Pinery Water Pipeline Project



Castle Rock Water — Securing our future drop by drop

0 1,000 2,000 4,000 Feet

Date: 1/25/2023 1 inch = 1,500 feet

FIGURE 2.8

VICINITY MAP

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Dominion Water and Sanitation District Wheeling Infrastructure
On May 15, 2018, the Town entered into a Cost Sharing IGA with Dominion Water & Sanitation District (Dominion) for the design and construction of the Plum Creek Raw Water Return Pipeline (PCRWRP) jointly with Dominion's Eastern Regional Pipeline Project (ERPP). The Town's pipeline extended from our Plum Creek Diversion near Sedalia approximately 6 miles back to town, connecting this renewable water source to our PCWPF raw water supply lines. Dominion's ERPP paralleled the PCRWRP from Sedalia back to the town, connecting to existing potable distribution lines near SH85 and the Outlets shopping complex. A control and metering vault with SCADA was also constructed. The PCRWRP was completed in late 2020, in time to send water to the AT processes at the PCWPF. To date, Dominion has not requested that any water be wheeled through the system to their connection in Sedalia.

Cherry Creek Project Water Authority (CCPWA) - Walker Reservoir
Walker Reservoir is a proposed CCPWA water storage project, located northwest of Franktown. The project will provide 650 AF of storage which will be filled from a combination of future alluvial and deep wells near the reservoir and is to be stored for use during high demand periods. CRW's portion of the storage capacity is 150 AF. The water that is stored in the reservoir will be discharged into Cherry Creek by the project pump station to be picked up downstream by project members.

The CCPWA contracted for the reservoir construction in 2021 for $11.6 million. The project includes a slurry wall surrounding the reservoir that is constructed up to 80 feet deep and into bedrock to provide a watertight seal from the water in Cherry Creek. At the end of 2022, mass excavation for the reservoir was approximately 30% complete with 152,000 of 475,000 cubic yards complete. All rebar, pipes, and pumps are onsite and electrical equipment is currently stored off-site. Project completion is expected in the fall of 2023. The well construction (3 alluvial and 1 Arapahoe deep well) that will supply the reservoir, started in March 2023.

Walker Reservoir under construction

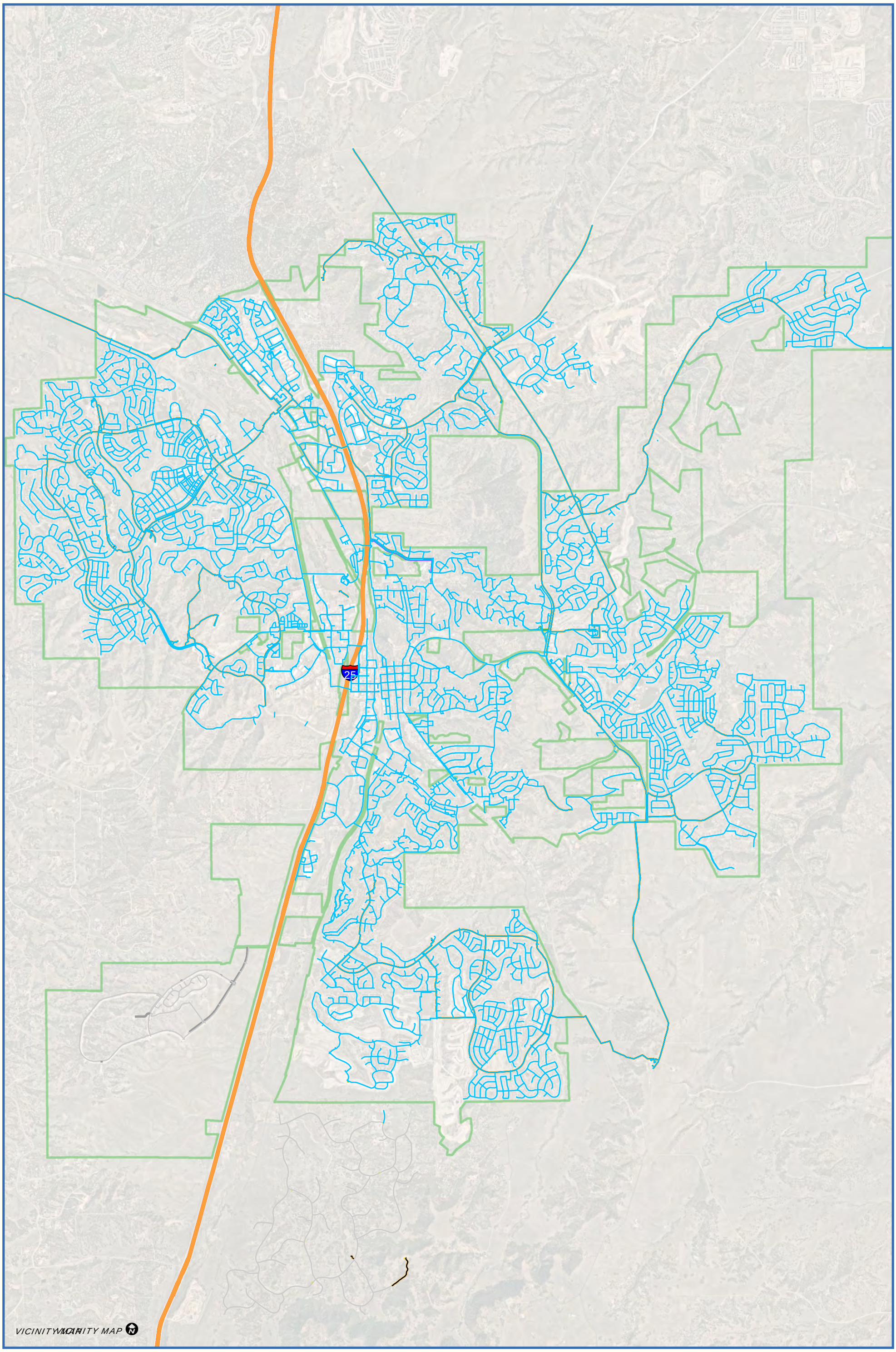
3. Hydraulic Modeling

A hydraulic model of the water transmission and distribution system is a powerful tool for predicting future conditions in the network, solving pressure issues, making adjustments in day to day operations, and modeling “what if” scenarios. The Town’s potable water hydraulic model was originally created in 2009 using Innovyze InfoWater software. The hydraulic model is updated annually with the addition of new infrastructure installed into the distribution system. The most recent update was performed in early 2022. The distribution network is geographic information system (GIS) based and the model is tied to Castle Rock Water’s GIS mapping. The distribution network was mapped and field verified using handheld global positioning system (GPS) equipment. Elevations are accurate to the nearest three to five feet and horizontal location is accurate to the nearest 0.5 foot. As new infrastructure is added to the Town, it is imported into Castle Rock Water’s GIS, field verified and adjustments within the mapping are made accordingly. Elevations and coordinates for features recorded on record drawings are assumed to be as accurate as the recorded information. Figure 3.1 represents the current water infrastructure within the Town’s service area.

In order to accurately model the water system, a model was built based on Castle Rock Water’s mapping and then calibrated. The hydraulic model was calibrated using operating data collected via SCADA (Supervisory Control and Data Acquisition) between September 2, 2009 and September 5, 2009. Additional fire flow tests were conducted during this period to improve the accuracy of the C factors (pipe roughness coefficients) used in the model. The comparison between the hydraulic model data and the SCADA data show good correlation. This original hydraulic model was validated by a third party, URS. Refer to the 2010 Water Master Plan Update, Appendix D.

The water distribution system is designed based on the dynamic hydraulic model. Future growth demands are based on an average day demand (ADD) of 265 gpd/SFE to reflect the updated landscape and irrigation requirements for new homes starting in 2023. The model was run simulating a maximum day demand continuously for 41 consecutive days. The distribution system had to be able to maintain tank levels and the required pressures in the distribution system at all times during the simulation. Pump stations were sized to convey the water throughout the distribution system under each simulation. Demands for Bell Mountain Ranch were included in the model; the pipes themselves will be included in the 2023 modeling update.

The hydraulic model is updated annually with new demand data along with the new infrastructure. Billing data is analyzed to determine how the system demands are distributed throughout the system. The data from July 2022 was used to populate the demands in the model. The billing data from July 2022 was selected because the summer months have demands for all of the irrigation accounts that are active. This allows these demands to be more accurately distributed in the model. Using the latest possible billing data provides for the most accurate list of accounts and their distribution throughout the distribution system.



CASTLE ROCK water
Securing our future drop by drop

0 2,100 4,200 8,400 12,600 Feet

1 inch = 4,167 feet

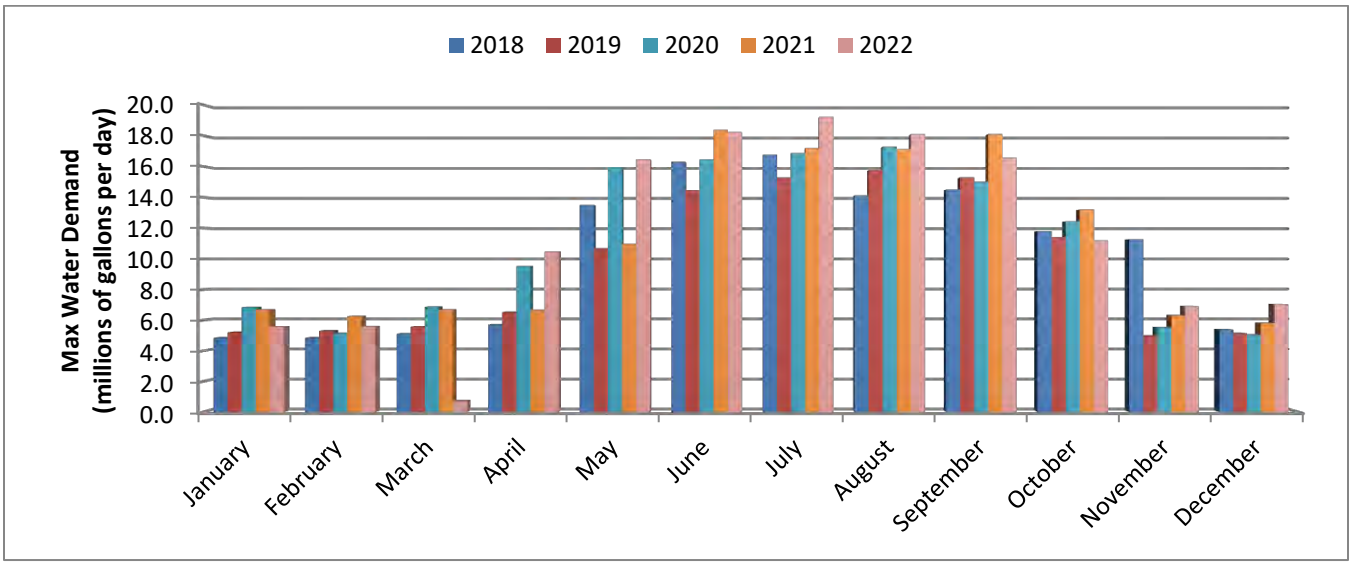
Disclaimer: The data presented has been compiled from various sources, each of which introduces varying degrees of inaccuracies or inconsistencies. Such discrepancies in data are inherent and in supplying this product the Town of Castle Rock assumes no liability for it's use or accuracy. Questions or comments regarding the cartographic composition of this map including, but not limited to, errors, omissions, corrections, and/or updates, should be directed to the Utilities Department, Town of Castle Rock, (720) 733-6056. Copyright 2022, Town of Castle Rock Utilities Mapping.

CASTLE ROCK WATER
FIGURE 3.1
HYDRAULIC MODEL

Date: 3/1/2023 Document Path: J:\GIS\Standard Maps\10.6\11x17 Portrait.mxd

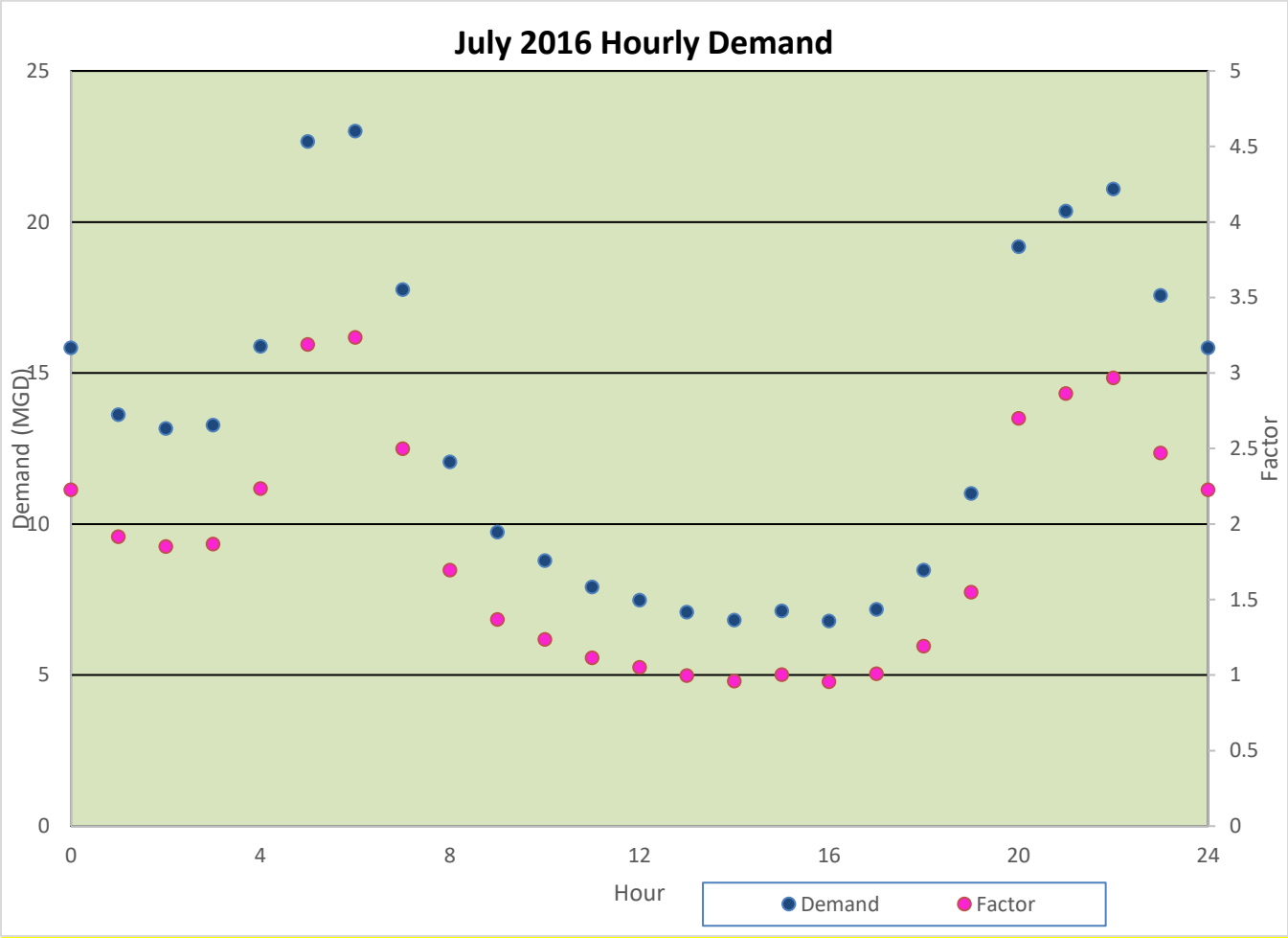
Unfortunately, the billing data only provides monthly water demands for each account. The operational SCADA data is used to convert the billing data into a maximum day demand (MDD) for the model. The billing data was factored up by the ratio of the SCADA average day demand (ADD) to the daily average demand of the billing data. Then the data was factored up by the ratio of the MDD to the ADD from the SCADA data. Once the billing data was converted to MDD, it was imported into the model to generate the current MDD model for 2022. See Figure 3.2 for monthly max day water demands for 2018 to 2022.

Figure 3-2: Historic Monthly Water Demand (peak day demands)

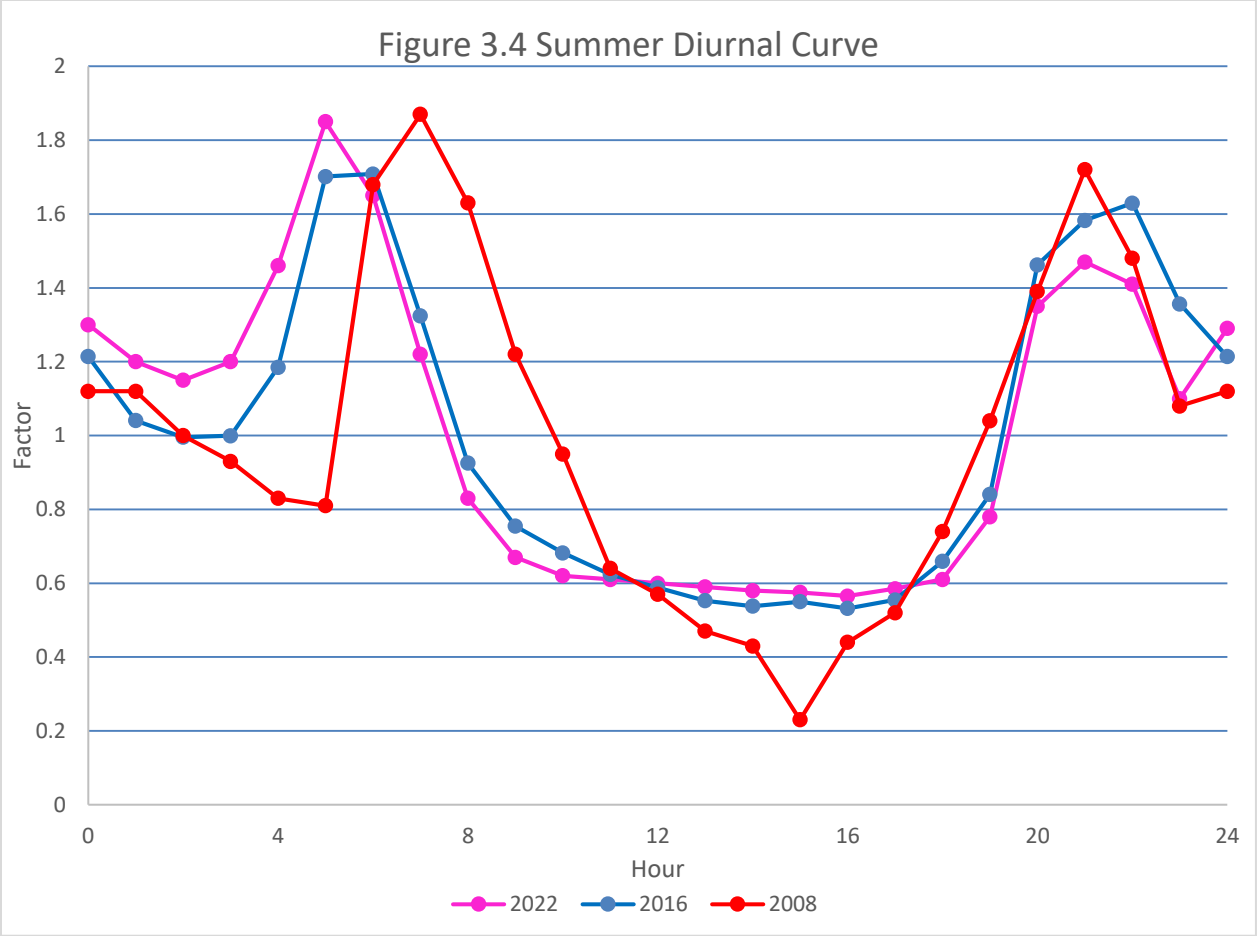


The July 2022 SCADA data was used to generate a summer diurnal curve and determine the peaking factors for maximum day and peak hour demands. The annual average daily demand for 2022 was 9.38 MGD, the minimum was 4.07 MGD, and the maximum was 19.22 MGD. Based upon this data, the maximum day to average day factor was set at 2.5 and the peak hour to average day factor was set at 5.5, which are factors that have not changed from the previous Water Master Plan. The peak hour factor was calculated based on SCADA data collected during 2016. The data from July 2022 was used to calculate an hourly demand for every hour in July. The demands for each hour were then averaged and then divided by the average daily demand (ADD) for 2016. The resulting peak hour factor was approximately 3.0. The data for July 2016 is shown in Figure 3.3.

Figure 3.3



A similar approach was used to generate a water demand diurnal curve that was used for maximum day modeling. The July 2022 SCADA data was collected and used to calculate the hourly demand for each hour in July. The demands were averaged for each hour and then divided by the average daily demand. The resulting diurnal curve for 2022, compared to the original 2008 diurnal and 2016 diurnal, is shown in Figure 3.4. The shift in the 2022 curve to the left as compared to the 2016 curve reflects changes to the watering windows for both the commercial and residential irrigation schedule.



The hydraulic model used for this master planning effort was based upon the calibrated maximum day demand model. This model is an extended period model using the diurnal curve shown above and simulating a maximum day demand over thirty consecutive days.

Water supplies were again obtained from the latest Water Resources Master Plan and the existing distribution system was evaluated. The projects that were identified in the modeling effort are a result of the future growth, the transition from a non-renewable water supply to a renewable water supply, and changes to the landscape regulations in 2022. Model predictions are the basis for sizing components of the water distribution system. As the Water Resources Master Plan evolves, adjustments may be required for transmission lines to convey those water sources into Town. The distribution network within Town also depends on certain infrastructure being constructed by development. The Town looks for opportunity to upsize planned pipes to meet future needs. However, there is always the possibility that the need for larger pipes could occur before developer contributed infrastructure is built, in which case the Town may need to construct new distribution or transmission lines or upsize existing pipes, and potentially seek developer reimbursement. Refer to Section 4 for discussion of future CRW CIP and developer required projects.

Three separate hydraulic models were created to model the distribution system at different time intervals during the future planning horizons. The first model created represents the system at the end of the five-year planning horizon. The projects identified in the five-year planning horizon are associated with the new renewable water supplies identified in the Water Resources Master Plan.

The second model created represents the system at the end of the ten-year planning horizon. System demands were estimated using the same approach as described in the five-year model. Again, available water supply estimates were obtained from the Water Resources Master Plan for the ten-year planning horizon. The existing distribution system was evaluated to determine whether improvements are required to distribute the available water.

The third model created represents the build-out condition of the planned growth for the Town. The modeled water demands are based on existing demands, planned development within the Town boundary, and areas that are most likely to be annexed and/or served in the future. For planning purposes, it makes sense to assume that infill areas someday will be part of the Town through annexation. Additionally, the area to the south of Town in the rust color is Bell Mountain Ranch and the Town began serving this area through an intergovernmental agreement effective in 2022. Other areas which are not included in the high use scenario that eventually could be served by CRW include Silver Heights and Castleton Center, shown in green in the Figure 3.5 as separate water districts. Other impacts on future water demands include future annexations, nearby water districts that may request service and redevelopment of certain geographies such as the implied consent area of Town.

The system was modeled using water demand from existing billing data and growth projections as shown in Figures 3.6 and 3.7. Available estimated water supplies from the Water Resources Master Plan were used as input to the existing and future water treatment facilities.

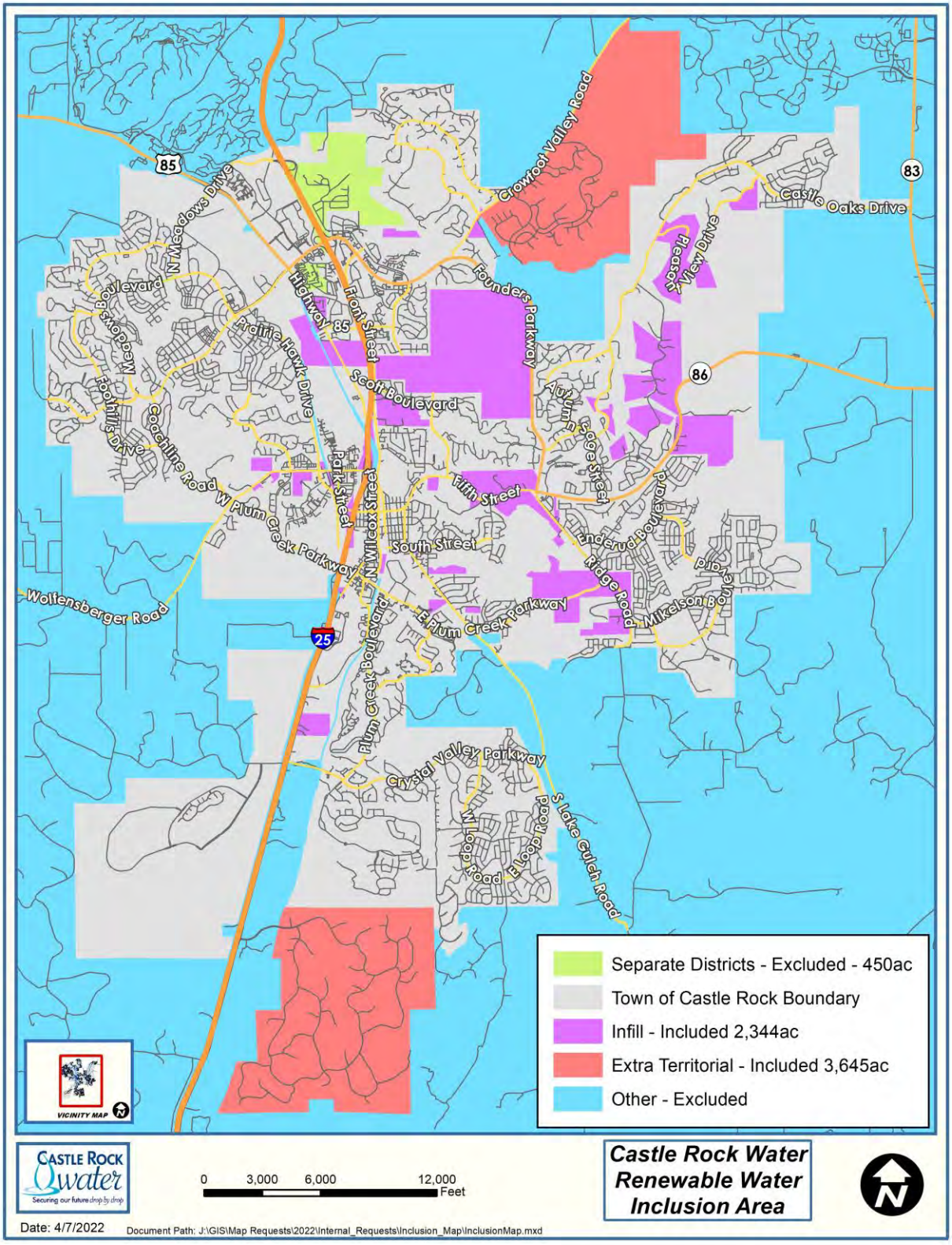


Figure 3.5 Renewable Water Inclusion Map

The assumed build-out planning numbers, by planning area, are shown in Figures 3.6 and 3.7. Projecting future growth values can be difficult, but Town planners currently project a future built-out population of 122,000 people. However, if existing entitlements build to 100%, the future population (by 2050) could be as high as 140,000 with future annexations and extraterritorial service adding a demand equivalent of an additional 15,000 people. For planning purposes, we estimate high-case and low-case scenarios to encompass a range of possibilities. In order to plan for varying scenarios, CRW has identified that projected demands could be as low as 12,546 AF under the high water conservation scenario of 100 gpcd, and 112,000 people versus 23,439 AF under a low water conservation scenario of 135 gpcd with 155,000 people. The base scenario is 118 gpcd at a population of 122,000, and corresponds to a projected demand of 16,126 AF by 2050 (note the assumption that once a built-out population is reached, no more population growth is planned).

FIGURE 3.6 BUILD-OUT PLANNING NUMBERS

Data through December 31, 2022, please note that these are estimates, and numbers are subject to change

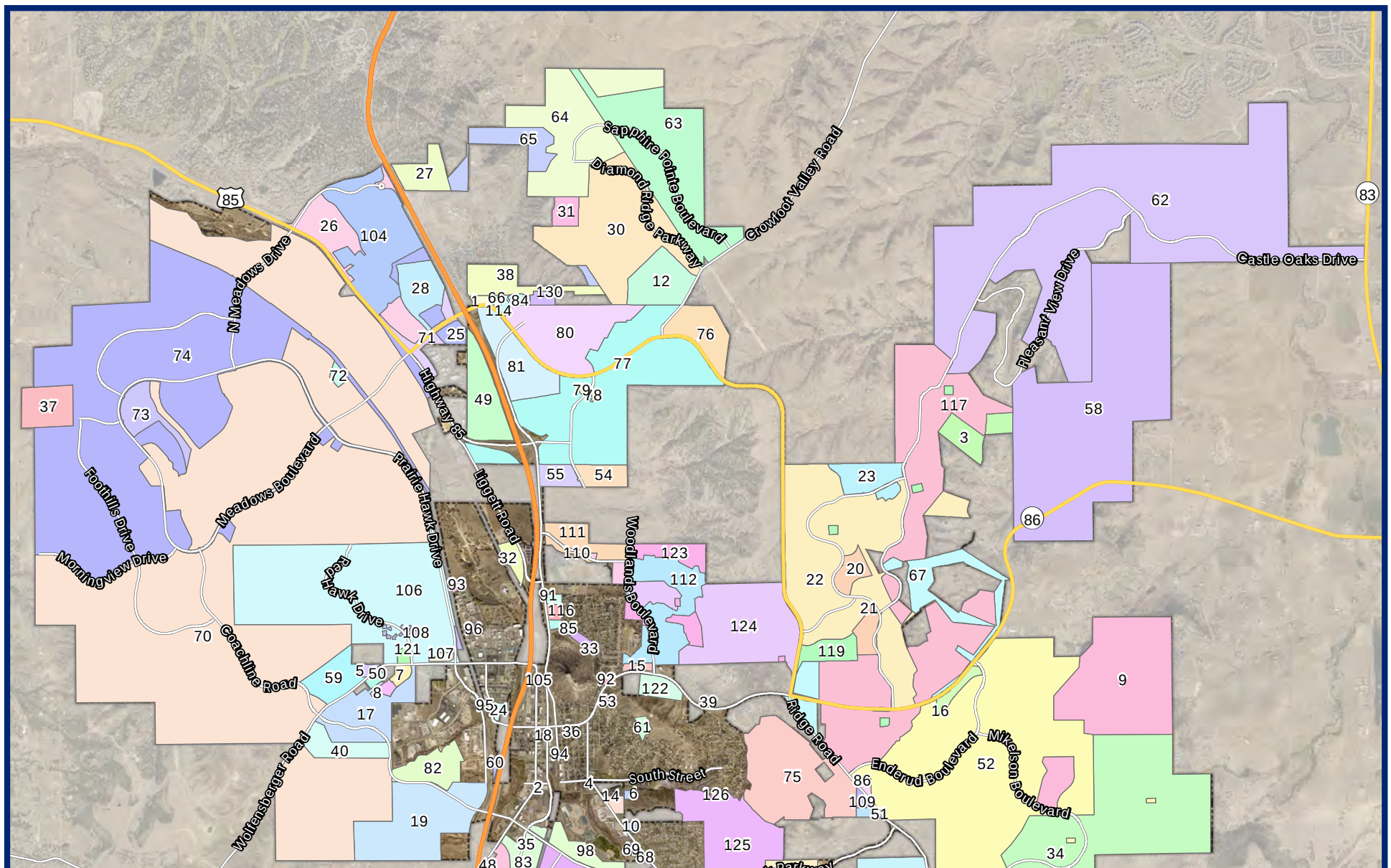
		MAXIMUM ZONED UNITS			PLATTED (SF) SDP (MF)				UNITS BUILT (CO)			Potential HIGH Buildout				Potential LOW Buildout			
PD #	Planned Developments (year initially zoned)	SF	MF	Total	SF	MF* SDP	MF platted, no SDP	Total	SF	MF	Total	SF	MF	Total	delta from Max Zoned	SF	MF	Total	delta from Max Zoned
130	Alexander Place (2020)	26	99	**125**	0	0	0	**0**	0	0	**0**	0	134	**134**	9	26	99	**125**	0
5	Arbors (2002)	38	80	**80**	0	0	no	**0**	0	0	**0**	0	80	**80**	0	38	0	**38**	-42
7,8	Auburn Ridge (2013)	0	286	**286**	0	286	no	**286**	0	186	**186**	0	286	**286**	0	0	266	**266**	-20
12	Brookwood (2003)	72	0	**72**	72	0	n/a	**72**	62	0	**62**	72	0	**72**	0	72	0	**72**	0
16	Cambridge Heights (2003)	0	100	**100**	0	0	no	**0**	0	0	**0**	0	63	**63**	-37	35	0	**35**	-65
17	Castle Highlands (1984)	132	200	**332**	131	200	no	**331**	127	200	**327**	131	200	**331**	-1	131	200	**331**	-1
19	Castle Meadows (1989)	0	440	**440**	0	0	no	**0**	0	0	**0**	0	1500	**1500**	1060	0	400	**400**	-40
3,20,21,22,23,117	Castle Oaks /Terrain (2002)	1992	775	**2767**	2172	0	no	**2172**	2101	0	**2101**	2277	0	**2277**	-490	2277	0	**2277**	-490
25,26,27,28,104	Castle Pines Commercial / Promenade (1987)	0	1410	**1410**	0	1362	no	**1362**	0	1062	**1062**	0	1362	**1362**	-48	0	1362	**1362**	-48
29	Castle Ridge East (1996)	30	0	**30**	28	0	n/a	**28**	28	0	**28**	28	0	**28**	-2	28	0	**28**	-2
30,31	Castle Rock Estates - Diamond Ridge (1995)	126	0	**126**	126	0	n/a	**126**	126	0	**126**	126	0	**126**	0	126	0	**126**	0
33,87,88,89,90	Castleview Estates - The Oaks of Castle Rock (1985)	248	326	**574**	239	0	no	**239**	241	0	**241**	367	0	**367**	-207	367	0	**367**	-207
34	Castlewood Ranch (1998)	1300	0	**1300**	1292	0	n/a	**1292**	1282	0	**1282**	1292	0	**1292**	-8	1292	0	**1292**	-8
straight zones, downtown	Central Castle Rock (varies) NO maximum zoning**	1538	3462	**5000**	1533	1437	redevelop-ment potential	**2970**	1535	1188	**2723**	1538	3962	**5500**	500	1538	2962	**4500**	-500
40	Covenant At Castle Rock (2014)	58	0	**58**	58	0	n/a	**58**	58	0	**58**	58	0	**58**	0	58	0	**58**	0
42,43,44,45,46	Crystal Valley Ranch (2000)	2670	753	**3423**	3051	0	no	**3051**	2502	0	**2502**	3051	96	**3147**	-276	3051	0	**3051**	-372
47	Dawson Ridge (1986)	2447	5453	**7900**	0	0	no	**0**	0	0	**0**	3408	2445	**5853**	-2047	2400	1600	**4000**	-3900
52,9	Founders Village - Inc. Founders 24 and Bella Mesa (1985)	2776	2905	**5681**	2634	0	no	**2634**	2597	0	**2597**	3345	0	**3345**	-2336	3234	0	**3234**	-2447
54,55	Hazen Moore (2000)	243	0	**243**	161	0	n/a	**161**	161	0	**161**	161	0	**161**	-82	161	0	**161**	-82
56,57	Heckendorf Ranch (1985)	406	224	**630**	404	0	no	**404**	299	0	**299**	404	0	**404**	-226	404	0	**404**	-226
59	Hillside (2009)	120	0	**120**	54	0	n/a	**54**	0	0	**0**	120	0	**120**	0	120	0	**120**	0
118	Lanterns (2003)	1200	0	**1200**	940	0	n/a	**940**	268	0	**268**	1200	0	**1200**	0	1200	0	**1200**	0
62	Liberty Village (2004)	1245	0	**1245**	1238	0	n/a	**1238**	1081	0	**1081**	1238	0	**1238**	-7	1238	0	**1238**	-7
63,64,65	Maher Ranch (1988)	923	100	**1023**	767	96	no	**863**	771	96	**867**	767	96	**863**	-160	767	96	**863**	-160
70,72,73,74	Meadows (1985)	6867	4002	**10869**	7357	555	yes (12.799 acres in TC)	**7912**	7231	555	**7786**	7434	1055	**8489**	-2380	7422	555	**7977**	-2892
75	Memmen Young Infill (1985)	559	476	**1035**	0	0	no	**0**	0	0	**0**	710	0	**710**	-325	600	0	**600**	-435
76,77,78,79,80	Metzler Ranch (1996)	1037	660	**1697**	751	660	no	**1411**	742	580	**1322**	751	660	**1411**	-286	751	660	**1411**	-286
97,98,99,101,103	Plum Creek (1983)	3025	0	**3025**	1188	360	n/a	**1548**	1189	360	**1549**	1188	360	**1548**	-1477	1188	360	**1548**	-1477
100	Plum Creek Ridge (2006)	92	70	**162**	120	0	no	**120**	120	0	**120**	120	0	**120**	-42	120	0	**120**	-42
102	Plum Creek South (1985)	307	198	**505**	140	0	no	**140**	137	0	**137**	140	0	**140**	-365	140	0	**140**	-365
106,107,108	Red Hawk (1996)	660	268	**928**	887	0	no	**887**	821	0	**821**	887	0	**887**	-41	887	0	**887**	-41
129	Ridge Estates (2020)	52	0	**52**	52	0	0	**52**	0	0	**0**	52	0	**52**	0	52	0	**52**	0
110,111	Scott II (1987)	85	220	**305**	78	220	no	**298**	78	220	**298**	78	220	**298**	-7	78	220	**298**	-7
113	Sellers Landing PD (1982)	0	94	**94**	0	82	0	**82**	0	77	**77**	0	82	**82**	-12	0	82	**82**	-12
115	Stanbro PD (1987)	32	92	**124**	0	0	no	**0**	0	0	**0**	32	92	**124**	0	16	46	**62**	-62
119	Villages at Castle Rock / Echelon (1981)	12	542	**554**	0	238	no	**238**	0	0	**0**	12	238	**250**	-304	0	238	**238**	-316
121	Wolfensberger - formerly Graham PD (1996)	0	56	**56**	0	56	no	**56**	0	56	**56**	0	56	**56**	0	0	56	**56**	0
122,123,124,112	Woodlands - Inc. Scott Ranch (1983) Woodlands Crossing (1987)	990	0	**990**	551	0	n/a	**551**	537	0	**537**	605	0	**605**	-385	605	0	**605**	-385
125,126	Young American (1983)	78	1138	**1216**	375	186	no	**561**	375	186	**561**	1012	186	**1198**	-18	825	186	**1011**	-205
		ZONED UNITS			PLATTED (SF) SDP (MF)				UNITS BUILT (CO)			Potential HIGH Buildout				Potential LOW Buildout			
		* MF counts shows approved by SDP																	
		SF	MF *	Total	SF	MF*	MF platted, no SDP	Total	SF	MF	Total	SF	MF	Total	delta from Max Zoned	SF	MF	Total	delta from Max Zoned
TOTAL UNITS		**31,386**	**24,429**	**55,777**	**26,399**	**5,738**		**32,137**	**24,469**	**4,766**	**29,235**	**32,604**	**13,173**	**45,777**	**(10,000)**	**31,247**	**9,388**	**40,635**	**(15,142)**
POPULATION ESTIMATES		**95,413**	**48,858**	**144,271**	**80,253**	**11,476**		**91,729**	**73,178**	**9,532**	**82,710**	**99,116**	**26,346**	**125,462**	**(18,809)**	**94,991**	**18,776**	**113,767**	**(30,505)**

*Castle Meadows does not have a maximum cap in the zoning, however 440 MF units was listed in the most recent traffic study for this property. This property could develop with more or less residential units.

**Central Castle Rock includes straight zoned land as R-1, R-2, R-3, and B zone areas in the Downtown Overlay that allow multifamily. There is no maximum cap in the zoning, so land area and typical densities have been used to determine the area could develop out at 5,000 units.

*** Dawson Trails rezoning was approved by Council in the 3rd Quarter of 2022 (formally Dawson Ridge). As this report is through September 30, 2022, the Dawson Trails zoning documents had not been recorded, therefore theDawson Ridge numbers are shown. Once the zoning documents have been recorded the report will be updated to reflect the new Dawson Trails zoning.

FIGURE 3.7 PLANNING AREAS



Planned Development Zoning

An illustration of the names and boundaries of all Planned Developments and Amendments. There is no significance represented by the colors used except to delineate boundaries. Numbers in table do not represent chronological order of Planned Development approvals. There are two types of zoning mapped within the Town: Standard Zone districts and Planned Development (PD) districts. Standard Zoning consists of a series of pre-established districts. The criteria for these zone districts (permitted uses, setback requirements, and maximum building heights) remain the same, no matter where the zone is located. Standard Zoning is an historic approach to land use management and is still in effect for the core of Town, which refers to the older downtown area and nearby residential areas. Each Planned Development district is unique and relates to a development plan that was prepared specifically for that property (typically large properties). All "newer" communities situated within the Town are zoned PD. For a detailed explanation of zoning requirements, specific to either Standard or PD Zoning districts, refer to Title 17 of the Town of Castle Rock Municipal Code.

0 0.25 0.5 1
Miles

Coordinate System: SPCS Colorado Central (0502)
Projection: Lambert Conformal Conic
Datum: North American 1983
Units: Foot US
Creation Date: 10/15/2020

Legend

1. 1-25 AND FOUNDERS PKWY CONOCO PD
2. 18 WILCOX PD
3. 1ST AMD TO CASTLE OAKS PRELIM PD SITE PLAN AMD 1
4. 710 SOUTH STREET
5. ARBORS PD
6. ASPEN MEADOWS PD
7. AUBURN RIDGE PDP NO.1
8. AUBURN RIDGE PDP NO.1 AMD 1
9. BELLA MESA PDP
10. BISHOP COURT PD
11. BROOKSIDE BUSINESS CENTER AMENDED
12. BROOKWOOD PD
13. BURT AT CASTLE ROCK PD
14. BW SQUARED PD
15. CALVARY CHAPEL PDP
16. CAMBRIDGE HEIGHTS PD
17. CASTLE HIGHLANDS MAJOR MODIFICATION
18. CASTLE MANOR PD
19. CASTLE MEADOWS INTERCHANGE OVERLAY PDP
20. CASTLE OAKS AMEND NO. 1 PPD, 2ND
21. CASTLE OAKS AMEND NO. 1 PPD, 3RD
22. CASTLE OAKS AMENDMENT NO. 1
23. CASTLE OAKS ESTATES PDP NO. 1
24. CASTLE PARK SOUTH PD
25. CASTLE PINES COMMERCIAL AMENDMENT (1995)
26. CASTLE PINES COMMERCIAL AMENDMENT (2000)
27. CASTLE PINES COMMERCIAL MAJOR MODIFICATION
28. CASTLE PINES COMMERCIAL PD
29. CASTLE RIDGE PD
30. CASTLE ROCK ESTATES I AMENDMENT
31. CASTLE ROCK ESTATES II PD
32. CASTLE ROCK MARINE PD
33. CASTLEVIEW CONDOMINIUMS PD
34. CASTLEWOOD RANCH MINOR AMENDMENT
35. CENTRE ON PLUM CREEK FLG 2 AMENDED
36. CHRISTS EPISCOPAL CHURCH PD
37. CHURCH OF THE ROCK PD
38. COOPER-HOOK PD
39. COUNTRY ACRES PD
40. COVENANT AT CASTLE ROCK PDP
41. CREEKSIDE PD
42. CRYSTAL VALLEY RANCH 2ND AMENDMENT
43. CRYSTAL VALLEY RANCH 4TH AMENDMENT
44. CRYSTAL VALLEY RANCH MAJOR AMENDMENT
45. CRYSTAL VALLEY RANCH PDP AMENDMENT NO. 5
46. CRYSTAL VALLEY RANCH PDP AMENDMENT NO. 6
47. DAWSON RIDGE AMENDMENT
48. DEMIS PD
49. DOUGLAS COUNTY JUSTICE CENTER MAJOR MODIFICATION
50. EPIPHANY EVANGELICAL LUTHERAN CHURCH OF CASTLE ROCK PD
51. FAITH LUTHERAN CHURCH PD
52. FOUNDERS VILLAGE AMENDED (1986)
53. GANNON MED/DENTAL PD
54. HAZEN MOORE AMENDMENT
55. HAZEN MOORE PDP NO. 1
56. HECKENDORF RANCH AMD NO.1
57. HECKENDORF RANCH PDP AMD NO.4
58. HERITAGE FARM PD
59. HILLSIDE PDP
60. KREFT PD
61. LARRYS PD
62. LIBERTY VILLAGE 2ND AMENDMENT
63. MAHER RANCH MAJOR AMENDMENT (PHASE 1)
64. MAHER RANCH MAJOR AMENDMENT (PHASE 2)
65. MAHER RANCH PD
66. MAIN PLACE PD
67. MALL AND OFFICE CENTER INFILL
68. MASTER MAGNETICS 2 PD
69. MASTER MAGNETICS PD
70. MEADOWS FOURTH AMENDMENT
71. MEADOWS PARKWAY PD
72. MEADOWS PDP NO. 1
73. MEADOWS PDP NO. 2
74. MEADOWS THIRD AMENDMENT
75. MEMMEN YOUNG INFILL
76. METZLER RANCH 2ND MAJOR AMENDMENT
77. METZLER RANCH PD (1996)
78. METZLER RANCH PD 5TH AMENDMENT
79. METZLER RANCH PPD 4TH AMENDMENT
80. METZLER RANCH THIRD MAJOR AMENDMENT
81. MILESTONE OFFICE CAMPUS AMENDED (1998)
82. MILLER'S LANDING INTERCHANGE OVERLAY PDP
83. MILLER RANCH PD
84. MONTANA VISTA PDP
85. MOUNTAIN SHADOWS PD
86. MT. ZION LUTHERAN CHURCH PD
87. OAKS OF CASTLE ROCK AMD NO.1
88. OAKS OF CASTLE ROCK AMENDMENT NO. 3
89. OAKS OF CASTLE ROCK AMENDMENT NO. 4
90. OAKS OF CASTLE ROCK PD
91. OAKWOOD APARTMENTS PD
92. OAKWOOD PARK PD
93. OMNI STORAGE PD
94. P S MILLER HOUSE
95. PARK STREET BUSINESS CENTER II PD
96. PD (ORD# 3.60 & 3.61)
97. PLUM CREEK AMENDED
98. PLUM CREEK FIRST AMENDMENT
99. PLUM CREEK POINTE AMENDMENT
100. PLUM CREEK RIDGE PD
101. PLUM CREEK SECOND AMENDMENT
102. PLUM CREEK SOUTH PD
103. PLUM CREEK WEST PD
104. PROMENADE AT CASTLE ROCK PDP
105. Q-PETROLEUM PD
106. RED HAWK AMENDMENT NO. 1
107. RED HAWK CROSSINGS PDP NO. 1
108. RED HAWK PD
109. RIDGE VIEW PD
110. SCOTT II AMENDED
111. SCOTT II MAJOR MODIFICATION
112. SCOTT RANCH PD
113. SELLERS LANDING PD
114. SHOPPES ON FOUNDERS
115. STANBRO PD
116. STONE CREEK APARTMENTS PD
117. TERRAIN PDP
118. THE LANTERNS AMENDMENT NO. 3
119. VILLAGES AT CASTLE ROCK PD
120. WESTFIELD TRADE CENTER AMENDMENT
121. WOLFENSBERGER PDP
122. WOODLANDS CROSSING PD
123. WOODLANDS MINOR MODIFICATION
124. WOODLANDS SECOND AMENDMENT
125. YOUNG AMERICAN PD
126. YOUNG AMERICAN SECOND AMENDMENT
127. YOUR STORAGE CENTER AT CASTLE ROCK PDP
128. YOUTH FOR CHRIST PD
129. RIDGE ESTATES
130. ALEXANDER PLACE PD

4. Capital Improvement Program

Summary of Previous Master Plan Projects

The 2017 Water Master Plan had identified three planning horizons for capital improvement projects (CIPs), and identified priority projects for each phase. We will discuss the projects from the five-year 2018-2022 planning horizon, and discuss whether projects were completed, delayed, or removed from the CIP plan altogether. Several projects were completed as rehabilitation projects, emphasizing the importance of maintaining CRW assets. Other projects may have been delayed due to changes in the development plan, or changed due to changes in future requirements (for example, changes in the landscape and irrigation regulations, which emphasize the importance of revisiting the model and the CIP plan each year).

2018-2022 Planning Horizon – Projects Not Completed

Tank 6B demolition

Tank 6B has deteriorated to the point that it has been removed from service and will be demolished, and a future tank (Tank 6B Rep) constructed on the site in the future build-out timeline. Demolition was originally budgeted $250,000 as a project for 2018, however, staffing limitations due to many projects, a lack of regional knowledge and experience with demolition of post-tensioned tanks, and concerns with the budget being insufficient, have delayed completion of this project. The project is in the CIP schedule for 2023 at a revised budget of $600,000.

Tank 11 to Pine Canyon (not constructed; Pine Canyon development not approved yet)

Future infill annexation of the Pine Canyon and Pioneer Ranch will require a transmission line from the purple zone tank. The developer must install a pipeline to serve the Pine Canyon development and initial planning documents indicate the size will be 16 inches; however, it has been identified that a future twenty-inch transmission may be required. The Town would pay to upsize the waterline from 16 to 20 inches. This project was not completed because the Pine Canyon development has not been approved by the Town. It is still budgeted in the CIP for future buildout phase, dependent upon approval of the Pine Canyon/Pioneer Ranch developments.

Young American Valve Replacement

A project to repair/replace older valves and add new valves at critical locations. The cost for this project was estimated at $160,000. The project was not completed due to budget constraints at the time. The area has been identified for future pipeline replacement in the Waterline Rehab Plan (draft 2022) which will also include replacing and adding water valves to the area. The design for a replacement project will begin in 2023 with construction planned in 2024. The project may be phased due to size of the area and budget constraints.

2018-2022 Planning Horizon – Completed Projects from 2017 Water Master Plan

Distribution System Upgrades

Upgrades to the distribution system include the automation of key PRVs to help with the efficient flow of water through the distribution network, the addition of and rehabilitation of valves and fire hydrants in older neighborhoods, and minor piping projects to help with connectivity and distribution of water within and between pressure zones. Other improvements include rehabilitation projects to improve reliability and decrease ongoing maintenance. The annual budget for this work is $250,000.

Distribution system upgrades projects completed from 2017 to 2022 include:

- Milestone Pump Station PRV – This project was identified in the 2017 WMP. Upgrades were made to the original PRV, installed in 2002, to add an automated valve which would allow operations staff to move more WISE water from the Terrain area down into the Meadows. This project was completed in 2022 as part of the Terrain Control Valve project to gain economies of scale by combining two smaller projects into a larger project. Project cost for the PRV was $57,274.
- Oakwood and Mt. Royal PRV Improvements - This project completed in 2019 included the replacement of two existing PRV vaults: The Oakwood PRV located near the intersection of Mountain View Drive and Oakwood Drive and the Mt. Royal PRV located near the intersection of Mt. Royal Drive and Plum Creek Boulevard. Both PRV vaults were constructed in the late 1980s. Both vaults were not constructed per today's Town's standards. The vaults were constructed without solid floors, which allowed groundwater to periodically flood the vaults. The flooding had caused corrosion to the valves and piping within the vaults. The design of the existing vaults also made repairs difficult due to a lack of adequate working space. The new vaults were constructed with adequate space to work in and with solid concrete floors, per our current standard detail. In addition, each vault includes a sump to collect and remove any groundwater or leaks from the piping. Project cost was $355,575.
- Terrain Control Valve - The red pressure zone on the east side of Town is supplied with water from the Ray Waterman Regional Water Treatment Center (RWRWTC). The east side red pressure zone has two tanks associated with it, Tank 16 and Tank 14. Tank 16 is located near the King Soopers along Ridge Road, and Tank 14 is located at the north end of the Diamond Ridge subdivision. When the high service pumps at RWRWTC pump into the red zone, water more easily flows into Tank 16 due to its closer proximity to RWRWTC. Eventually, Tank 16 would overflow before Tank 14 is filled, preventing full utilization of the storage capacity of Tank 16. The Castle Oaks Control Valve was installed in 2003 to restrict the flow of water into Tank 16. Unfortunately, this also restricts the flow of water out of Tank 16 and into the distribution system. The restricted flow in and out of Tank 16 can result in water quality issues in the tank. The Terrain Control Valve is located along Founders Parkway, just north of Crimson Sky Drive. It was designed to work with the existing Castle Oaks Control Valve to direct the water produced at RWRWTC between the two red zone tanks, Tank 14 and Tank 16, and balance the system demand on both tanks. With the addition of the new Terrain Control valve, the two valves divided the existing red zone into two zones, essentially with a

storage tank dedicated to each zone. The project was completed in 2022 at a cost of $242,742.

Raw Water Supply

Castlewood Ranch 1 Deep Wells

Two, new deep Denver basin groundwater wells were constructed in 2017-2018, near Matney Park in Castlewood Ranch. The water supply goes to the Founders WTP. Projected was completed in time for 2018 summer demand. Project cost: $2,296,000.

Castlewood Ranch 1 Well Facility (aka: the Founders Wells Raw Waterline and Well Facility from the 2017 WMP)

A new well facility and approximately 5,200 linear feet of eight-inch raw waterline was constructed to transfer groundwater from the new Castlewood Ranch 1 Deep Wells to the Founders Water Treatment Plant (FWTP) for treatment. The well facility included a flow meter vault, electrical, variable frequency drive, and control panels. The facility also included the yard piping from each well and pump to waste pipe. The contractor also constructed a new 8-inch transmission main between the well facility and an existing raw water transmission main. The well facilities and pipeline were constructed in the first half of 2018. This project was completed in 2018 at a cost of $5.5 million.

Lanterns Deep Groundwater Wells, Facility and Raw Water Pipeline

Three, new deep groundwater wells were constructed in the Lanterns area. The project consists of the three wells, controls and meter facilities, as well as a transmission pipeline to convey the water to the PCWPF. The wells, in the Dawson, Denver and Arapahoe formations, are expected to produce an average of 1.2 million gallons per day.

The raw water transmission pipeline from the new Lanterns Well Facility connected to an existing raw water transmission main located on the west side of East Plum Creek. The raw water transmission main had some unique challenges associated with the pipeline construction. The new pipeline crossed the Union Pacific Railroad (UPRR) and East Plum Creek. The creek and railroad are within 100-feet of each other but have an elevation difference of about thirty feet. A Horizontal Directionally Drilled (HDD) pipe installation was identified as the only reasonable method to cross these obstructions. The railroad regulations required that the new pipeline be installed within a steel casing pipe under their right-of-way. For this project, the casing pipe and carrier pipe were assembled above ground and installed together in a single pull. The raw water transmission pipeline was completed in May 2019; the well facility was completed in early 2020 due to electrical equipment delays. The total project (wells, facility, raw waterline pipe) cost was 5.5 million.

Heckendorf Raw Waterline Replacement Project

The Heckendorf Raw Waterline replacement project was an unplanned project. The exposed raw waterline was discovered during a bank stabilization project in 2017 to protect an existing sewer interceptor. The raw waterline had been exposed due to shifting of the creek alignment and was at risk of damage or failure, which could have removed approximately 1.8 MGD of raw water supply from conveyance to the PCWPF. The raw waterline conveyed water from the Heckendorf wells to the PCWPF, and would also convey the future raw water supply from

the new Lanterns wells to the PCWPF. The replacement line was designed in 2018 and added to the budget. The line was proactively replaced in 2019 at a project cost of $627,890.

Exposed Heckendorf Raw Waterline in East Plum Creek

BMR Denver Well Rehab

In 2018 CRW staff repaired and operated the newly acquired Denver well at the Bell Mountain Wellfield. This well water is pumped into East Plum Creek and is recovered downstream by the Castle Rock 1 Diversion (CR-1) for treatment at the Plum Creek Water Purification Facility. The well was acquired with the acquisition of the United Water Assets in late 2017.

New RWRWTC groundwater wells and ASR

In 2022, construction began on two additional deep groundwater wells at the RWRWTC with ASR capability to store excess WISE water. Supply chain issues have delayed completion of those wells, and final EPA approval is expected in 2023. Typical ASR wells have a maximum injection rate of 80% of the average pumping rate. Based on the information available, staff believes that up to a total of 600 AF/yr of renewable water could be stored in the two existing ASR wells in the Meadows and the two new ASR wells at RWRWTC.

Storage

Liberty Village Yellow Zone Tank (Tank 18)

The Cobblestone Ranch subdivision (formerly known as Liberty Village) currently is served through a long transmission main that crosses three pressure zones. A 2 MG water storage tank was identified to provide dedicated storage for maximum day demand plus fire flow in this area. The project is under construction in 2022 for completion in 2023 and the contracted cost is $3,246,000. The Cobblestone developer is required by a development agreement for the area to construct almost a mile of 16-inch pipeline to send water to and from the proposed tank to the distribution system; construction on the developer pipeline is expected in 2023.

Transmission

Highway 85 Transmission (completed in 2019)

During the planning process for the 2017 Water Master Plan, the Highway 85 Transmission Project was identified in the 2018-2022 planning horizon. Castle Rock Water added WISE water as a new source of supply in 2018. WISE water subscription rates would increase yearly for the next few years after that. The WISE water enters the water distribution system at the Ray Waterman Regional Water Treatment Facility (RWRWTF). The water flows throughout the Town based on the needs of the system. The 2017 master planning effort identified a restriction in the movement of water from the RWRWTF to the Meadows and Promenade subdivisions. The master planning effort identified the Highway 85 Transmission Main Project to eliminate this restriction.

The Highway 85 Transmission Main Project installed a new 20-inch main between Justice Way and Meadows Parkway. The new pipeline ties into existing stubs located at Meadows Parkway, Industrial Way and Justice Way. About 2,045 linear feet of 20-inch waterline was installed to complete the transmission loop just north of Liggett Road in order to move additional WISE supply around Town as demand increases. The cost for the project was $693,687 and it was completed within budget.

Tank 18 Blue Zone Transmission

Transmission main to provide second source of water to Tank 18. This project will eliminate a long dead-end transmission main. The Town began construction in 2022, for completion in early 2023, the 1.55 mile, 16-inch water supply pipeline to the new tank to provide a second source of water and to eliminate a long dead-end transmission main serving the Cobblestone development. Project cost of $4.1 Million.

Pumping:

Blue Zone Pump Station Upgrade

In 2018, Pump 1 at the Blue Zone Pump Station under-went extensive improvements in order to meet increasing pumping demands. The station was originally built with two large pumps and a smaller jockey pump. Staff contracted with Water Technology Group to replace the smaller pump with a full size pump, along with the motor, piping, and variable frequency drive, circuit breaker, conduits, and wiring. After completion, the pump station will have three pumps serving as two primary and one backup configuration capable of 4,100 gpm. The cost of this project was $40,271.

Ray Water Regional Water Treatment Center Red Zone Pump Upgrades

The Ray Waterman Red Zone high service pumps supply water to Tanks 14 and 16. These pumps are critical to supplying water during the summer peak demand season. Castle Rock Water's engineering staff determined that due to increasing population growth and the need to move WISE water flows through the distribution system, the pumps should be replaced with higher capacity pumps, in order to meet current and future demands. Plant mechanics took the lead to complete the pump upgrades. This upgrade increased the total capacity of the Ray Waterman Red Zone Pump Station by a total of 1,165 gpm, resulting in additional pumping capacity of 1.66 MGD. The project was completed in 2020 at a project cost of $96,875.

Ray Water Regional Water Treatment Center Green Zone Pump Upgrades

Castle Rock Water's engineering staff determined through hydraulic modeling that due to increasing population growth and future increases in WISE water flows, the Ray Waterman Green Zone pumps should be upsized with higher capacity to better meet current and future demands. Furthermore, with expected increases in WISE water imported flows, larger high service pumps were needed to move the additional water throughout the Green Zone distribution system. The two new Green Zone pumps were sized to increase pumping capacity from 2,780 gpm to 3,400 gpm, each. These improvements completed in 2021 increased the total Green Zone pumping capacity by 1,240 gpm or 1.78 MGD.

In 2021, CRW plant maintenance staff pulled one pump at a time for replacement; shipping each pump a vendor for disassembly and rebuild. Upgrading one pump at a time allowed the facility pump station to continue to operate normally during the pump upgrade process. The cost of this project was $79,292.

Green Zone Pump Replacement at the RWRWTC

Treatment:

Meadows WTP Rehab

A critical equipment upgrade was completed at the Meadows Water Treatment Plant with the replacement of 24 obsolete valves and electric actuators on Filters 5-8. The Meadows plant operates eight filters as part of the treatment process. Each filter has six valve-actuator pairs for control of flow and backwashing of the filters. Castle Rock Water pre-purchased 24 Valmatic valves matched to AUMA actuators from Pipestone Equipment, which a contractor installed. The project required extensive pipe rigging, electrical wiring, training, startup, and testing. The work completed a two-year project to replace all 52 filter valves and actuators.

These improvements ensure the Meadows plant is properly equipped to operate at full capacity and meet its eight million gallons per day demand.
The cost of the project was $205,342.

Media Replacement
Water treatment media replacement is budgeted to replace and/or supplement media every five years, alternating among the treatment facilities, or as needed. $500,000 is budgeted every five years, and includes contractor services and disposal of spent media. In 2021, CRW added additional anthracite media to the filters in the Founders WTP and the PS Miller WTP. Some media can be lost over time during filtration and backwash processes, and a facility may only need media augmented, not fully replaced. Project cost was $38,000.

PCWPF Membrane Addition
The Plum Creek Water Purification Facility (PCWPF) Membrane Project (water filtration system) was completed in May 2017, with work being finished on schedule and budget. This was an expansion of the existing 4 MGD Pall system, which added one membrane rack equal to 2 MGD of treatment capacity, increasing total plant production capacity to 6 MGD. The contractor was Moltz Construction and the cost of the project was $990,000.

Miller Water Treatment Plant
The Miller Water Treatment Plant, which was disconnected from the Town's water system in 2012 just prior to the PCWPF coming online, underwent extensive rehabilitation to be returned to service and be ready as a peaking plant for the 2019 summer pumping season. The improvements included: replacement of the clearwell hatch, the re-drill and replacement of wells W15 and W16, the rehabilitation of the chemical feed equipment for the sodium hypochlorite and ammonia disinfectant systems, the new installation of two new chlorine analyzers, the excavation and sealing of the electrical room wall to prevent water infiltrating beneath the motor control center, and improved SCADA programming. This water treatment plant rehabilitation, which spanned 2017 into 2019, cost $209,535. Costs were kept to a minimum because much of the work was performed in-house. This project was not identified in the 2017 WMP. Bringing the facility back into service has provided redundancy to the treatment processes and ensured growing peak summer demands can be met.

Staff inspecting the upgraded Miller Water Treatment facility.

PCWPF Advanced Treatment Processes

In December, 2017, the Town awarded a Design Consultant Agreement in the amount of $1,455,320 to Burns & McDonnell Engineering Co., Inc. for the design of the Plum Creek Water Purification Facility (PCWPF) Advanced Treatment Project upgrades. This renewable water project supports the Town's long-term water goal of providing a 75 percent renewable water supply for the community by the year 2050. The advanced treatment upgrades project consisted of treating collected renewable surface water sources from East Plum Creek. Design of the PCWPF Advanced Treatment processes centered on a multiple barrier approach to treat the new source water for removal of pathogens, organics, regulated drinking water contaminants, and non-regulated contaminants of emerging concern (CECs). The advanced treatment processes include ozone, biologically active carbon filtration, granular activated carbon filters, and UV disinfection. The primary goal of the PCWPF Advanced Treatment Project was to meet or exceed requirements of the U.S. EPA Safe Drinking Water Act, as well as anticipated additional requirements from the Colorado Department of Public Health and Environment (CDPHE).

In general, the PCWPF Advanced Treatment Project included a new one-million-gallon raw water blending tank, an ozone system for advanced oxidation, a biologically activated carbon (BAC) filter conversion, granular activated carbon contactors, an ultraviolet disinfection system, facilities for onsite handling of solids, and a new 1,250kW generator to provide emergency electrical power for the AT processes.

Following design and CDPHE approval, the construction project was awarded to Garney Construction using two separate work packages. Town Council awarded Work Package 1 (WP1) in December 2018, and Work Package 2 (WP2) in May 2019. WP1 included purchasing advanced water treatment systems and construction of a one-million-gallon raw water blending tank. WP2 included construction of a new building to house the new treatment equipment, a backwash solids settling tank, a raw water meter vault, converting the existing PCWPF

greensand filter to a biologically active carbon filter, and all other associated facilities and equipment to complete the project.

Once the PCWPF Advanced Treatment Project was completed it began treating collected renewable surface water from Plum Creek. Surface water is pumped by the Plum Creek Diversion Pump Station to PCWPF from CRR1 in Sedalia through the Plum Creek Raw Water Return Pipeline. The Advanced Treatment processes at PCWPF use a multiple barrier treatment approach to treat this new water source. These systems are designed for removal of pathogens, organics, regulated drinking water contaminants, and nonregulated CECs. The project was completed at a cost of $28,452,538 (within budget), in early 2021. The facility began treating renewable water in early 2021.

Waterline Rehabilitation and Replacement

Johnson Drive, Place and Court Waterline Replacement (Summer 2017)

The project consisted of replacing 1,675 linear feet of six-inch cast iron pipe with eight-inch PVC pipe. In addition to replacing the aging water main, the project added nine additional valves, four additional hydrants, and a water quality sample station. The additional valves reduce the number of customers that will have disrupted service in the event of a main shut down, and enhance the fire protection reliability by reducing the number of fire hydrants that may be out of service during a repair or other shutdown. The street was also lacking fire hydrants required by current design criteria, and the old six-inch pipe could not convey an adequate fire flow of 1,500 gpm. The pre-existing water main did experience a break during construction, further emphasizing the need for this project.

The original waterlines were installed in 1975 (without bedding material and corrosion protection that are now required) and had a history of breaks that had caused significant damage to the streets. Pipelines typically are designed for a fifty-year life and this pipeline was more than forty years old. The project was completed ahead of major road reconstruction by the Public Works department; Project cost was $268,123.

Gordon Drive Improvements Project (July 2020)

Castle Rock Water and the Public Works Department partnered to complete infrastructure improvements along Gordon Drive, in the Memmen subdivision, to address stormwater flows along the surface of the roadway. An underground storm sewer to capture and convey approximately one hundred acres of on-site and off-site flows to minimize street flooding and bring the roadway up to current standards for drainage was critical infrastructure constructed as part of the project.

Existing water and sewer infrastructure in the neighborhood was approximately forty years old, and the water lines were undersized to meet current standards. In order to construct the storm sewer, modifications to the existing sanitary sewer and water lines were necessary. CRW proactively replaced remaining sanitary sewer services and water lines along Gordon Drive, Gordon Court, Gordon Place and Gordon Lane as part of the project. Improvements also included reconstruction of the roadway from an inverted crown to a standard crown with catch curb and gutter along Gordon Drive, between Johnson Drive and Gordon Lane, as well as full depth pavement reclamation of the remainder of Gordon Drive, Gordon Court, Gordon Place and Gordon Lane. Construction kicked off in April 2019 and was completed by July 2020. The $2.8 million project was

jointly funded through the Stormwater, Water and Wastewater Enterprise Funds, and the Transportation Fund.

Glovers Waterline Replacement 2019-2022 (two phases; phase 1 complete in 2021; second phase complete in 2023)

Over 10,550 linear feet of old six inch cast iron pipe was replaced in the Glovers neighborhood, in two phases over a three-year period. The pipe was old, undersized 6 inch cast iron pipe, had a history of breaks, was over forty years old, and was due for replacement.

During Phase 1 construction of the new water mains, the pavement began to fail. The pavement was less than three inches thick in most areas, and appeared to be original pavement from the 1970s. The pavement was not holding up well to the street cuts and heavy equipment and was no longer a candidate for patching back. The area was scheduled for pavement reconstruction in 2027, under the Pavement Maintenance Program (PMP) managed by Public Works (PW). CRW was planning a follow-on project in 2025 to replace aging sewer service laterals in advance of the future road reconstruction by PW. However, with the pavement scope expanded to require full replacement in 2021 in the Phase 1 project area, Castle Rock Water decided to expedite replacement of the sewer service laterals and include them in the project scope of work for completion in 2021, in advance of repaving at completion of the project. This was to avoid having a patched roadway network if the sewer service laterals were delayed to a future year. The Phase 1 project cost was $3,025,215, with over $650K of reimbursement from PW for the roadway reconstruction.

Phase 2 of the project, completed in 2022 replaced approximately 7,000 feet of six-inch cast iron pipe with an eight-inch PVC pipe. The Phase 2 project also replaced all of the water service lines and sanitary sewer laterals within the roads. Once the utility portion of the project was completed, Public Works reconstructed the road with full-depth reclamation. The total project cost was $3,000,000 and was completed within the approved budget. Public Works will reimburse Castle Rock Water $289,000 for the road and sidewalk rehabilitation. The project was completed ahead of schedule.

Craig and Gould North Infrastructure Improvements (scheduled for completion in 2023)

The Craig and Gould North Infrastructure Improvement Project is the second phase of improvements in the oldest residential neighborhood in Historic Downtown Castle Rock. The subdivision of Craig and Gould was originally platted in 1874 and the first house within the north area was built in 1897. This neighborhood was first paved in the 1980's with inverted crown streets for drainage and gravel shoulders for parking. Since that time, the Town has responded to several complaints from residents whose houses sit lower than the street and experience flooding during heavy rain events. The Town has addressed this over the years by adding curbing and inlets where necessary to reduce the occurrence of flooding. These solutions were temporary and the neighborhood ultimately needed an overhaul to bring it up to current standards for drainage and safety.

The objectives of the Craig and Gould North Infrastructure Improvement Project were to add storm sewer within the public right-of-way to capture stormwater runoff, replace aging water and sewer infrastructure and upgrade the streets to current residential standards for safety. This includes two travel lanes on all residential streets, parking lanes, curb, gutter and sidewalks throughout the majority of the project. Existing alleyways that remained dirt up to

this point were paved with concrete. In order to convey stormwater runoff, an outfall system was needed crossing the railroad. This outfall includes an underground water quality chamber to remove pollutants prior to discharging to East Plum Creek. The $7.6 Million project, jointly funded by the stormwater, water, wastewater and public works funds, will be completed in 2023.

Water and sewer main replacement in the Craig and Gould neighborhood.

SCADA Master Plan Projects

A SCADA Master Plan was prepared in 2008 and updated in 2016, and revised again in 2019. Improvements identified in the latest SCADA Master Plan are being implemented based on priority over a 6-year time line. The 2019 SCADA Master Plan identified $12.1 Million in improvements over course of the six years; of that budget, $10 Million was for water facilities improvements. The annual budget for minor SCADA replacements and improvements is $50,000 per year. In order to fully fund the SCADA project list for execution in a timely manner, and to minimize the impact to rates and fees, the Waterline Rehab and Replacement Account was reduced from $2 Million per year to $600,000 from 2024 through 2027 in the CIP budget.

SCADA Construction Specifications

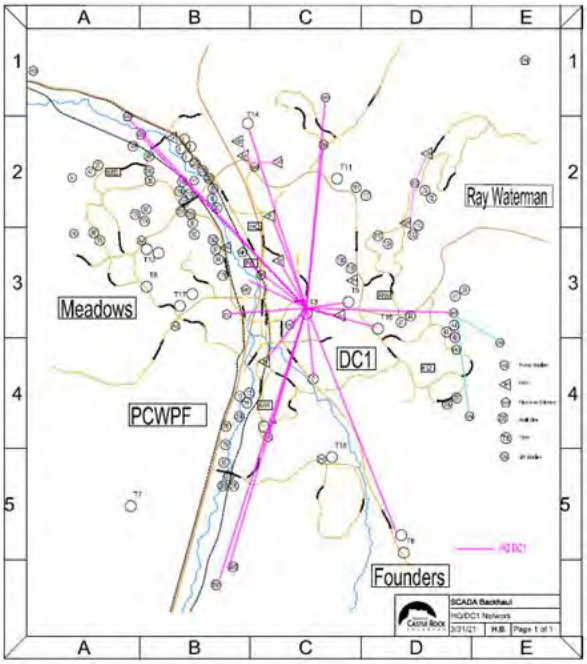
SCADA system construction specifications were developed to ensure uniformity among controls and data acquisition equipment at all facilities, particularly as new facilities are constructed or older equipment at existing facilities is replaced.

Backhaul Ring

The SCADA system is a separate and segregated system and is a stand-alone process by which many Castle Rock Water (CRW) assets are controlled remotely. CRW uses SCADA to monitor and control all processes in the water and wastewater systems for Castle Rock. CRW began the SCADA Backhaul and Radio Network Upgrade Project in August of 2021 and it was completed August 31, 2022. The project was identified as a priority in the SCADA Master Plan.

The old backhaul communication system had been in place for almost two decades and technology had evolved immensely over that period. Although some hardware components had been replaced and software upgrades had been performed over the years, a total upgrade of the

backhaul and radio network system was needed. The more robust operational system addressed deficiencies within the existing system and brought the system into compliance with modern cybersecurity and equipment safety standards. It also reduced network failure risk due to aging equipment, reduced costs of support by utilizing current, non-obsolete hardware and software, improved operator efficiency by standardizing equipment and procedures, and properly managed risk and resilience associated with process automation.



Schematic of the SCADA Backhaul Ring Network

The high speed microwave network includes 82 remote utility sites. The new backhaul bidirectional ring replaced existing T1 copper service lines and was mounted on or near six existing water tanks (using antennas), which were connected to five water treatment plants with high speed redundant communication paths. A vendor performed site path studies to ensure that all locations were able to communicate, and to allow for future growth with the addition of three remote sites. The project was completed in late 2022 at a total project cost of $1,801,157.

Water Resources CIP projects Completed

Related to our WISE partnership, renewable water goals, and also as a result of acquiring the United Water Assets in late 2017, CRW expedited several priority Water Resources Projects for completion from 2017 to 2022 to augment water supplies and also bring renewable water supplies back to the Town:

<u>WISE Phase 1 Pipeline</u>

Construction began in late 2016 on 5.3 miles of 36-inch pipeline to convey WISE waters from a connection with Parker Water and Sanitation District. The project was completed in 2018. After nine years of planning and more than $50 million in infrastructure, CRW began importing WISE water on schedule in April 2018.

CR-1 Diversion at PCWPF

In June 2017, Castle Rock Water completed the CR-1 Diversion Project near the Plum Creek Water Purification Facility (PCWPF), just in time for peak water demands. The diversion was designed to capture up to 3.7 million gallons of renewable water per day. The project consisted of modifying an existing 24-inch pipe, which was exposed in East Plum Creek, into a diversion structure. A portion of the 24-inch pipe was removed and replaced with a screen, to allow water to flow into the pipe. Since the pipe was an existing structure and the pipe modification did not disturb the stream, Federal permitting was not required to complete these modifications. A new pump station and pipeline was constructed to convey this water to PCWPF. Approximately 1,300 linear feet of 12-inch pipe was installed between a new pump station and the existing raw water transmission pipeline that feeds PCWPF. Additional facilities that were constructed with this project included a flow monitoring station and control facilities for operations.

If CR-1 were to operate at an average rate of one million gallons per day of production per year, the value of this water in terms of capital investment would be approximately $28 million per year (in 2017 dollars). At year-end 2017 CRW set records for renewable production, getting more than three million gallons on some days, even though the creek was running at a really low flow at the time. This project enabled us to run on more than sixty percent renewable water over the winter, allowing us to rest many of our deep wells. The contractor was T. Lowell Construction and the total project cost was approximately $773,000, including design and construction.

Plum Creek Diversion Pump Station

Castle Rock Water purchased United Water and Sanitation District's infrastructure, which included the Plum Creek Diversion near Sedalia, in November of 2017. The Plum Creek Diversion has a capacity to capture up to 25.8 million gallons per day (MGD), but at the time was only able to pump 1.15 MGD up to Castle Rock Reservoir 1. Castle Rock Water contracted with Dewberry Engineers on the design of a new pump station for the existing diversion facility. The new pump station was designed to pump up to 25.8 MGD of captured water from East Plum Creek to Castle Rock Reservoir 1. The pump station was also designed to pump up to 8 MGD from Castle Rock Reservoir 1 to the Plum Creek Water Purification Facility (PCWPF). These pumps are also designed to be expanded to pump up to 15 MGD back to PCWPF in the future. The project was completed in late 2020 within the budget of $11 Million.

Plum Creek Raw Water Return Pipeline (PCRWRP)

Through a cost-sharing intergovernmental agreement, Castle Rock Water (CRW) partnered with Dominion Water and Sanitation District (DWSD) on a joint pipeline project located between Castle Rock and the Plum Creek Diversion in Sedalia. The project team included Providence Infrastructure Consultants for the design and Reynolds Construction for construction services. The project involved the installation of two 30-inch pipelines and a master water metering facility located near Highway 85 and Atrium Drive. DWSD's pipeline will be used to wheel their WISE and other available water supplies through CRW's infrastructure, and to the Sterling Ranch Development located in northwest Douglas County. CRW's 5.87-mile-long pipeline will be used to deliver raw water from Castle Rock Reservoir No. 1 (CRR1) to the Plum Creek Water Purification Facility for treatment. Ultimately, our water reuse system will account for approximately one-third of the Town's water supply. The Town's overall cost of this project was approximately $16.3 million, including design, easement acquisition and support, project administration, and construction services. Construction began in early 2019 and was completed in late 2020, in advance of the AT processes being completed at the PCWPF.

Red Hawk Reuse Pipeline

The Red Hawk Reuse Project was identified to bring new reuse water supply to the Red Hawk Ridge Golf Course. During dry months, Castle Rock Water has supplemented the golf course's groundwater well with raw water from other deep groundwater and alluvial wells. The new source supply is the Town's treated effluent water from the Plum Creek Water Reclamation Authority (PCWRA) that has historically been discharged from PCWRA directly to Plum Creek, or sent to other golf courses. On average, over four million gallons per day of the Town's wastewater is reclaimed at the PCWRA, which can be beneficially reused for irrigation and other uses. The Red Hawk reuse system was designed to deliver more than 650,000 gallons per day to the golf course.

The Reuse Project Team developed a pipeline alignment for a new dedicated 8" reuse water-line between PCWRA and the golf course. The 3.5-mile alignment minimized land acquisition and utilized undeveloped parcels. Staff issued a request for proposals and Global Under-ground was selected as the contractor to construct the project utilizing minimal design documents to accelerate the project schedule.

Global began constructing the pipeline in May while staff finalized construction agreements with landowners along the alignment. Six horizontal directional drilled crossings under roads and creeks were required, as well as an auger bore under the railroad. The pipeline was substantially completed in October in advance of completion of the new reuse pump station. The first reuse water was delivered to Red Hawk Golf Course in November 2019. Nearly one mile of the total 3.5 miles was constructed utilizing trenchless construction. Staff is now working on a follow-up pipeline project to repurpose the golf course deep groundwater well as additional municipal raw water supply for the Meadows Water Treatment Plant. The new pipeline will help the Town maximize reuse water rights, reduce demands on the municipal water system, supply sustainable irrigation water for the golf course and additional nutrients for the turf, reduce irrigation pumping costs, and increase community familiarity with reuse. Cost of the project was $1.8 million (under budget).

Red Hawk Reuse Pump Station

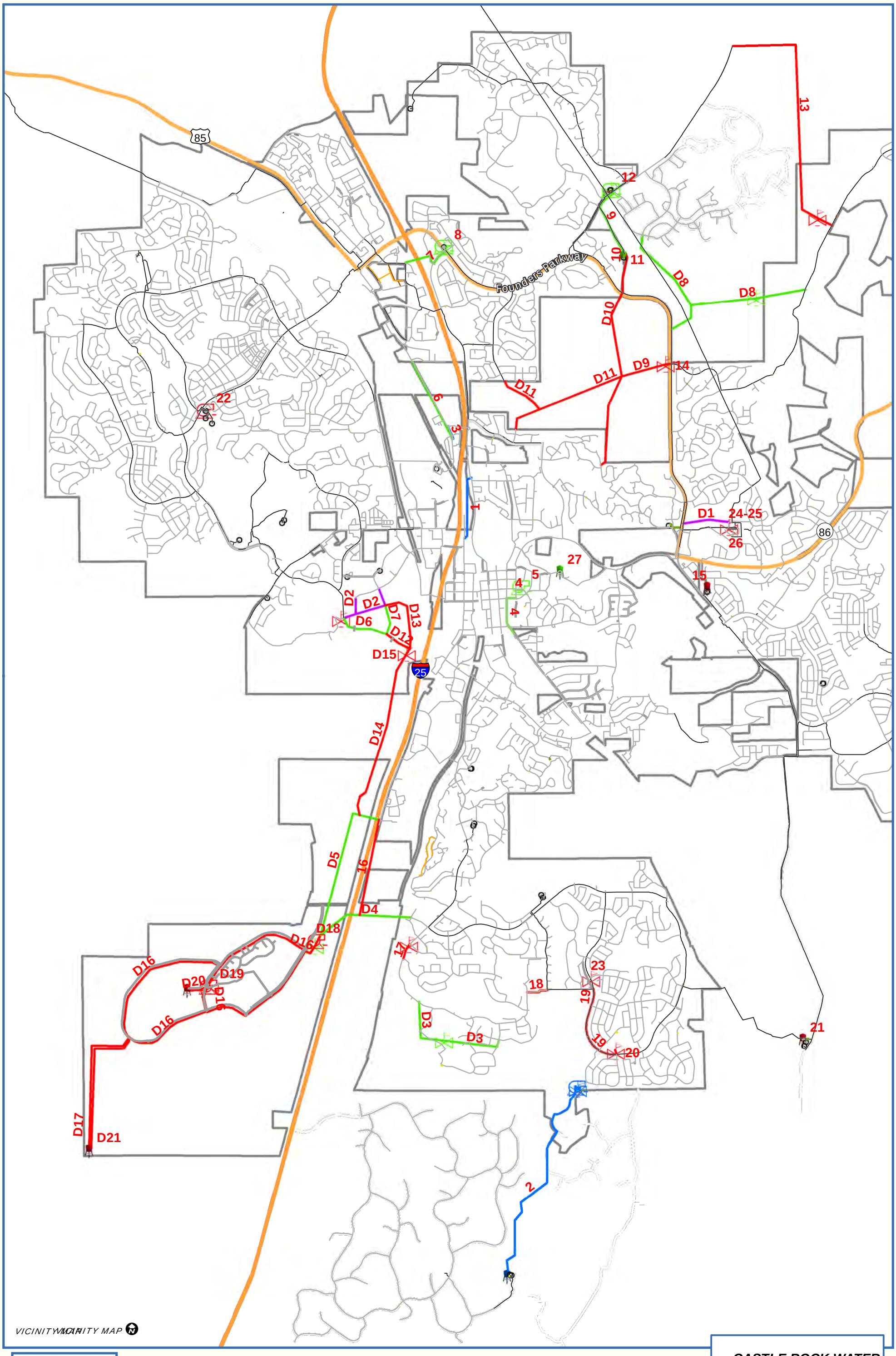
As part of the overall Red Hawk Reuse Project, a new dedicated pump station was needed to send treated reuse water through 3.5 miles of new pipeline from the Plum Creek Water Reclamation Authority (PCWRA) to the Red Hawk Ridge Golf Course. Castle Rock Water has been actively involved in the PCWRA Capacity Expansion Project, which began construction in the fall of 2018. Burns & McDonnell Engineering and Moltz Construction provided design and construction management services for the plant expansion. With both entities already onsite at PCWRA in 2019, the Town contracted with Burns & McDonnell and Moltz to design and construct a dedicated Red Hawk Reuse Pump Station at PCWRA. With PCWRA and Town input, a design was developed to retrofit the existing reuse pump station at PCWRA with a new Red Hawk Reuse pump, motor, piping and appurtenances, and electrical and controls equipment. The project also required installation of approximately 800 feet of reuse pipeline across the PCWRA treatment plant property.

CRW SCADA and Plant Mechanics teams installed new telemetry and pond level monitoring equipment at the golf course pond and at PCWRA and worked out details for communication signals between the CRW and PCWRA's systems. The reuse system was ready for fully automated use when the golf course begins irrigating in early spring of 2020, and it is capable of exceeding the golf course's peak day demand of 650,000 gallons per day.
Project cost: Approximately $671,000 (under budget)

Future Projects

Following are all water infrastructure capital improvements, listed by planning horizons, identified in this updated master planning effort, including a brief discussion of scope. There are three planning horizons based on model year 2022: current five year that includes 2023-27; ten year (2028 through 2033); and build-out conditions beyond 2034. Table 4-1 shows the capital plan, by planning period, through build out. The location of each project is shown on Figure 4.1. The table and figure also shows anticipated future infrastructure to be constructed by new development (Developer CIP) with a "D" prefix. The projects in the five year plan are shown in "blue"; projects in the ten year plan are shown in "green"; projects in the buildout planning period, beyond 2034, are shown in "red".

Table 4.1 CIP Project List				
Phase	Project	Project Type	Project Name	Description
5	1	Pipe	Front St Downtown Connection	2600 feet of 12" transmission main to connect Front Street to Wilcox
5	2	Pump	Bell Mountain Infrastructure	Bell Mountain PS, Tank, and Transmission Main
5	3	Pipe	Liggett Road Upsize	Liggett Road bottleneck 600 feet of 16"
5	24	Pump	RWRWTC Red Zone Pump Upgrades	RW Red Zone Pumping Upgrades 4500 gpm
5	D1	Pipe	Echelon Distribution	Red zone connection and distribution pipes (underway)
5	D2	Pipe	Millers Landing Infrastructure	Red zone connection to 16" in PC Parkway, distribution pipes, PRVs
10	4	Pipe	Hillside Improvements	Hillside PS Transmission main 2100 feet of 12"
10	5	Pump	Hillside Pump Station Upgrades	Hillside PS 2600 gpm @ 450 feet
10	6	Pipe	Liggett Road Transmission	Liggett Road transmission 3500 feet of 16"
10	7	Pipe	Front St. Improvements	Castleton to Front 1300 feet of 16" and 1100 feet of 20" under I25
10	8	Pump	Milestone PS Upgrades	Milestone PS upgrade 4000 gpm
10	9	Pipe	Tank 11B Transmission	Tank 11B transmission main 2300 feet of 20"
10	10	Pipe	Crowfoot Purple Zone Upsize	Crowfoot Valley purple zone 200 feet of 16"
10	11	Tank	Tank 11B	second purple zone Tank 11 (Tank 11B)
10	12	Pump	Diamond Ridge Pump Station Upgrades	Diamond Ridge red zone 2800 gpm
10	D3	Pipe	Lanterns Pipelines	Lanterns distribution
10	D4	Pipe	Dawson Trails Infrastructure	Dawson Trail 16-inch transmission main
10	D5	Pipe	Dawson Trails Infrastructure	Dawson Trail 12-inch transmission main
10	D6	Pipe	Millers Landing Infrastructure	Millers Landing 16-inch transmission main extension
10	D7	Pipe	Millers Landing Infrastructure	Millers Landing distribution
10	D8	Pipe	Canyons Far South Infrastructure	Canyon Far South distribution
10	27	Tank	Tank 3B	new Tank 3B to replace oldest tank
BO	13	Pipe	Canyons South Infrastructure	Canyons South to Cobblestone loop 10,500 feet of 16"
BO	14	Valve	Pioneer Ranch FCV	Pioneer Ranch automated flow control valve
BO	15	Tank	Tank 16B	second red zone tank, Tank 16B
BO	16	Pipe	Frontage Road Transmission	I25 Frontage Road Loop 4000 feet of 12 inch
BO	17	Pipe	Plum Creek Transmission	Plum Creek Transmission 700 feet of 12" and PRV
BO	18	Pipe	Lanterns Inwood Place Upsize	Inwood Place upsize 1000 feet of 16 inch
BO	19	Pipe	CVR Loop Road Transmission Upsize	Loop Road upsize 3500 feet of 24"
BO	20	WTP	CVR Water Treatment Plant	Crystal Valley WTP
BO	21	Tank	Replacement Tank 6B	new Tank 6B
BO	22	Pump	Blue Zone Pump Station Upgrades	Blue Zone PS second high service pump
BO	23	Valve	West Loop Road PRV Upgrades	W. Loop Road PRV Upsize
BO	25	Pump	RWRWTC Red Zone Pump Upgrades	RW Red Zone Pumping Upgrades 6330 gpm
BO	26	Pump	RWRWTC Green Zone Pump Upgrades	RW Green Zone Pumping Upgrades 4200 gpm
BO	D10	Pipe	Pioneer Ranch Infrastructure	Pioneer Ranch T11 transmission 20 inch
BO	D11	Pipe	Pioneer Ranch Infrastructure	Pioneer Ranch Distribution
BO	D12	Pipe	Millers Landing Infrastructure	Millers Landing 16 inch transmission extension
BO	D13	Pipe	Millers Landing Infrastructure	Millers Landing distribution
BO	D14	Pipe	Dawson Trails Infrastructure	Dawson Trails Meadows connection 16" main
BO	D15	Valve	Dawson Trails Infrastructure	Dawson Trails Meadows connection PRV
BO	D16	Pipe	Dawson Trails Infrastructure	Dawson Trails distribution
BO	D17	Pipe	Dawson Trails Infrastructure	Dawson Trails Tank 21 fill and supplies transmission mains
BO	D18	Pump	Dawson Trails Infrastructure	Dawson Trails Red Zone Pump Station
BO	D19	Pump	Dawson Trails Infrastructure	Dawson Trails Green Zone Pump Station
BO	D20	Tank	Dawson Trails Infrastructure	Dawson Trails Tank 19 and transmission main
BO	D21	Tank	Dawson Trails Infrastructure	Dawson Trails Tank 21
BO	D9	Pipe	Pioneer Ranch Infrastructure	Pioneer Ranch transmission 20 inch



VICINITY MAP

CASTLE ROCK water
Securing our future drop by drop

0 1,750 3,500 7,000 10,500 Feet

1 inch = 3,500 feet

Disclaimer: The data presented has been compiled from various sources, each of which introduces varying degrees of inaccuracies or inconsistencies. Such discrepancies in data are inherent and in supplying this product the Town of Castle Rock assumes no liability for it's use or accuracy. Questions or comments regarding the cartographic composition of this map including, but not limited to, errors, omissions, corrections, and/or updates, should be directed to the Utilities Department, Town of Castle Rock, (720) 733-6056. Copyright 2022, Town of Castle Rock Utilities Mapping.

CASTLE ROCK WATER
CIP PROJECT MAP
FIGURE 4.1

Date: 4/10/2023 Document Path: J:\B. PLAN & ENG\13.0 Engineering\13.8. Planning\Master Plans\2022 Master plan update\Water Mast

2023-2027 Planning Horizon (Five Year Plan)

Waterline Rehab and Replacement

W. Prestwick Way Waterline

The W. Prestwick Water Line Rehab Project is located west of Plum Creek Blvd., near the intersection of Plum Creek Blvd. and Mt. Royal Dr. This project will replace the aging potable water distribution piping in W. Prestwick Way. The water main in W. Prestwick Way has had a significant number of main breaks in recent years. The water main was constructed in the early 1980s with ductile iron pipe. The existing pipe does not appear to have been wrapped in plastic when it was installed. The breaks that have occurred appear to have been caused by corrosion. Construction will begin in 2023. Total construction cost is expected to be approximately $1,204,648.

Young American

The area has been identified for future pipeline replacement in the Waterline Rehab Plan (draft 2022). Design for replacement will begin in 2023 with construction planned in 2024. The project may be phased due to size of the area and budget constraints.

Supply

East Plum Creek Open Space ASR Wells

This project will include the drilling, completion, and pump testing of one Arapahoe Aquifer well, one Denver Aquifer well and one Dawson Aquifer well. Staff anticipates that the Arapahoe Aquifer well will produce 250 to 300 gallons per minute (gpm), the Denver Aquifer well will produce 200 to 250 gpm, and the Dawson Aquifer well will produce 50 to 80 gpm or approximately a total of 0.72 to 0.90 million gallons per day (Mgd). This facility has been designed with the flexibility to produce water that can be sent to the PCWPF or the Meadows Water Treatment Plant (MWTP). This will give the operations team the ability to send water to the MWTP in the summer to maximize water production or to PCWPF for blending in the winter. Additionally, this facility is design for ASR to bank renewable water during the off peak season. Construction will begin in 2023. Total construction cost is expected to be approximately $2,613,215.01

Bell Mountain Infrastructure

The Ridge Estates development in lower CVR needed water storage in a zone higher than existing pressure zones within the CRW service area and needed storage within the Bell Mountain service area. BMR was also short on fire flow storage for its 321 residences within their service area. The developer, BMR and the Town are jointly constructing an additional 0.40 MG storage tank within BMR, and also a pump station and potable water interconnect between CVR and BMR. This interconnect and pump station will allow CRW to provide service to BMR in the future to either make improvements at the BMR WTP for continued service or to decommission the plant altogether if a CVR WTP is constructed. Also, a new raw waterline from one of the existing Bell Mountain Wells will be extended to the existing Bell Mountain Ranch WTP in summer 2023.

Treatment

PCWPF Expansion, Phase 1

Current plans for full expansion of PCWPF will follow a three phases schedule of construction to reach ultimate treatment, pumping and distribution capacity of 12 MGD by 2031. Phase 1 will increase the treatment and distribution capacity to 8 MGD by early 2026. Included in Phase 1 is the replacement of 12,500 linear feet of existing 16-inch potable pipeline with new 30-inch pipe, to include a 1,500 linear feet horizontal directional bore under Plum Creek to minimize impacts to endangered Prebles Mouse Habitat. Phase 2 will increase treatment and pumping capacity to 10 MGD, for completion in 2028. Phase 1 design should occur in 2023, with a two-year construction phase in 2024-2025, with processes online to meet demand in 2026.

Distribution and Transmission Lines

Future transmission lines may be required to efficiently move water supplies around Town. Developers install the transmission and distribution lines required to serve their development. The Town can require that distribution lines be installed at up to 12" by the developer, and can request that the lines be "upsized" beyond 12", with the additional upsize costs incurred by the Town. Future in-fill annexations in the Pine Canyon, Pioneer Ranch, Macanta, and Dawson Trails could require additional or upsized transmission lines. Depending on the timing of developer projects, future demands, and availability of out of service area water supplies, it could be necessary for the Town to build infrastructure, with potential recoupment from future benefited development.

Liggett Road Upsize

A short section, 600 LF, of the existing distribution main in Liggett Road must be upsized to 16 inches to accommodate increased flows from the PCWPF. The estimated project cost is $373,000.

Front Street Downtown Connection

2600 LF of 12" transmission main to connect Front Street to Wilcox Street, to support downtown development. The estimated project cost is $1,063,000.

Echelon Distribution (Developer)

Red zone connection to transmission main in Founders Parkway and internal distribution pipes. Project is underway in 2022.

Millers Landing Infrastructure (Developer)

Red zone connection and looping pipes in Plum Creek Parkway, internal distribution, and PRVs as required to support the development; this is anticipated in the 5-year timeline of 2023-2027.

Pumping

RWRWTC Red Zone Pump Upgrades

Pumping improvements are needed as the WISE water becomes more available. The red zone and green zone pumps at the Ray Waterman Regional Water Treatment Center (RWRWTC) will undergo several phases of upgrades to keep up with increasing supplies of

water to the plant. Phase 1 Red Zone Upgrades were completed in 2020 when the red zone pumps needed to be rehabilitated.

2028– 2033 (Ten Year) Planning Horizon

RWRWTC High Service Pump Station

Supply

Crystal Valley Ranch Wells

Over 5 MGD of new deep well water supply is planned at dedicated well sites in the Crystal Valley Ranch area. The estimated project cost is $19.5 Million.

Treatment

Media Replacement

Water treatment media replacement is being budgeted to replace media every five years, alternating among the treatment facilities.

Membrane Rack Replacement

Membrane filtration racks at the PCWPF are scheduled for replacement of one rack every year.

Granular Activated Carbon (GAC)

The GAC media filtration tanks at PCWPF had the carbon media fully replaced in early 2023:

PCWPF Expansion to 12 MGD

Current plans for full expansion of PCWPF will follow a three phase schedule of construction to reach ultimate treatment, pumping and distribution capacity of 12 MGD by 2031. The final two phases to reach 12 MGD of treatment and pumping are planned to be completed by early 2031. Current estimated opinion of costs (in 2022 dollars) for the three-phased expansion to 12 MGD is about $58.8 Million.

New CVR WTP 8 MGD

An alternatives study completed in Feb 2023 recommended construction of a new 8.0 MGD WTP in the CVR area over a new facility in BMR; $50 Million has been included in the CIP planning budget for design and construction of this new WTP, beginning in about 2028 with design.

Storage

Tank 11B

A new purple zone tank will be required to support future development in currently unincorporated areas of Castle Rock being planned as Pioneer Ranch and Pine Canyon. The Tank will be 2.3 Mgal in capacity; estimated cost $6,600,000.

Tank 3 Replacement

Tank 3, built in 1969, is currently the Town's oldest storage tank. In 2015 the upper deck was repaired, which probably gained another 15 to 20 years of usable life, however, future replacement is warranted. Estimated cost to replace the 1.0 MGD tank is $2,200,000.

Tank 3 Roof Deck, Pre and Post Rehab

Pumping

Hillside Pump Station Upgrades

The Hillside pump station will need to be upsized from current pumping capacity of 800 gpm to 2,600 gpm at a head of 450 feet.

Milestone Pump Station Upgrades

The existing Milestone Pump Station will need pumps upsized from 3,000 gpm to 4,000 gpm to move future treated water from the PCWPF.

Diamond Ridge Pump Station Upgrades

The red zone pumps at the existing Diamond Ridge Pump Station will need to be upsized from 1,440 gpm to a 2,800 gpm flow rate.

Distribution and Transmission

Hillside Improvements

Concurrent with pump station upgrades, a new transmission main, 2,100 lf of 12-inch pipeline, will need to be constructed.

Front St. Improvements

Transmission pipes from Front St. to Castleton will need to be upsized; 1,300 lf of 16-inch pipe and 1,100 lf of 20-inch pipe (under I-25) will need to be constructed.

Crowfoot Purple Zone Upsize

225 linear feet of 20-inch pipeline to upsize existing purple zone transmission in Crowfoot Valley Road. Required to move additional water supplies. The project timing may also depend on public street improvements. The estimated project cost is $390,000.

Liggett Road Transmission

Almost 3,500 lf of 20-inch transmission main will need to be constructed in Liggett Road to convey future PCWPF flows.

Tank 11B Transmission Main

2,300 lf of 20" transmission main will need to be constructed to support the future Tank 11B.

Lanterns Pipelines (Developer)

Additional distribution and transmission pipes are installed as the neighborhood grows towards buildout.

Dawson Trails Infrastructure (Developer)

Internal distribution pipes and larger 12-inch and 16-inch transmission mains will need to be installed as the neighborhood develops.

Millers Landing Infrastructure (Developer)

Various extensions of existing 16-inch mains, connections to existing mains, and internal distribution pipes will be installed as the development proceeds.

Canyons Far South Infrastructure (Developer)

Connections to existing mains and future distribution pipes to support the development will need to be constructed.

2034– Buildout Planning Horizon

Storage

Tank 16B

A new red zone tank will be on Ridge Road next to the existing Tank 16. This tank is needed to facilitate the pumping of imported renewable water. The volume of the tank will be 2.0 MG and the tank will cost approximately $5,500,000.

Tank 6B Replacement
The existing Tank 6B will be demolished and a new 2.2 Mgal storage tank built on the existing site. Estimated cost is $4,400,000.

Dawsons Trails Infrastructure (Developer)
Future Tank 19 (Red Zone Tank) and transmission mains, and future Tank 21 (Green Zone Tank) to provide storage and fire flow for the development.

Pumping
RWRWTC Red Zone and Green Zone Pumping Upgrades
Future pumping improvements will be needed as the WISE water becomes more available. The red zone and green zone pumps at the Ray Waterman Regional Water Treatment Center (RWRWTC) will undergo several phases of upgrades to keep up with future increasing supplies of water to the plant. Phase 2 Green Zone Upgrades and Phase 3 Red Zone Upgrades are planned in this timeframe. Estimated Costs: $2.5 Million.

Blue Zone Pump Station Upgrades
The second high service pump at the Blue Zone Pump Station will need to replaced/upsized.

Dawson Trails Infrastructure (Developer)
The Red Zone and Green Zone pump stations to supply water to the Red and Green Zone tanks will have to be constructed.

Treatment
Crystal Valley Ranch Water Treatment Plant
A new 8 Mgd water treatment plant, with associated new wells and raw water supply lines. Project may be built in phases.

Distribution and Transmission
Canyons South Infrastructure
Over 10,500 lf of 16-inch transmission main linking Canyons South to the Cobblestone loop will need to be constructed.

Dawson Trails Infrastructure (Developer)
Future Dawson Trails to Meadows 16-inch transmission main, connection to existing, and PRV. Internal distribution pipelines, and fill/supply mains to/from the future Tank 21.

Pioneer Ranch Infrastructure (Developer) - Future infill annexation of the Pine Canyon and Pioneer Ranch will require a transmission line from the Tank 11 purple zone tank. The developer must install a pipeline to serve the Pine Canyon development and initial planning documents indicate the size will be 16 to 20 inches. Also, internal distribution piping of various sizes will have to be installed to support the development.

Pioneer Ranch Flow Control Valve
A flow control valve from the Pioneer Ranch development to the existing transmission mains in Founders Parkway will need to be installed.

Crystal Valley Ranch Loop Road Transmission Upsize
3,500 linear feet of 16-inch transmission main upsized to 24-inch to move future supplies.

West Loop Road PRV Upgrades
Existing PRV is upsized to meet future transmission demands.

Frontage Road Transmission
Transmission main to loop blue zone in I-25 Frontage Rd. The project consists of approximately 4,000 feet of 12-inch pipe.

Plum Creek Transmission
Installation of about 700 lf of 12-inch pipe and a new PRV.

Lanterns Inwood Place Upsize
Upsize of approximately 1,000 lf of existing pipelines to 16-inch.

Millers Landing Infrastructure (Developer)
Future 16-inch transmission main extension along Plum Creek Parkway; construction of distribution looping mains within the development.

5. Recurring Capital Improvement Projects

In addition to identified capital improvement projects, there are several programs budgeted annually to cover routine or as-needed projects, generally due to the aging or obsolescence of equipment and assets:

Waterline Rehab and Replacement

Older water mains within the distribution system require replacement after their useful life, which generally is fifty years. Castle Rock Water identifies critical lines based on a history of water main breaks, age, pipe material and condition score, and tries to time replacement projects in advance of, or in coordination with, the Public Works Pavement Maintenance Program. For the long-term viability of the distribution network, $600,000 per year is currently budgeted starting in 2024 but increases to $2,000,000 per year budgeted beginning in 2028. Castle Rock Water anticipates that in the near future, waterline rehabilitation and replacement may require a larger annual financial dedication to ensure that system reliability, as measured by the KPI (number of leaks plus breaks per 100 miles of piping) of water distribution system integrity, defined as the total number of leaks/breaks per total miles of distribution system piping, remains in the top quartile. Castle Rock Water scored a KPI of 7.2 in this category for 2022. A low score is desirable, and to be in the top quartile the score must be 11.1 or less. A 10-year plan for rehab and replacement of waterlines has been developed that focuses on pre-1980 distribution pipe. Refer to Figure 5.1.

Water Treatment Plant Upgrades and Equipment Replacement

The Town relies on six (five main, one peaking) water treatment facilities to treat water and the equipment in each plant has a limited life. This project fund is for smaller capital equipment replacement and general facility upgrades at these facilities. The budgeted cost is $150,000 per year.

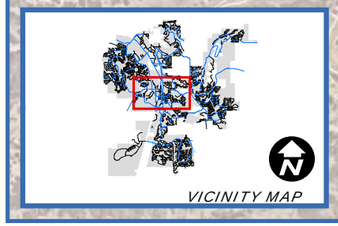
Water Supply Wells:

- Well Redrills

  Castle Rock Water, recognizing the importance of the deep groundwater wells to the Town's water supply portfolio for the long-term, budgets $2,000,000 every two years for the re-drill of a deep well, and budgets $1,000,000 yearly for other well maintenance and equipment

Legend

- Tank 3 Water
- DC High School
- Bishop Ct Water
- Wilcox St Water
- Young Am Water Ph2
- Castle Rock Heights Water
- Rock St Water
- Fifth St Water
- Kinner St Local Water
- Fair St Water
- South St Water Ph3
- South St Water Ph2
- South St Water Ph1
- Young American Water



Legend

- Sanitary Sewer
- Stormwater Conduit
- Fiber
- Raw Water Distribution Main
- Water Distribution Main

CASTLE ROCK Qwater
Securing our future drop by drop

0 500 1,000 2,000 3,000 Feet

1 inch = 1,000 feet

CASTLE ROCK WATER
WATER REHAB MAP
FIGURE 5.1

Date: 9/6/2022

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replacement. The Town currently operates 52 deep groundwater wells that pump from three Denver Basin aquifers: Dawson, Denver, and Arapahoe. The typical life expectancy of a municipal well is approximately 25 years. In order to maintain adequate groundwater supply, older damaged or unproductive wells have to be replaced. A capital replacement plan has been developed whereby unusable wells are replaced by drilling new wells at the same location. The program is funded so that one deep well can be replaced every other year at a cost of approximately $2,000,000 to cover the drilling, new pumping equipment, and costs for retrofitting well controls.

Rig set up over existing well to pull down-hole equipment.

- Well Equipment Replacement

Down-hole pumps and motors in wells will periodically experience mechanical or electrical failures due to wear and tear of the equipment. The typical life expectancy of well pumping equipment is approximately seven years, depending on factors such as the amount of runtime and well conditions. Pumping equipment is rebuilt or replaced in wells depending on the type of failure. In addition, as failures occur, there is a program in place to evaluate the condition of the well casing and screens, and determine if the well efficiency and production rate will benefit from a rehabilitation effort. To do the evaluation the down-hole equipment and column pipe must be pulled from the well and a video survey conducted. The survey allows the condition of the casing and screens to be inspected for buildup and scaling. Depending on the well condition, a rehabilitation program is designed that is tailored for the individual well. Rehabilitation can consist of mechanical methods such as wire brushing with a wire line tool, or by chemical means such as introducing a mild acid into the well. A third method called Sonar-Jetting uses sonic waves to strip scale, and to agitate and rearrange the gravel pack in the well annulus. All three of these rehabilitation methods can be used individually or combined, depending on the severity of the well screen plugging. Declining well performance can be improved with rehabilitation, and the life of the well structure extended with proper operation and maintenance. The annual budget for the Well Equipment Rehabilitation and Replacement program is approximately $1,000,000.

VFD Replacement

Each of Castle Rock Water's treatment plants and pump stations have many pumps, and often these pumps have associated variable frequency drives (VFDs), which have a finite life like many components. $125,000 is budgeted each year for replacement of VFDs, as needed or as planned.

Pump Station Equipment Replacement
Electrical and mechanical equipment needs to be replaced as equipment reaches the end of its useful life. A preventive maintenance program associated with asset management will be used to determine replacement schedules based on the type of equipment, service duty and operating conditions. $50,000 is budgeted yearly.

Tank Rehabilitation
Rehabilitation and improvements to existing water storage tanks are identified in conjunction with the tank cleaning and inspection program. Expenditures of $50,000 per year are budgeted for capital improvements to the existing water storage tanks.

Distribution System Upgrades
Upgrades to the distribution system include the automation of key PRVs to help with the efficient flow of water through the distribution network, and minor piping projects to help with connectivity and distribution of water within and between pressure zones. Other improvements include rehabilitation projects to improve reliability and decrease ongoing maintenance, such as the addition of and rehabilitation of valves and fire hydrants to older neighborhoods. The annual budget for this work is $250,000.

Typical PRV

General Facility Upgrades
Upgrade projects are small projects that improve the functionality and/or appearance of Town water facilities. Projects include roofing replacement, exterior repairs, drainage, landscaping, and site improvements at existing facilities. Also included are minor improvements associated with mechanical and electrical systems. The annual budget for upgrades is $75,000. These are typically smaller projects identified during routine maintenance.

Security and SCADA Improvements
$25,000 is budgeted yearly for security improvements (alarms, fences, cameras, etc.), and $50,000 yearly for SCADA improvements at the various water facilities. This is currently budgeted separately from the overall funding for the SCADA master plan projects.

6. Operations and Maintenance

Key Performance Indicators

By participating in the AWWA Utility Benchmarking program, Castle Rock Water tracks many metrics in order to benchmark the utility against other utilities nationwide, in support of Castle Rock Water's efforts to be a national leader.

Manpower and Staffing

Castle Rock Water's Operations Division is responsible for day-to-day operation and maintenance of 67 well facilities, six treatment plants, 16 water storage tanks, 20 finished water pump stations, and 507 miles of raw, transmission and distribution piping and appurtenances that serve more than 26,400 water service accounts at the end of 2022. There are seventeen licensed water treatment operators that run six water treatment plants. CRW employees began operating the newly acquired Bell Mountain WTP in early 2023. The Plant Maintenance Division of Castle Rock Water has one supervisor, five plant mechanics, one preventative maintenance technician, and one grounds and facilities technician dedicated to facilities maintenance. Plant mechanics are responsible for most preventive maintenance and repair of electrical/mechanical equipment at the wells, treatment plants, pump stations, and other wastewater facilities. The water fund also shares support of seven employees in the Engineering/GIS Division, which includes four professional engineers. Engineering provides support to operations and manages capital programs and projects. GIS provides mapping and asset management support. Three SCADA personnel (with a fourth to be added in 2023) keep systems up-to-date and operational. Customer Relations, Billing, Meters, and Administration personnel are also partially funded from the water fund. Many of the distribution staff hold system operator certifications. All of the water treatment operators are licensed operators.

Training /Professional Development

Water staff averaged over 17 hours of training (safety, technical and professional development) per employee in 2021. This compares to 17.7 hours per employee for those utilities in the top quartile that are participating in the AWWA Benchmark program.

Equipment

Wheeled Excavator

In 2021, Operations purchased a wheeled excavator and attachments at a cost of $350,000. Field staff presented the business case that over the years Castle Rock Water has installed and/or purchased several miles of large diameter (>16'') pipeline (WISE pipeline, Sedalia pump station raw water return pipeline, the PCWPF alluvial well line, Mitchell Creek Force main). These pipelines are mostly PVC, or in the case of the Ravenna pipeline, Fiberglass (FRP), and have areas of deep bury depths. There have been multiple breaks on these lines over the years. These repairs have either been repaired in house or have been contracted out. Prior to the excavator purchase, the repairs that we were able to perform in-house had to be located in very accessible and open areas; allowing for 360-degree access around the break. In most cases, our best option was to utilize an emergency contractor to complete the repair. While contractors have been available and able to complete the repairs in a timely

manner, the cost is significantly higher than repairs completed in house, typically 2-4 times the cost of doing the repair in house.
Before the excavator was purchased, any repair task that exceeded 12' in depth generally required contractor support due to the limited excavation depth of the backhoe generally used. With the purchase of this excavator dig depth increased to 20'. The excavator's lifting capabilities broadened the scope of work performed by Field Services. Including utilizing larger trench boxes on excavations, lifting barricade blocks and street plates during repairs, setting large manholes and vaults, etc. The extended reach of the excavator also provided benefits in safety and efficiency. The further reach allowed for safer removal of compromised pavement around sink holes. It also allowed for equipment to be placed further away from excavations, reducing the risk of trench collapse or equipment being driven into the excavation. The excavator's dig bucket is significantly larger than the bucket used with our back hoe or mini-excavator. This is important when removing sediment from storm ponds. Renting an excavator for stormwater maintenance came at a cost of $3,500 per week. Having our own excavator translated to increased opportunity and less rental cost for stormwater maintenance. The main advantage of the wheeled excavator is that it can be driven to job sites, eliminating the need for truck and trailer transport, which reduces vehicle maintenance needs.

All-Terrain Vehicle (ATV)
Operations staff purchased a four seat, side by side, all-terrain vehicle (ATV) in 2020 at a cost of $23,000. With the acquisition of the Plum Creek Diversion and the pipeline to Ravenna, and the installation of the Plum Creek Raw Water Return Pipeline and the Red Hawk reuse line, CRW gained many new assets including: valves, manholes, air relief valves, low point blow offs, service connections and locate wire test stations. All of these assets require routine maintenance and inspections, as well as emergency responses. The majority of these line runs through rough terrain which includes multiple creek crossings and steep grades. Negotiating this terrain is very difficult if not impossible for standard work trucks. Another major concern was that the majority of the terrain is also covered in tall native grasses. During dry months, fires can ignite when the dried grass comes into contact with the catalytic converter on a work truck. The ATV is equipped with undercarriage skid plates and spark arrestors, minimizing the wildfire hazard. The safest and most effective way too many of the easement is by ATV. While the side by side primarily resides in field services, it is used by locates, GIS, and SCADA staff to assist in performing job responsibilities along the pipelines and other infrastructure that is located in remote areas.

Tandem axle dump truck
Operations is proposing the purchase of a tandem axle dump truck in 2023 at a cost of $240,000. The Field Services Water Distribution team is responsible for providing routine maintenance and repair services to all of Castle Rock Water's distribution and transmission systems. The Distribution team also provides seven days per week 24 hours per day emergency response to all of Caste Rock Water's customers. The response area now includes the Bell Mountain Ranch and, in the future, the Dawson's Trails subdivisions. These two new developments, along with the Plum Creek Diversion, Crystal Valley Ranch, Montaine and Cobblestone Ranch are located in outlying areas of the town proper. With the growth of the Town's infrastructure, it is now necessary to haul excavation equipment with a flatbed

trailer utilizing the towing capacity of a tandem axle dump truck. The addition of a tandem axle dump truck will greatly improve response times within town, as well as to the outlying areas within CR Water service areas. Trailering heavy equipment, rather than driving it to locations within the Town, creates a much safer environment for citizens and the Operators. The Distribution fleet's current single axle dump truck is undersized and cannot pull the required heavy equipment. A tandem axle dump truck can haul nearly the same amount of backfill and spoils material as two single axle trucks. This results in a more efficient operation, reducing overall project costs.

Vactor Truck

There are multiple maintenance tasks throughout all of Castle Rock Water's (CRW's) assets that can only be safely completed by utilizing a high pressure jetting operation (Jet), a high volume vacuum (Vac), or a combination of both. These tasks include: primary task of collection system cleaning and maintenance; ancillary tasks that include: Stormwater infrastructure cleaning and maintenance; distribution system maintenance such as cleaning valve boxes; hydro excavation; cleaning water tanks; cleaning equalization basins and wet wells; cleaning treatment plant clear wells; and alluvial well rehabilitation. The Vac truck is also used in emergency response to sanitary sewer overflows, waterline breaks and other unplanned assignments. All of these activities are currently achieved through the use of CRW's combination vac truck. Currently the various operations groups within CRW must share this vital piece of equipment and schedule labor and work tasks appropriately, which takes schedule time from the primary task of collection system cleaning and maintenance. On top of all of these tasks, the Vac truck is a very complex piece of machinery that requires routine maintenance and repairs, which result in the Vac truck out of service roughly eight days annually. When the sole Vac truck was out of service, it was not available for emergency response.

A business case analysis determined that the addition of the proposed second Vac truck to CRW's Fleet would allow for the new Vac truck to be used by other teams without impacting the sewer line cleaning program, would provide redundancy for emergency response, and increase maintenance productivity among water, wastewater and stormwater operations. The second vac truck was purchased in 2018 at a cost of $450,000. The two vac trucks are scheduled for replacement in 2024 and 2033.

Asset Management

GIS and asset management play an important role at Castle Rock Water (CRW) by supporting day-to-day operations, as well as providing data analysis and metrics. While GIS has been used by CRW for over fifteen years, a Computerized Maintenance Management System (CMMS) was implemented in 2014 and is still very much in development. Cartegraph's Operations Management Software (OMS), an asset management specific software used to track asset condition, cost and work history, was selected as the CMMS for CRW.

The goal of GIS and AMP is to help CRW make data driven decisions and track maintenance. CRW created the asset management program to allow the department to operate more effectively and efficiently to meet the growing demands associated with a rapidly growing customer base. To help guide the Town's investment, CRW has incorporated information management and GIS to become more proactive in terms of planning, operations, and asset

maintenance management. Maintaining accurate and up-to-date infrastructure data is a major priority, along with implementing technologies that provide a significant return on investment in cost, business functions and improved customer level-of-service.

Operations and Maintenance Policy and Programs

Several policies and programs drive the Operations and Maintenance costs. Foremost, levels of service drive day-to-day operations.

Hydrant Inspection

Fire hydrants are placed within the distribution to ensure the availability of water for firefighting capabilities. These hydrants are exposed to damage by traffic, vandalism and the elements and the American Water Works Association (AWWA) recommends that hydrants should be inspected at least annually. Hydrant maintenance includes inspecting all external parts for damage, operating the hydrant and measuring the flow, lubricating all moving internal parts and painting the exterior when necessary. The Town currently has over 4,720 potable water hydrants in the distribution system, which are inspected annually. To accomplish this program at its current level requires two Field Services staff. In 2022, hydrant inspection and flushing involved 4,177 tasks, 1017 labor hours, and a labor cost of $51,604. Hydrant maintenance and repair accounted for 166 tasks, 462 labor hours and a labor cost of $25,145.

Flushing

To maintain the water quality of the distribution system, the system must be flushed periodically. Dead-end mains pose a significant threat to water quality, and are generally the priority with water flushing. These dead-end mains are flushed as needed to move sediment and stale water out. Ideally, any portion of the distribution that does not enjoy significant turn-over would be flushed annually as well. Currently, flushing is performed in conjunction with the hydrant inspection program. Operations staff invests approximately 700 hours each year on the flushing program at a cost of $43,000 per year.

Valve Inspection

Valves are placed in the distribution system to isolate small sections of the distribution system for maintenance or emergency repair with minimal disruption of service to surrounding residents and businesses. These valves must be inspected and exercised routinely to ensure they are accessible and operational. Additionally, it is imperative that these valves are in the proper position to ensure water quality is not compromised and that adequate fire flow is available in an

emergency. Currently, valves are inspected and exercised every two years by the Field Services section. The Town currently has approximately over 14,800 system valves in the water system. AWWA standards recommend that valves be inspected and exercised bi-annually. To accomplish this program at its current level requires two Field Services staff investing approximately 3,618 tasks, 1,038 labor hours and a labor cost of $47,272 in 2022.

Leak Detection

AWWA estimates that the average water system leaks three gallons per minute per mile of pipe. With approximately 510 miles of active buried water lines (raw, reuse and potable) in Castle Rock, hypothetically speaking, the Town's water system could be leaking 804 million gallons annually. Fortunately, this is not the case for Castle Rock Water, based on water accounting and an active leak detection program in place. Castle Rock budgets $25,000 annually for leak detection services by a third party. The Field Services group has a goal of leak surveying one-third of the distribution system annually by a combination of contract services and data logging. CRW tracks its Infrastructure Leakage Index (ILI), a measure of leaks per mile of transmission and distribution pipe. For 2022, CRW's ILI was 0.8, putting the utility in the top ten percentile of all utilities reporting as part of the AWWA Utility Benchmarking Program. This favorable index reflects the return on investment of the Leak Detection Program, and a commitment to rehab and replacement of aging pipe, but is probably also low due to the fact that much of CRW's distribution system is young by most standards – 65.2 percent has been installed since 2000.

Key Performance Indicators

By participating in the AWWA Utility Benchmarking Program, Castle Rock Water tracks many metrics in order to benchmark the utility against other utilities nationwide, in support of the Castle Rock Water's efforts to be a national leader. Several key performance indicators associated with the water system integrity are Apparent Water Loss and Real Water Loss; both are measures of nonrevenue water.

Apparent water loss (AWL) is the total volume of water lost due to unauthorized consumption, meter inaccuracies, and systematic data handling errors, reported as gallons per service connection per day. Apparent losses consist of unauthorized use and inaccuracies associated with metering, and systematic data handling errors. Real water losses (RWL) are true losses of water from the system, up to the point of customer metering. They consist of leakage on transmission and distribution mains, leakage and overflows at storage tanks, and leakage on customer service connections up to the point of customer metering, reported as gallons per connection per day. For both metrics, CRW places between the 25th percentile and the median.

	Combined Utilities Reporting			
2022 KPI	CRW	25th percentile	Median	75th Percentile
AWL	5.0	2.7	5.2	9.3
RWL	21.6	22	36.6	66.1

As part of the Colorado Water Loss Initiative (CWLI), in 2022 CRW chose to participate in a test of the accuracy of the flow meters at the five water treatment plans (excluding Bell Mountain Ranch). The test results showed that all meters tested are accurately measuring flow. The Ray Waterman Red line meter was the only test to be outside of the margin of error, but still was within +/-2%. The total uncertainty of the volumetric tests is between +/- 1.3% and +/-2.0% for all tests, taking into consideration uncertainty associated with meter totalizer resolution and tank reference volume calculation.

Preventive Maintenance

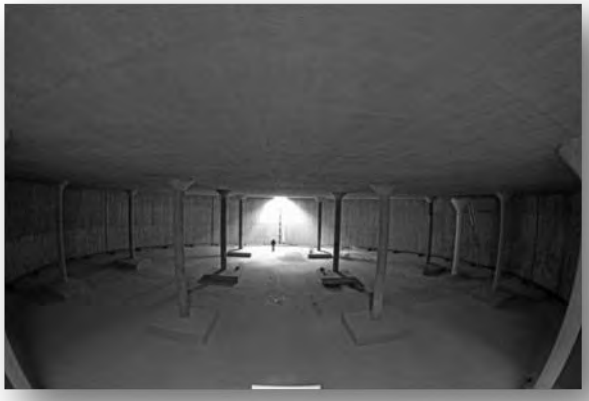
The Operations Division is charged with delivering safe and reliable drinking water to the Town of Castle Rock. This charge mandates that equipment is kept in proper operating condition at all times. The Plant Maintenance Division has an established Preventive Maintenance (PM) program to keep mechanical and electrical systems in good, working order.

Pressure Reducing Valve Inspections

Pressure Reducing Valve (PRV) stations are an integral component of a water distribution system. Due to varying elevations within a distribution system, the system must be divided into pressure zones. The pressures within these pressure zones are regulated and maintained by complicated pressure sensors and valve systems (PRVs), of which there are 73 active PRVs in the Town's distribution system (note: there may be multiple PRVs at a single location). To ensure the proper function of these valves, crews inspect and maintain these valves on a quarterly basis. In 2022, PRV inspections totaled 51 tasks, 21. 25 hours, and a labor cost of $12,198

Tank Cleaning and Inspection

Water storage facilities within the distribution system provide storage of treated water for fire protection, meeting consumption demands, and maintaining steady pressures for consistent operations. To maintain the high quality of water being delivered to the distribution system by our water treatment plants, Castle Rock's 16 active water storage tanks are cleaned and inspected every two to three years by Castle Rock Water's staff. The cleaning and inspection of these tanks require the investment of both Operations and Engineering staff. It requires a crew of five employees approximately forty hours to drain, clean, inspect, disinfect, fill and return the tank to service. Time and materials is approximately $6,500 per tank, or $37,000 annually for the entire program.



Tank 6C inspection prior to filling and placing in service.

Water Quality

Sampling and Compliance Testing

A substantial number of water samples (over 100 per month, on average) are collected for analysis throughout the year from Castle Rock's source water(s), the finished water at the treatment plants, and throughout the distribution system. A majority of these samples are collected for the purpose of ensuring compliance with the stringent state and federal regulations that surround drinking water utilities. Others are for internal data collection and to monitor conditions in the distribution system. The water quality staff also communicates with customers and responds to water quality complaints/inquiries. The investigation itself typically includes an on-site investigation of the issue. The water quality staff may request assistance or input from other divisions, depending on the nature of the issue. Staff then collaborate to resolve the issue or to educate the customer on the nature of the situation. A record of these investigations is kept on file for reference.

Key Water Quality Performance Indicators:

The Key Performance Indicator in regards to Regulatory and Water Quality is the compliance ratio. Specifically, the number of days in compliance with applicable regulations divided by 365 days for the year. Castle Rock Water has had one hundred percent compliance since 2014.

One other key performance indicator that is tracked is the number of technical service complaints divided by the total number of water accounts. The AWWA national standard to be in the top quartile of water providers is less than 2.1 percent technical water quality complaints. For all of 2021, Castle Rock Water's technical service complaints rate was 0.2, (the number of complaints per total accounts), placing CRW in the top quartile among surveyed utilities, exemplifying the commitment of staff to provide the best quality water one hundred percent of the time.

System Optimization

Castle Rock Water uses the hydraulic model to investigate ways to optimize the system. Examples of things that can be investigated include:

- Where to complete or upsize pipes to efficiently move water around town, reduce pressure losses or increase fire flow capability;
- How to manage tank levels to ensure disinfection residual and good water quality;
- Where to include pressure reducing valves to modulate system pressures;
- When and where might additional storage in the system be warranted;
- When do pipes need to be upsized to transport increased flows or to meet peak hour demands;
- When does additional pumping capability need to be added?

Modeling results help determine existing system operational modes, but also help define the future capital plan.

7. Rates and Fees and the Financial Management Plan

Annually CRW completes a rates and fees study. For common understanding, "rates" refers to the collective monthly fixed charges and volumetric rates billed to existing customers. "System Development Fees" is a general term used for Water, Water Resources and Wastewater System Development Fees (SDFs) and Stormwater Development Impact Fees (DIFs). Water, Water Resources and Wastewater SDFs are calculated and assessed at the time of permitting for the right to access existing system capacity and for payment of a proportionate share of the capital cost required for new capacity to meet the potential demand the new customer is expected to place on the system. SDFs ensure that growth pays for the cost of growth. The steps for completing this year's study, as in previous studies, are grounded in industry standards for cost-of-service ratemaking as summarized in the American Water Works Association's AWWA Manual M1. As in prior years, work products include the following tasks:

- Growth Forecast
- Customer Characteristics Analysis
- Capital Improvement Projects (CIP) Forecast Updates
- Revenue and Expenditures Forecast Updates (in conjunction with budgeting)
- Rates & Fees Modeling
- Cost of Service Modeling
- Community Engagement

For the sixth year in a row, Castle Rock Water has engaged Stantec Consulting Services, Inc. to assist with preparation of the rates and fees study. To reduce costs, Castle Rock Water staff continued to prepare the Customer Characteristics Analysis in-house for the 2022 Study. However, Stantec prepared the System Development Fees Models, Financial Rate Models, and the Cost of Service Models for the 2022 Study.

Growth Forecast

The last five years have been high-growth years, exceeding 800 new single family attached and detached homes per year, and also a significant increase in multi-family permits. Nevertheless, for planning and budgeting purposes, Castle Rock Water tries to be conservative in estimating future growth, especially with respect to input in the annual cost of service rates and fees study. However, the rate of growth has implications for the timing of capital projects. Planning data was collected from the Town's Development Services Department, and the past 5-year growth scenario is shown below in Table 7-1.

Table 7-1
Town's 5-Year Growth Projections/Actuals in SFEs

Year	2017	2018	2019	2020	2021	2022
Projected SFEs	800	800	800	800	800	800
Actual SFA and SFD units	862	1,029	901	1,086	1,167	638

Actual MF units	402	372	23	293	538	320
Total New SFEs	1,131	1,278	916	1,282	1,527	852

Note: multifamily units count as a 0.67 SFE for modeling and demand projections.

The growth forecast for customers in Town continues to be developed in conjunction with Development Services based on both historical performance, discussions with developers and home builders, and anticipated changes to economic conditions in the coming year. Customers that may be served through extraterritorial agreements are evaluated by Castle Rock Water and added to the totals within the Town boundaries as appropriate. Growth forecasts include all customer classes converted to single family equivalents.

The projected 2022-2027 growth projections are shown in Table 7-2 below.
Note, budget SFEs are only used for budget purposes and are generally conservative so that the Town doesn't overestimate projected revenue from system development fees (SDFs). The projected actual SFEs are projected by Development Services; the higher SFE for actual expected is used for hydraulic modeling and CIP planning.

Table 7-2
SFE Projections 2022-2027

Year	2022	2023	2024	2025	2026	2027
Budget SFEs	800	800	800	800	800	Not Provided Yet
Projected Actual SFEs	942	940	716	873	866	721

For years beyond the five-year window, Castle Rock Water used an average value of 721 single family equivalents for future growth of the customer base in the financial models. Based on these growth projections build-out in the community and service to extraterritorial areas could occur by 2042, assuming current maximum estimated build-out of 125,000 people is reached.

New customers provide revenues through SDFs to fund growth-related capital projects and the monthly revenues to fund the remaining costs as an existing rate customer. Actual growth in 2021 was strong, however growth has slowed in 2022. In 2022, 677 single family home permits were issued, down from 1,167 issued in 2021.

Customer Characteristics Analysis

There were no major changes to customer characteristics affecting this year's recommendations. The topics reviewed included growth projections and how they are considered in long-range planning, residential consumption trends, and the various ways that CRW is continuing to promote conservation in the Town. In general, we have seen some favorable trends in regards to average residential consumption in recent years and will likely see additional improvements

beginning in 2023 as the proposed changes to Castle Rock's landscape and irrigation criteria manual (i.e. new limits on turf grass for new development) are implemented. CRW's customer characteristics that are analyzed in the study include the following for the water system:

- Base Water Demand
- Maximum Day Extra Capacity
- Maximum Hour Extra Capacity
- Meters and Services
- Number of Customers

The percentage of each customer class' share of each characteristic above forms the basis for allocating costs of service to each customer class.

Capital Improvement Projects Forecast Updates

Significant additions were made to the long term capital plan. Costs for renewal and rehabilitation of existing infrastructure, improvements to existing infrastructure to meet upcoming regulatory requirements, infrastructure additions driven by the renewable water program, capital investment adjustments and revenue forecast changes based on the proposed changes to Castle Rock's landscape and irrigation criteria manual (i.e. new limits on turf grass for new development), and an updated growth forecast are incorporated into the study. Capital costs are escalated by 3.00% per year in future years past 2023 consistent with the latest Engineering News Record Construction Cost Index (ENRCCI) in the financial model.

With respect to capital plans, there were some significant changes to the five-year capital plans, but there were also several major changes to the long term (>5 years out) capital plan which were made for this study year. Additional requirements for desalination related to Water Infrastructure Supply Efficiency (WISE) as well as increases in Plum Creek Water Purification Facility (PCWPF) expansion were incorporated into the Water Resources capital plan and account for a large increase in near term spending. Long term planning was impacted by upcoming proposed changes to turf restrictions on new homes and non-residential development which will reduce the future capacity needs as consumption and peak demands in new development will be significantly less than current areas of Town. Significant changes to the five-year capital plan by enterprise are summarized in Table 8-3 and in more detail below.

Table 7-3: 5 Year CIP and Long Term CIP Differences by Fund

Fund	2022 Study CIP 2023-2027	2021 Study CIP 2022-2026	Variance	2022 Study CIP thru 2065*	2021 Study CIP thru 2060
Water	$54,464,630	$45,895,546	$8,569,084	$395,956,625	$302,853,812
Water Resources	$194,430,446	$96,907,949	$97,522,497	$428,033,838	$525,619,757
Stormwater	$22,857,056	$14,409,255	$8,447,801	$149,087,566	$135,107,884
Wastewater	$22,712,590	$24,932,187	($2,219,597)	$163,584,621	$186,916,719
Total All Funds	**$294,464,722**	**$182,144,937**	**$112,319,785**	**$1,136,662,650**	**$1,150,498,172**

Note: CIP timeframe was extended through 2065 during the 2022 study

Changes by fund include:
Water Fund:

- Added $10.3M in Well Redrills
- Added $3.9M in New Wells and Waterlines

Water Resources Fund:

- Added $41.2 M for WISE Infrastructure Desalination Facilities
- Added $6.3 M for WISE Infrastructure Pipeline
- Added $12.1 M for Castle Rock Reservoir No. 2 Construction
- Added $58.8 M for PCWPF expansion
- Added $13.4 M to Plum Creek Pipeline to PCWPF
- Added $8.0 M to Plum Creek to Rueter Hess Reservoir Pipeline and Pump Station
- Added $1.3 M for East Cherry Creek Valley North-South Pipeline capacity

Stormwater Fund:

- Added $8.5M in funding for Stream Stabilization

Wastewater Fund:

- Added $0.5M in funding for the Castle Oaks Lift Station Upgrade
- Moved $2.2M for Kinner Street Bottleneck beyond 2027

Revenue Requirements

A long term financial plan is prepared to project the revenues required for each of CRW's four enterprise funds. The long-term financial plan allows the integration of debt, accumulation/use of reserves, and other assumptions to forecast funding of CRW's water system operations and maintenance (O&M) expenses and capital improvements for each respective enterprise. For each enterprise fund, the financial plan calculates the annual service charge revenue requirements. The projection period developed for each enterprise financial plan was driven by the length of the capital improvement program (CIP) and ends in 2065.

Although the projection period extends to 2065, revenue requirements and capital improvement programs are presented in this report for the 5-year planning period 2023 through 2027 for all four enterprise funds. The estimated 2023 total revenue requirements from rates are shown below in Table 7-4.

Table 7-4

Revenue Requirements From Rates for 2023	
Water	$18.8 Million
Water Resources	$14.5 Million
Wastewater	$12.1 Million
Stormwater	$3.8 Million

Concurrent with the preparation of the proposed rates and fees for 2023, staff has updated the Financial Management Plan (FMP), to ensure the study is consistent with the goals of the FMP. The FMP was completed to assist CRW in achieving the following goals:

- To minimize debt carrying costs at or below industry standards
    - *CRW continues to stay in the top 25% in the industry with the lowest debt. This is positive, but the current financial models do indicate that we will need to take out significant additional debt towards the end of this decade to keep pace with our needs for renewable water supplies and infrastructure. This debt could move us into the median category.*
- To minimize risk by balancing fixed and variable revenues with expenses as appropriate
    - *CRW focuses on keeping these matched to the extent possible while still sending a conservation oriented message with a variable rate.*
- To keep costs at or under budget for capital and operational budgets each year by fund and to continuously strive towards more efficient operations
- To keep our rates and fees competitive with surrounding communities
- To keep adequate reserves and maintain fund balances between minimums and maximums
    - *CRW continues to maintain adequate reserve balances in all funds for operating, catastrophic event, rate revenue stabilization and capital reserve.*
- To keep our rates and fees affordable within various national affordability indices
    - *Last year CRW had Stantec's help in looking at two affordability methods created by Teodoro. The first of these is the Affordability at the 20th Income Percentile (AR20). This method measures the affordability of the average water and wastewater bill to the 20th percentile income. This indicates that of the monthly disposable income for this group, 4.29% is spent on essential water and wastewater usage for CRW assuming the recommended 2023 rates are approved. The average for large cities is 12.4%, which puts CRW well below average, a positive result.*
    - *The second method is the Basic Household Water and Sewer Cost Expressed in Terms of Hours of Labor at Minimum Wage (HM). This metric shows the number of hours required for one to work at minimum wage to pay the monthly water bill. For CRW, the proposed 2023 rates result in an HM value of 8.29 hours. The average for large cities is at 10.1, which puts CRW slightly below average, again a positive result.*
- To develop regional partnerships to provide economies of scale to reduce total costs of infrastructure to our customers
    - *CRW has formed many partnerships with individual water providers like Dominion and Parker and regional organizations such as South Metro Water Supply Authority, WISE Authority, Plum Creek Water Reclamation Authority (PCWRA), and Cherry Creek Project Water Authority (CCPWA), just to name a few.*
- To be an industry leader in the application of financial management benchmarking ourselves against others locally and nationally
    - *Castle Rock Water has thirty different key performance objectives and indicators (KPIs) with measurable outcomes. Many of which are*

benchmarked against other water providers nationally, regionally and locally. More information and results for these KPIs are available in our strategic plan.

Rate Analysis Results

Cost-of-Service Methodology

The basic philosophy behind a cost of service (COS) methodology is that utilities should be self-sustaining enterprises that are adequately financed with rates that are based on sound engineering and economic principles. In addition, rates should be equitable and proportionate to the costs of providing service to a given type of customer.

Once the first four steps are completed, the capital plan is put into the system development fee models along with the projected new single family equivalents that this capital will support. Proposed system development fees from these models are then put into time based financial models otherwise known as the rates and fees models, one for each enterprise fund. These models look at financial data through 2065. For purposes of this year's models, additional debt of approximately $40M was included towards the end of the decade. Castle Rock Water then works to ensure that over the modeling period (out to 2065):

- there are no large rate increases forecasted (greater than 7.5%) to be needed;
- fund balances are maintained within reasonable limits according to upcoming capital needs through 2065;
- Minimum reserves are maintained for all enterprises throughout the study period;
- Debt needed is reasonable with respect to Castle Rock Water's borrowing capacity.

If these conditions are not met, adjustments are made to the capital plan and operating expenses where changes can be made without impacting levels of service to balance these items. Revenue requirements for each enterprise are then determined from the models based on the change in revenue needs for each enterprise according to the forecast capital and operational expenses. Once the total revenue requirements are identified in each enterprise, cost of service models are used to spread those revenue requirements over the different customer classes. The end results are the rates and fees recommendations.

Proposed Rates and Fees for 2023 through 2027

Based on impacts of the revised capital plan and projected system growth by fund as well as the other key changes, the "2022 Study" has resulted in projected required rate revenue increases as shown in Table 7-5 below.

Table 7-5: Rate Required Revenue Increases by Enterprise – 2022 Study

	2023	2024	2025	2026	2027
Water Fund	4.5%	3% to 4.5%	3% to 4.5%	3% to 4.5%	3% to 4.5%
Water Resources	7.5%	3% to 7.5%	3% to 7.5%	3% to 7.5%	3% to 7.5%
Stormwater	4.5%	4.5%	4.5%	4.5%	4.5%
Wastewater	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7-6 summarizes proposed monthly fixed charges for 2023 from this year's study.

Table 7-6: Single Family Residential Monthly Fixed Charges

	2022 Actual Typical Bill	"2022 Study" Proposed 2023 Typical Bill	$ Change	% Change	"2021 Study" Proposed 2023 Typical Bill
Water	$9.54	$9.97	$0.43	4.5%	$9.83
Water Resources	$26.93	$28.95	$2.02	7.5%	$26.93
Wastewater	$8.57	$8.57	$0.0	0.0%	$9.02
Stormwater	$7.30	$7.63	$0.33	4.5%	$7.33
TOTAL	**$52.34**	**$55.12**	**$2.78**	**5.3%**	**$53.11**

System Development Fees

Moreover, is the expectation that growth pays for growth and that system development fees should reflect and support this development model. New customers provide revenues through SDFs to fund growth-related capital projects and the monthly revenues to fund the remaining costs as an existing rate customer. Actual growth in 2021 was strong, however growth has slowed in 2022. Single family home permits issued in 2022 are down forty-two percent from those issued in 2021. Budgets have been adjusted to reflect a lower growth figure, however, if growth falls short of this forecast, revenues are at risk with the severity and service delivery impacts dependent upon the depth of the shortfall. Growth in 2023 and beyond is difficult to predict. As a result, Castle Rock Water uses a conservative approach to estimating future growth. If growth falls short of current forecasts, revenues in 2023 and beyond could fall short of requirements for the current capital plans requiring a delay on some of these projects. Similarly, if growth significantly exceeds current forecasts, capital projects will need to be moved forward. Castle Rock Water uses our water supply and demand model to evaluate the pace of growth as it relates to our capital improvement plans to ensure that we have the ability to react to changes in actual growth relative to the projected growth.

SDFs for Water Fund

On an annual basis, Castle Rock Water conducts a comprehensive rates and fees study for water, water resources, wastewater, and stormwater. The purpose of this study is to provide CRW with a comprehensive and updated review of its System Development Fees (SDFs) and the underlying assumptions that are used to calculate the 2023-2027 fees.

Methodology

For calculating SDFs there are two commonly accepted methodologies. They are the equity buy-in approach and the incremental cost (or improvement) approach. A third approach that is also acknowledged by the American Water Works Association (AWWA) and the Water Environment Federation (WEF) is the combined or hybrid approach. This hybrid method is used to calculate CRW's water, water resources and wastewater SDFs, which is summarized below.

For stormwater, the incremental cost approach is used to identify remaining capacity to serve growth. It is assumed that CRW's existing infrastructure and improvements have no available capacity for new development and capital improvements are available to provide runoff capacity for new customers.

Equity Buy-In Approach
The equity buy-in approach is most appropriate in situations where new customers can be served by the existing system. Under this method, new customers pay a proportionate share of the value of the existing infrastructure. The AWWA recommends that the equity method is best used within systems that have adequate capacity to serve both existing and future customers without major system expansions.

Incremental Cost (Improvement) Approach
The incremental cost approach is most appropriate when the existing system is at or near its maximum capacity and new customers cannot be served without significant investment in infrastructure. Under the incremental cost approach, new customers pay a proportionate share of the expansion related costs of the new infrastructure. The SDF is calculated using the capital improvement plans (CIPs) developed in CRW's master planning process.

Combined Approach
The combined approach can be the most appropriate approach because new customers tend to use capacity available in the existing infrastructure (buy-in), as well as new capacity that the utility must build in order to accommodate growth and the additional units to be served (incremental cost). This method best conforms to "growth pays for growth" policies, which is also CRW's policy.

With the combined approach, the equity method and incremental cost method are essentially combined so that new customers of the utility pay for their share of the existing system equity, as well as their share of the capacity expansion costs. The equity portion of the connection fee is called the buy-in component and the incremental cost portion of the fee is referred to as the improvement component.

The combined approach as follows for water, water resources and wastewater SDFs complies with the criteria for impact fees required in the Colorado Revised Statutes (CRS) 29-20-104.5. This statute requires that SDFs and impact fees are:

- Legislatively adopted
- Applied to a broad class of property
- Recover the costs imposed by proposed development

The incremental cost approach for the stormwater development impact fees also complies with CRS 29-20-104.5.

Capacity Definitions
Defining capacity in both the existing infrastructure and new capital improvements is a critical step in determining SDFs. Moreover, defining capacity required by a single-family equivalent user is required for each of the SDFs and the stormwater development impact fee. For CRW, the following assumptions on capacity definitions apply:

- A single-family equivalent (SFE) is a measure of the amount of water/wastewater flow required to meet potential demand of a single-family detached residence.
- For the water and water resources systems, one SFE is assumed to require 400 gallons per day (GPD).
- For the wastewater systems, one SFE is assumed to require 220 GPD of flow capacity.
- For stormwater capacity, one SFE equals 3,255 square feet (sq. ft.) of impervious area.

Equivalency Schedule

There are two different types of equivalency schedules. The first is the hydraulic capacity method in which is based on the relative capacity of different meter sizes and meter types utilized to deliver water. These can also be based on the relative potential demands of different customers. Based on the characteristic hydraulic demands, a single family meter size of ¾" is designated as the base for one SFE. The maximum flow rate of water through the meter in gallons per minute (gpm) becomes the unit of comparison. The maximum flow rate demanded by new customers is compared to the base demand in order to determine the equivalency ratio. For example, if the base single family residential customer requires 30 gpm and a commercial customer requires 200 gpm, the equivalency ratio equals 6.67.

The second method is the actual use equivalency schedule, which is based on the relative average monthly water usage of CRW's customers. Average monthly use per account by meter size was calculated using a 2014 to 2016 three-year average of monthly consumption data from the customer characteristics memo. The average usage of a single family residential meter size is designated as the base. The average usage of larger meter sizes is divided by the base usage to calculate equivalent ratios. The actual use equivalency schedule is what was used to calculate the SFEs for the water, water resources and wastewater SDFs. These ratios are shown in Table 7-7 below.

Table 7-7 Calculated Meter Equivalency Ratios

Meter Size	Max Flow Rate (GPM)	Equivalent Meter Ratios
5/8" x ¾"	20	0.67
¾"	30	1.00
1"	50	4.40
1.5"	100	9.32
2" C2	200	11.20
2" T2	250	18.31
3" C2	500	18.28
3" T2	650	34.96
4" C2	1,000	132.76
4" T2	1,250	98.20
6" C2	2,000	110.49

System development fees (SDFs) are a function of year-end 2021 fixed assets, 2022 year-end estimates of capital improvement project costs, 2023 through 2065 capital improvement project plans, and system capacity for water, water resources, and wastewater and developable acres for stormwater.

Growth forecasts and increases to the capital plans in the "2022 Study" indicate that total SDFs for a typical SFE will need to increase from the 2022 adopted fees. The "2022 Study" indicates fees will need to increase in 2023. The recommended increase this year is approximately 13.3% as shown in Table 7-8.

Table 7-8: Single Family Equivalent System Development Fee Comparison

PLUM CREEK BASIN

	2022 Actual Fees	"2022 Study" Proposed 2023 Fees	$ Increase (Decrease)	% Change	"2021 Study" Proposed 2023 Fees
Water	$5,700	$6,270	$570	10.0%	$5,700
Water Resources	$26,458	$30,383	$3,925	15.0%	$26,458
Wastewater	$4,909	$5,400	$491	10.0%	$4,909
Stormwater	$2,128	$2,339	$211	10.0%	$2,128
TOTAL	**$39,195**	**$44,392**	**$5,197**	**13.3%**	**$39,195**

CHERRY CREEK BASIN

	2022 Actual Fees	"2022 Study" Proposed 2023 Fees	$ Increase (Decrease)	% Change	"2021 Study" Proposed 2023 Fees
Water	$5,700	$6,270	$570	10.0%	$5,700
Water Resources	$26,458	$30,383	$3,925	15.0%	$26,458
Wastewater	$4,909	$5,400	$491	10.0%	$4,909
Stormwater	$1,116	$1,228	$112	10.0%	$1,116
TOTAL	**$38,183**	**$42,281**	**$5,098**	**13.4%**	**$38,183**

Uses of Funds

The financial plans allow the integration of debt, accumulation/use of reserves, and other assumptions to finance the Town's utility system operations and maintenance (O&M) expenses and capital improvements for each respective utility. Using ratemaking terms, the financial plan calculates for each utility fund the annual user charge revenue requirements. These are based on the cost of providing utility service. The projection period developed for each utility financial plan was driven by the length of the Capital Improvement Program (CIP). The projection period for the water fund is 53 years, from fiscal year 2022 through fiscal year 2065. In the CRW 2022

report, revenue requirements and capital improvement programs are presented only for the 2023 through 2027 study period.

Uses of funds include all expenditures, either operating or capital and any reserve requirement or increase in fund balance CRW plans to achieve. The major assumptions for uses of funds are as follows.

- Operating Expenses – For the water fund most operating costs are fixed; meaning not varying based on the volume of water sold; with the exception of energy, treatment chemicals and certain other supplies, which vary with production.
- Personnel Services – CRW reviews full time equivalent (FTE) needs each year to determine how many new FTEs are projected over the budget period and includes these into the expense projections. The total projected FTEs for all four enterprise funds for the five-year period is 13 new FTEs.
- Supplies – The supplies for the water fund are expected to remain consistent over the five-year study period at about $2.0 million a year.
- Energy Costs – Over the five-year study period these are expected to increase at an average rate of approximately 3%.
- Capital Improvements – Total water system capital improvement costs from 2023-2027 are expected to be $54.5 million in today's dollars. Only improvements and replacements that provide benefits to existing customers are included in revenue requirements. Improvements to serve growth are funded from SDFs.
- Inter-Fund Loans – The water fund does not have an Inter-Fund loan balance that it is paying on at this time as an expense.
- Transfers Out – These include the costs for the vehicle replacement fund which is transferred to the fleet department for about $2.1 million over the five-year period.
- Fund Balances – When fund balances are drawn down from initial balances, the use of those funds is a source of funding to cover water fund expenses. When it is building the fund balance it is a use of funds as cash is added to the water operating fund. These are projected to be kept at an acceptable level of working capital, which is a minimum of 60 days O&M in the operating reserve. This also conforms to the FMP goal to keep adequate reserves and maintain fund balances between minimums and maximums.
- Debt Service – The water fund currently has two outstanding revenue bond issues (2012 and 2015). The 2012 bond issue was a refinancing of 2003 and 2004 bonds and the 2015 bond issue was a refinancing of 2006 bonds. The water fund debt service amounts to approximately $1.7 million in 2023 and then drops down to approximately $687K through 2026.
- Debt Service Coverage – The debt service coverage ratio in the model is set to 1.2 times the total annual debt service amount, which is about $1.3 million. This is a bond covenant requirement.

Revenues and Expenditures Forecast Updates

As in previous year, complete revenue and expenditure forecast updates were prepared along with the budgeting process. Assuming the recommended rates are approved, the combined 2023 revenue budget for the department is $82 million and represents a 26% decrease from the 2022 budget, and a 38% decrease from the 2022 year-end estimates. These decreases are largely driven by the $30 million bond in Water Resources. When comparing 2023 to 2022, without the $30 million in bond revenue, the 2023 budget is up 1% compared to the 2022 budget

and down 20% to the 2022 year-end estimates. These revenue numbers are also being impacted by the reduced revenues projected for SDFs as a result of the proposed changes to the landscape and irrigation criteria (i.e. the 47% reduction in SDF revenue).

The combined 2023 expenditure budget associated with the major functions for the various CRW enterprises is approximately $128 million, a decrease of 14% from the 2022 amended budget and an increase of 35% over the 2022 year-end estimate. These changes are due to large changes in proposed capital spending in 2023 relative to 2022, primarily driven by the fact that many of the projects originally planned for 2022 are carrying over to 2023. Capital budgeting is variable based on long-term project planning and opportunity.

With respect to the operational budgets, the total combined budget for 2023 is approximately $49.1 million. This is a 3% increase to the 2022 Amended Budget and a 15% increase over the 2022 year-end estimate. The increase over the 2022 year-end estimate is due to increases in debt costs as the new water resources loan begins to be paid back, increases in personnel costs, increases in the amount of WISE water that will be taken as WISE ramps up towards full deliveries, increases in energy costs (i.e. CORE is going up 6% across the board for energy), and increased costs for supplies partly as a response to supply chain deficiencies and also cost impact to suppliers. CRW is also requesting five new positions: a Stormwater Inspector, a Water Efficiency Technician, a Collection System Operator, an Office Assistant, and a SCADA Instrument Technician.

The 2023 capital budget across the CRW enterprises is approximately $78.9 million, a 22% decrease over the 2022 Amended Budget and a 52% increase over the 2022 year-end estimates. Revenue and expense forecasts were completed through 2027 and then escalated in the model for years past 2027.

Fund Balances

Based on the revenue and expense forecasts, fund balances are reviewed through 2027 closely and more generally through the entire modeling period out to 2065. Savings in actual costs and the timing of spending on capital costs verses budgets each year have helped to keep fund balances stable throughout the years and projections through 2027 continue this trend except that in 2026 to 2030 timeframe a significant debt issuance is predicted in the Water Resources Enterprise to keep fund balances above minimum levels. Fund balances need to be built up with capital reserves ahead of large capital projects to ensure the money is available to proceed on the projects when the projects are needed to meet growth and other service goals. Fund balances are then drawn down significantly as capital reserves are spent on these projects. Keeping close tabs on the fund balances ensures that there are no negative impacts on the long term financial plan when large projects must be funded.

Fund balance for the Water Fund is projected to dip below average values of $17M through 2026 and then recover in 2027 to above average levels. In the Water Resources Fund, values have increased, partially due to the $30M debt issuance in 2022. Fund balances will remain high and funding is maintained for critical near-term projects. Current modeling indicates that debt issuance may be needed near the end of the five-year planning window to meet full capital needs. Stormwater Fund balance hit a value at the end of 2021 of around $13M and then is

projected to fall to $3.4M by year-end 2027. Wastewater Fund balance increased to around $22M at year-end 2021. The balance will continue to grow in the near-term ahead of large capital requirements in the 2030's.

Rate Revenue

While fixed revenues in the four enterprise fund models are set to generally trend up with the projected growth, variable revenues can be difficult to predict. These variable revenues are subject to two primary drivers, 1) weather and 2) national, state and local pressure to conserve water or at least use it more efficiently. For the 5-year planning period, CRW is forecasting annual increases of about 7% per year through 2027. For new houses and new development, rate revenue is projected to be less than previous estimates due to the proposed changes to landscape and irrigation criteria. As always, Castle Rock Water is aware of the need to be cautious when projecting rate revenues due to the unpredictability of weather, conservation efforts and sustainable growth.

Non-Rate Revenues

Non-rate revenues are generated through charges and fees for miscellaneous or ancillary services not accessed or used by the broader customer base. These special charges should recover the actual cost of service delivery consistent with cost-of-service principles and Town financial policies. Recovering costs directly from customers that access those services also enhances equity. These charges can also help manage demand for those services as well as address customer behavior patterns. In these cases, Caste Rock Water may set a special charge above the cost of service. Two examples of this include the Residential Landscape and Irrigation Inspection Fee and Meter Set Inspection Fees. Castle Rock Water was having issues with home builders failing these inspections multiple times which created resource issues for the department. As such, these fees were set to escalate after each failed inspection starting in 2022. Other special charges include late charges, disconnection charges, service transfer charges and administrative related fees, just to name a few.

Personnel

The 2023 budget includes five new full time equivalents (FTEs). These include a Stormwater Inspector, a Water Efficiency Technician, a Collection System Operator, an Office Assistant, and a SCADA Instrumentation Technician. From 2024 to 2027, Castle Rock Water is projecting to add eight FTEs, including a Customer Service Representative, a Plant Mechanic, and a Field Services Operator in 2024; a Lab Supervisor and a Plant Mechanic in 2025; a Field Services Operator in 2026; a Water Quality Technician and Field Service Operator in 2027. The Study reflects updated personnel cost allocations across the four enterprises to capture cost-of-service impacts on personnel resources, as well as Town-wide changes to the pay and benefits plans. After 2027, costs for personnel are escalated by 1.55% which is consistent with the long-term historical average CPI.

Electricity

The third largest operating cost, electricity, reflects full operation of the Plum Creek Water Purification Facility and other treatment plants, alluvial and groundwater well operations and pumping associated with water and wastewater service. Castle Rock Water has implemented an energy management and system optimization plan to maximize the efficiency of electrical usage. CORE, Castle Rock Water's electricity provider, increased rates in August 2022 by 6%. Electricity costs in 2023 have been adjusted to account for this mid-year increase and rates for the remainder of the five-year period assume an annual increase of 3%. After 2027, electricity costs are escalated by 1.55% consistent with the long-term historical average CPI.

Operations & Maintenance

Cost projections include operating and maintenance costs for CRW. Items impacting operating costs during the five-year planning period include:

- Meter costs under supplies are going up significantly as we transition to advanced metering infrastructure
- Operating costs for WISE will continue to increase as the full quota of Castle Rock's WISE water is delivered with that occurring in 2026
- Personnel costs have risen significantly in response to staffing shortages and competition for labor across the region with Castle Rock Water and the Town as a whole taking action on this issue in 2022
- CORE has increased rates for electricity by 6% across the board
- Stormwater is adding significant operational costs associated with a program for the inspection of aging corrugated metal stormwater pipes

This results in increases of 37% over the five-year period. To ensure only costs needed are included in the budget, line item details are reviewed. After 2027, operations and maintenance costs in the model are increased by 1.55% consistent with the long-term historical average CPI.

Utilization of Rates and Fees

Figure 7.1 summarizes how revenues are used by Castle Rock Water.

From this figure it is clear that the Capital Project Plan is a very significant portion of the rates and fees needed for operation of the funds. The infrastructure intensive nature of the business results in significant fixed costs. Castle Rock Water wants to continue to implement a strategy, to the extent possible within our cost-of-service model, which matches fixed revenues with fixed costs to ensure revenue stability thereby minimizing the potential for future rate shocks. This strategy also takes into account the need to incentivize water conservation and efficiency through variable rates for water use.

Figure 7.1
2021 Costs by Function

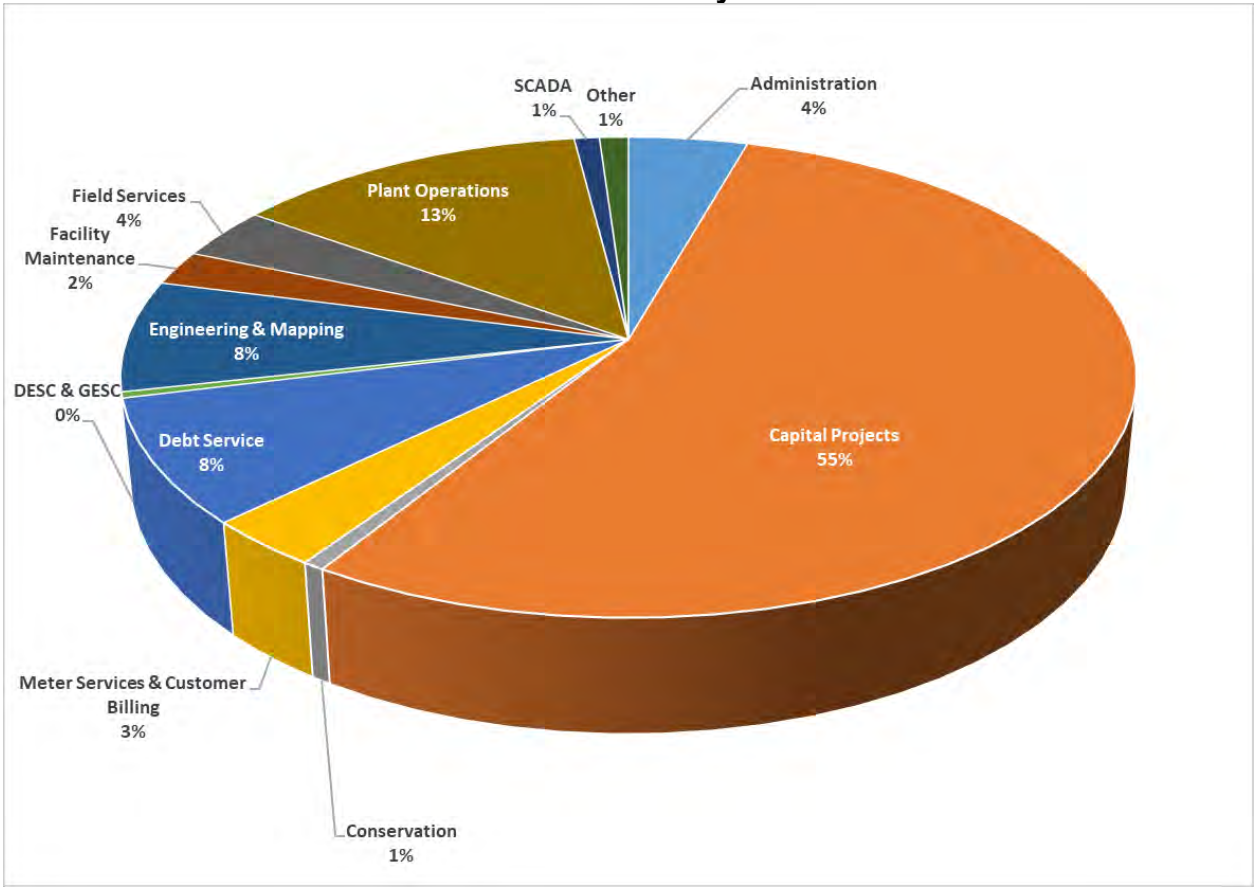
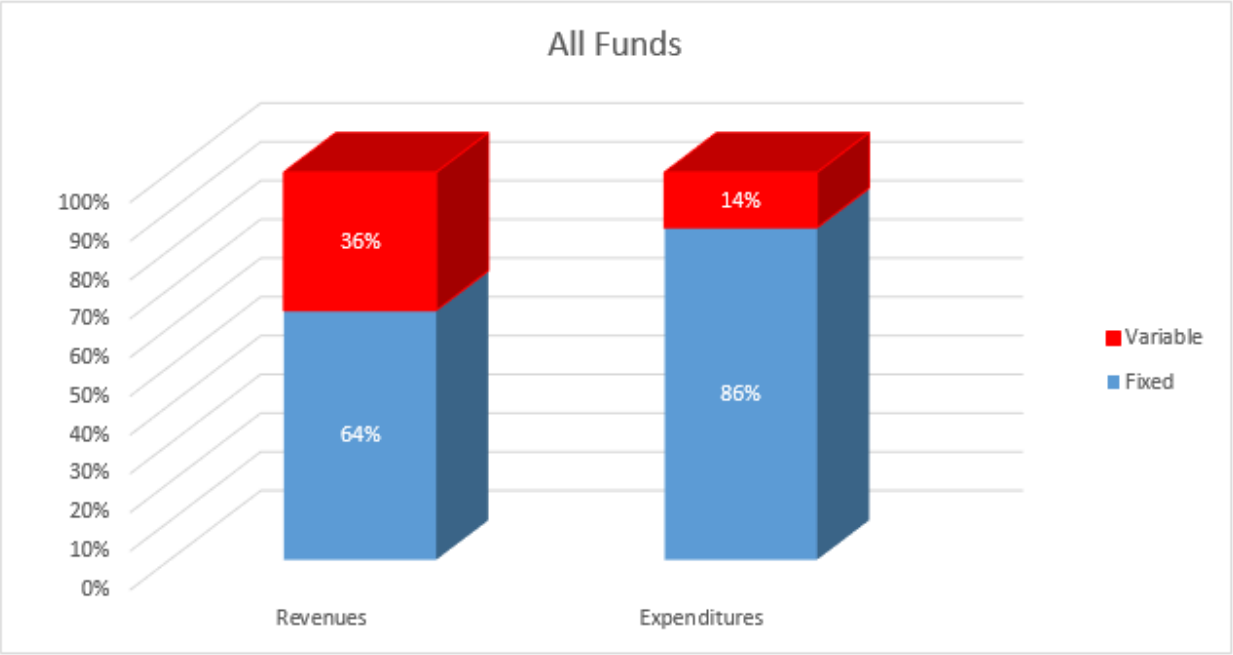


Figure 7.1 shows the breakdown between fixed and variable revenues and expenses for the fiscal year ending 2021. Variable revenues account for 36% of total revenue, with metered water sales being the largest components. The majority of expenditures for CRW are fixed in nature with the largest operational cost being personnel costs.

Figure 7.2
Fixed Versus Variable Revenues & Expenditures



Castle Rock Water compared the 2023 proposed rates and fees with other similar water providers in the South Metro area. Many of the water providers do not provide stormwater services, so we show these separately for accurate comparison purposes. The benchmarking comparisons include all fees related to water, water resources, and wastewater services. These fees have different names across the various water providers including for example water and sewer service fixed and volumetric fees, water resource fees, renewable water fees, capital improvement fees, sewer system replacement fund fees, and groundwater protection fees. The results of this comparison show that CRW remains consistently in the middle of the pack for rates and fees, and is slightly higher than the middle for SDFs.

Community Engagement

For consistency and transparency, there is continual messaging on rates and fees to customers year-round via standard methods including email, newsletter, website and social media. Messaging about rates and fees typically includes information on the annual rates and fees study, how the funds are utilized and that Castle Rock Water is a cost of service entity. Additionally, customers are always notified of rate changes when Town Council approves them and again in January when they go into effect. For the new 2023 rates, notice was placed in the Your Town Talk and in the monthly email.

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