Wastewater Master Plan

2022

Engineering Division

Table of Contents

List of Figures

List of Tables

Acknowledgments

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Definitions and Acronyms

Btu	British Thermal Unit
CCBWQA	Cherry Creek Basin Water Quality Authority
CCTV	Closed Circuit Televising
CDPHE	Colorado Department of Public Health and Environment
CECs	Contaminants of Emerging Concern
CIRSA	Colorado Insurance Risk Sharing Agency
CIP	Capital Improvement Project
CMOM	Capacity, Management, Operations, and Maintenance
COS	Cost of Service
COF	Consequence of Failure
CRW	Castle Rock Water
DOC	Dissolved Organic Carbon
DoIT	Division of Innovation and Technology
DWSD	Dominion Water and Sanitation District
EPA	Environmental Protection Agency
FOG	Fats, oils and grease
FTE	Full-time Equivalent
GASB34	Governmental Accounting Standards Board Statement 34
GIS	Geographic Information System
GPD	Gallons per Day
GPM	Gallons per Minute
I/I	Infiltration and Inflow
in	Inch
IGA	Intergovernmental Agreement
Kgal	Kilo (1,000) gallons
KBtu	Kilo (1,000) Btus
KPI	Key Performance Indicator
Lf, LF	Linear Feet
LOF	Likelihood of Failure
LS	Lift Station
mg	milligram
mg/L	milligrams/liter
MG	Million Gallons
Mgd	Million gallons per Day
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NASSCO	North American Society of Sewer Service Companies
O&M	Operation and Maintenance
OWTS	Onsite Wastewater Treatment Systems (septic systems)
PACP	Pipeline Assessment Certification Program
PCWRA	Plum Creek Water Reclamation Authority
PFAS	polyfluoroalkyl substances
PMP	Pavement Maintenance Program
PS	Pump Station
PWSD	Parker Water and Sanitation District
PWWD	Pinery Water and Wastewater District
PVC	Polyvinyl Chloride, a common pipe Material

QMRA	Quantitative Microbial Risk Assessment
RCNLD	Replacement Cost New Less Depreciation
SCADA	Supervisory Control and Data Acquisition
SDFs	System Development Fees
SewerCad	Sanitary Sewer System Model Software
SF	Square Foot
SFE	Single Family Equivalent
SSO	Sanitary Sewer Overflows
SWPP	Source Water Protection Plan
TDS	Total Dissolved Solids
TM	Technical Memorandum
TOC	Total Organic Carbon
Town	Town of Castle Rock
UP	Utility Plan
USEPA	United States Environmental Protection Agency
WW	Wastewater
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

Executive Summary

The Town is a growing community. As of early 2022, the Town of Castle Rock wastewater collection system, which serves a population of nearly 80,000, has more than 10,300 sanitary sewer manholes, is over 314 miles in total length and transports on average about 4.5 million gallons of wastewater each day to either the Plum Creek Water Reclamation Authority (PCWRA) or the Pinery Wastewater Treatment Facility. At an estimated build out population, the collection system could serve as many as 155,000 residents. At peak times, wastewater flow to be conveyed to the PCWRA or the Pinery for treatment via interceptors could more than double at future build-out conditions to a projected 10.6 million gallons per day (Mgd). The 2022 Wastewater Master Plan (WWMP) update highlights critical findings and recommendations resulting from a reassessment of wastewater program needs for the Town of Castle Rock.

This 2022 update builds on the previous master planning efforts and was completed with the following goals in mind:

- Identify collection system deficiencies and/or future facility requirements.
- Develop tools to update the plan as growth conditions change or new development occurs.
- Develop a capital plan for recommended and required projects that balances infrastructure requirements with fiscal responsibility.
- Develop preliminary cost estimates as a basis for input into the annual rates and fee analysis, which analyzes future requirements out to the year 2065
- Identify projects to be included in the 5-year capital plan budget
- Identify infrastructure that may be needed to be built or upsized by developers as growth occurs in currently undeveloped or underdeveloped areas.
- Identify and implement projects to ensure that all reusable wastewater resources are captured and/or treated and otherwise are beneficially reused.

The following principles serve as the base for the Town's wastewater 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 Wastewater Enterprise Fund as a Business, Balancing Revenue and Expenses**
- **Principle 5: Provide for Effective Long-term Operation and Maintenance of Collection System Facilities**
- **Principle 6: Ensure Wastewater Planning is Consistent with, and Considered Part of, a Fully Integrated Total Water Management Approach**

- **<u>Principle 7</u>: Identify and Implement Changes to the Wastewater System Which Will Improve Long Term Sustainability Through Resource Recovery and Net-Zero Energy Use**

Castle Rock Water employs a cost of service (COS) methodology to ensure the Wastewater program is a self-sustaining enterprise, adequately financed with rates that are based on sound engineering and economic principles. Moreover, rates should be equitable and proportionate to the costs of providing service to a given type of customer. Further, there is an expectation that growth pays for growth and that system development fees and developer infrastructure requirements should reflect and support this development model.

Part of the 2022 Plan update was to revisit the capital plan and the cost estimates used. Annually, Castle Rock Water does a rate study and revises the COS model in order to recommend changes, if any, to the fee schedule. In the 2010 Wastewater Master Plan, the overall, long-term capital plan totaled just under $80 Million; for the 2016 update, that total was just over $80 Million. In this 2022 update, the overall long-term capital plan total is estimated at $200.2 Million through the year 2065. The significant increase in the future long term capital budget has been primarily influenced by two factors: the potential for a future expansion of the Plum Creek Water Reclamation facility if the population served exceeds 105,000; and an updated future focused effort on sewer rehabilitation to ensure long term collection system integrity. 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 primarily affect new development, and support the policy that growth pays for growth. Increases in wastewater user charges reflect operations and maintenance costs and the costs of capital rehabilitation and replacement, while increases in volumetric rate fees affect those who may not use water wisely or do not practice conservation within the household.

1. Introduction

This 2022 Wastewater Master Plan (WWMP) update highlights critical findings and recommendations resulting from a reassessment of wastewater program needs for the Town of Castle Rock. In 2003, the Town prepared a Wastewater Master Plan that examined the existing wastewater system infrastructure and identified new wastewater program requirements, as well as capital improvement projects required to provide service to existing residents and to address future development through expected build out of the Town. In 2010, the Wastewater Master Plan was updated; the hydraulic modeling was updated to reflect changes in infrastructure and revisions to growth projections. That update was designed to be used as a companion document to the original 2003 WWMP. Similarly, the 2016 revision built on the previous master planning efforts but was also a standalone document.

This 2022 Wastewater Master Plan follows a similar approach as the 2016 update. The capital master plan was reevaluated out to the year 2065 and reflects changes in expected ultimate buildout population and attempts to plan for appropriate timelines for certain projects. Modeling results in support of this master planning effort for the most part have reconfirmed the capital improvement projects needed and most were identified in previous master plans. Key Performance Indicators (KPIs) for the wastewater function that are tracked include the Sanitary Sewer Overflow (SSO) rate, the Operational Cost per average daily wastewater flow, and the Millions Gallons Per Day (Mgd) processed per employee. These KPIs are evaluated quarterly and are benchmarked against other utilities using American Water Works Association (AWWA) utility criteria. Each KPI is discussed in more detail in later sections. The KPIs are used internally to gauge how well Castle Rock Water is continuing to meet or exceed its goals of being in the top quartile nationally when compared to our peers. In addition, CRW participates in the annual AWWA Benchmarking Survey which evaluates our performance relative to some of the best utilities in the country in over 150 plus statistics. Some of these parameters have also informed our planning in this update, e.g., system renewal/replacement funding.

The 2010 wastewater master plan update was developed with the following goals in mind:

- Analyze the Town's existing wastewater collection system for existing and future growth conditions in order to identify collection system deficiencies and/or future facility requirements.
- Develop tools and a hydraulic model that staff could use to update the plan as growth conditions changed or new development occurred.
- Develop a plan for phased implementation of recommended projects that balanced infrastructure requirements with fiscal responsibility and requirements.
- Develop cost estimates for both capital improvement projects and operation and maintenance programs as a basis for input into the annual rates and fee analyses.

The 2010 plan built on several previous planning efforts including the 1998 Sanitary Sewer Facility Plan by HDR Engineering, the 2003 Wastewater and Reclaimed Water Master Plan by CH2M Hill, and sanitary sewer system modeling performed by URS and CH2M Hill, to provide guidance for the wastewater program into the future. The 2010 plan update considered changes to the wastewater program as a result of substantial reductions in the Town's growth rate. Similarly, due to rapid growth that occurred from 2011 to 2015, for the 2016 update it was important to revisit the growth plan, the hydraulic model, the capital plan, including cost estimates, and also the impacts to rates and fees. Each year, Castle Rock Water revisits the capital plan, reviews and revises cost estimates, and completes a rates and fees study to fully plan for future financial obligations and to ensure that growth pays for growth. The 2022 update will reflect that the long term buildout population of Castle Rock is anticipated to be higher than the 2010 and 2016 plans accounted for. The most significant outcome is that a future expansion of the wastewater treatment facilities most likely will be needed, and there is a significant future cost associated with that need. That future cost is reflected in the significant increase in the overall capital plan funding estimate, and captured in increases to the wastewater system development fees that future homebuilders will pay for municipal wastewater service.

The Town is a growing community, and this continued growth creates increased wastewater flows that must be accommodated. Additionally, system components are deteriorating from age and use which results in the need for infrastructure rehabilitation or replacement. In fact, many collection system components, particularly in the Downtown area, predate the 1940's. Wastewater improvements are required to replace undersized pipes, rehabilitate aging infrastructure, provide collection for new developments, respond to regulatory requirements, and accommodate additional treatment capacity. At an estimated build out population, the collection system could serve as many as 155,000 residents. At peak times, Wastewater flow to be conveyed to the Plum Creek Water Reclamation Authority (PCWRA) for treatment via interceptors could more than double current flows at future build-out conditions. Infrastructure must be sized to accommodate local and/or system wide peak conditions, which can be influenced by infiltration and inflow (I/I). Minimizing I/I throughout the collection system by collection system rehabilitation can potentially reduce the need for future capital investment.

Currently the Town of Castle Rock wastewater collection system, which serves a population of nearly 80,000, has more than 10,300 sanitary sewer manholes, is over 314 miles in total length and transports on average in excess of 4.5 million gallons of wastewater each day to the PCWRA and the Pinery wastewater treatment facilities. Over the course of the last twenty years, much emphasis was placed on building infrastructure and expanding facilities to meet population growth and future demands. However, with an aging infrastructure, future priorities will most likely shift more towards rehabilitation and/or replacement of aged or undersized wastewater collection system components. Additionally, expansions and upgrades at the PCWRA may have to be undertaken to provide for additional treatment capacity, to potentially meet changing

regulatory requirements, ensure best quality effluent for current and future reusable and renewable water supplies, recover and reuse resources in the wastewater and move towards net zero energy use for the system as a whole.

The 2016 Wastewater Master Plan update was completed with the following principles in mind, which still hold true for this 2022 update, but include one addition:

➢ Principle 1 – Protect People, Property and the Environment

Community wastewater systems have been around for a long time, primarily developing from recognition by public health officials that many infectious diseases were caused by drinking water supplies contaminated by wastewater that was 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 federal Clean Water Act created discharge standards for wastewater treatment facilities. Municipalities further recognized the benefit of keeping wastewater separate from stormwater, and created separate collections systems. Now, as it becomes clear that wastewater is and will be an important source for future drinking water supplies and contains other valuable resources (energy and phosphorus, for example), collection, treatment and resource recovery have become even more critical. In line with the principle of protecting people, property and the environment, Castle Rock Water has implemented projects and programs to ensure we are good stewards.

- ***Sewer Rehabilitation Program*** - A sanitary sewer overflow (SSO) occurs when wastewater escapes the collection system; generally, either by a system failure (break/leak) or a line blockage. To minimize system failures and blockages, Castle Rock Water operations crews operate year round to clean and video inspect sewer mains. The Engineering group addresses system deficiencies by contracting for repair/replacement or lining of deteriorated sewer mains as part of the Sewer Rehabilitation Program. Castle Rock Water tracks SSOs over the course of the year to calculate an annual SSO rate that is compared to national rates as a key benchmark. The goal is to minimize or eliminate overflows at a level that keeps us in the top quartile nationally each year. In 2013 Castle Rock Water invested in a CCTV inspection truck and software program, and an additional crew person, with the goal of increasing the percentage of the system that can be inspected yearly, with a target goal of 20-33 percent each year. Previously, about 5 percent per year was being inspected. Targeted inspection of older areas of town, and areas that are on the planning horizon for pavement rehabilitation, is a key component of the sewer rehabilitation program. In 2022, operations staff incorporated a new cutting edge technology, completing a system-wide acoustic survey of the collection system intended to find potential blockages,

whether the blockages were from roots, grease, or sewer plugs unintentionally left behind, all which can lead to sewer overflows.

- ***Manage Infiltration/Inflow*** - Another key programmatic goal of Castle Rock Water is to keep inflow and infiltration (I/I) at levels that ensure the sewers do not become surcharged during wet weather events. Surcharged sewer mains can back up into houses, causing property damage, mental distress, and legal claims. Surcharged sewers can also overtop manholes, creating an SSO, where the wastewater then has the potential to reach and contaminate water bearing creeks and streams that are themselves a water source for Castle Rock and downstream entities. In this respect, managing I/I and SSOs are also source water protection measures. An essential component of minimizing I/I is good construction methods when new sewer systems are being constructed. Public Works inspectors ensure new mains are properly constructed and tested prior to use, and that builders are using best management practices to keep stormwater out of incomplete sewers under construction. Aging sewer mains, often more susceptible to I/I, can be relined to reduce I/I that can enter sewer mains at old or defective pipe joints, again highlighting the importance of the sewer inspection and repair programs. Since 2010 CRW has lined over 31,000 linear feet of sewer mains. Extreme precipitation events can significantly increase I/I. Proper design of sewer system collection and treatment facilities allocates some reserve capacity to I/I as a safety factor, but good design ensures manholes are out of stormwater flow paths; good construction ensures pipes and manholes are water-tight and above grade. A particularly detrimental effect of I/I is that it can hydraulically overload the wastewater treatment facility, contributing to inefficient treatment, and potentially requiring costly capital expansion to handle peak loads. Another effort to reduce I/I is the CRW policy of replacing sewer laterals to the edge of the right of way during major waterline or sewer line rehab projects. Examples include the Glovers Waterline Replacement projects in 2021 and 2022. Old sewer laterals, particularly old clay laterals, are suspected as causal to significant infiltration sources during prolonged wet periods. Additionally, the utility hopes to avoid major street cuts to newly paved roads by homeowners who need to replace failing sewer lines.

- ***Capacity Modeling*** – Fundamental to good planning and system operation is maintaining a complete and calibrated hydraulic model of the collection system. The model was fully developed for the 2010 master planning effort, and has been updated to incorporate new infrastructure and increased wastewater demands. By keeping the model up to date, Castle Rock Water can proactively plan for capital replacement and upsizing projects. Predictive modeling, coupled with in-the-field flow monitoring, helps ensure that adequately sized sewer mains are constructed in time to avoid capacity issues and surcharged mains and manholes. Staff utilize the hydraulic model to ensure new development is not exceeding the capacity of existing or planned downstream collection components; if such is the case, new

development must then plan and construct sufficient capacity. From a fiscal standpoint, this helps ensure growth pays for growth. Examples of developer driven capacity expansion would be the previously completed upsize of about 1,900 linear feet (lf) of 12-inch sewer to 15-inch along the Crystal Valley Loop Road, the future upsize of the Oman Street Interceptor, and the future expansion of the Dawson Trails interceptor.

- ***Planning and Coordination*** – Castle Rock Water coordinates sewer rehab projects with the Public Works Department and the Parks and Recreation Department and/or developer projects to avoid unnecessary pavement street cuts and to demonstrate fiscal responsibility. Developers are often required to construct upsized infrastructure to support their planned development, or contribute their calculated cost share of recent or future upgrades to the wastewater fund.

- ***Source Water Protection*** – Castle Rock Water considers and plans for the most cost effective way to handle water treatment plant solids from discharging into the collection system, giving due consideration to the PCWRA discharge permit, best available technologies at a reasonable cost, and being protective of wastewater as a renewable resource. Currently, water treatment plant solids, excepting the Plum Creek Water Purification Facility (PCWPF), are discharged to the sanitary sewer for treatment at the PCWRA. Due to changing discharge regulations in the future, Castle Rock Water may have to plan for residuals management at the other water treatment plants instead of discharge. Other Castle Rock Water programs that contribute to source water protection include the MS4 (Municipal Separate Storm Sewer System) program managed by the Stormwater Division, which includes erosion control management, an annual creek clean-up day, and other best management practices. Similarly, the industrial pretreatment program and fats, oil and grease (FOG) program managed by the PCWRA help eliminate potentially harmful or detrimental discharges to the collections system that could interfere with future reclamation and reuse of the effluent.

- ***Odor Control*** - While odor issues may not have health implications for the public, they can contribute to quality-of-life issues. Also, lack of control of hydrogen sulfide (H2S, the principle component of wastewater gas emissions; very odorous and offensive) can lead to corrosion and premature deterioration of collection system infrastructure, resulting in costly repairs. Hydrogen sulfide is also a hazardous gas, lethal at certain exposure limits, particularly in confined spaces, so it is a safety hazard for operations staff. Castle Rock Water employs chemical addition and aeration at most of the Town's lift stations to reduce the odor producing potential of the wastewater, and also has several facilities dedicated to odor control using active and/or passive treatment methods. Improving odor control and making it more efficient are key focuses in this plan going forward.

- ***Wastewater Treatment*** – While Castle Rock Water performs the day-to-day functions of wastewater collection and conveyance, wastewater treatment is performed by two plants, Plum Creek Water Reclamation Authority (PCWRA) and the Pinery, that serve the Town. The Pinery treats flows that generate in the Cobblestone Ranch neighborhood, and also serves the Macanta (previously known as Canyons South) development. All other wastewater flows in Town are conveyed to the PCWRA. Over 100 years ago, wastewater treatment was promoted as a way to protect public health. Beginning in the early 1970s, treatment goals evolved to focus not just on public health, but on the aesthetics and environmental concerns in order to achieve more effective and widespread treatment in an effort to improve the quality of surface waters. In the 1980s, additional treatment focus was placed on removing compounds with the potential for long-term health effects. Increasingly, treatment is moving towards more advanced treatment to meet ever more stringent regulatory requirements that protect public health, preserve water quality and recognize that wastewater is a valuable, renewable resource. In 2021 an expansion of the PCWRA was completed that increased the plant capacity from 6.44 to 9.44 Mgd, of which 7.14 Mgd (more than 75%) is allocated to the Town. With sustained growth expected in Castle Rock, staff anticipates that a second expansion will be required in the 2038 - 2043 time frame when/if the population approaches 105,000. Future costs have been incorporated into the capital plan and the rates and fees analysis. At the Pinery, CRW currently conveys about 0.12 Mgd for treatment. Future capacity needs at the Pinery are as much as 0.51 Mgd. Any needed expansions at the Pinery are paid through SDFs, and none are currently anticipated.

➢ 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 wastewater hydraulic model that could be used and updated as growth conditions change. Key components of the Castle Rock Water planning process include:

- Update the hydraulic model at least annually as assets in the system change.

- Analyze the Town's existing wastewater collection system at least annually for existing and future growth conditions, in order to identify collection system deficiencies and/or future facility requirements. Adjustments to the capital plan, the master plan, and budgets should be made accordingly yearly as part of the rates and fees study and the budgeting process.

- Maintain the tools and resources necessary to identify sewer infrastructure that has reached the end of its useful life and have a plan for replacement. Tools and resources include the hydraulic model, collection system video inspection equipment, the Granite sewer video/defect database and pipe scoring system, the database of SSOs, and the Cartegraph OMS asset management program. The video inspection program is most useful in identifying pipe defects so that proactive repair and replacement can be planned. The asset management program can be used to track SSOs and areas that might be requiring more maintenance, and eventually will be used to incorporate pipe condition scoring and costs in order to develop a predictive model for sewer pipe rehabilitation. A new tool being utilized by CRW in 2022 is the use of sound inspection technology to identify sewer lines that may be blocked, either by a mechanical plug (often installed during construction) or by a grease or root blockage. With this new tool, cleaning and video inspection work can be better targeted, improving efficiency, saving water and diesel fuel and reducing the risk of sewer overflows.

- Plan to fully utilize the asset management program to maximize the life of assets and minimize life-cycle costs.

- Explore expanding the service area to eliminate septic tanks and/or serve outside the Town service area where it makes sense, and with regards to the impact to the PCWRA service area and capacity. Expansion also needs to consider the potable water demands required to support new service areas.

- Measure and maximize recovery of wastewater flows in Cherry Creek and Plum Creek in order to be proactive with respect to reclaimed waste water as a renewable resource. Wastewater flows to the PCWRA are measured at the PCWRA, and treated effluent is currently discharged into the East Plum Creek. In the five years since the last update, CRW has constructed a pump station and pipeline from the Castle Rock Reservoir No.1 near Sedalia to bring the Town's renewable effluent water rights back for advanced treatment at the PCWPF to realize full beneficial capture and reuse of those flows. The Town has storage capacity in the CRR1 Reservoir and also in Chatfield Reservoir for the Plum Creek treated effluent flows, and has plans to expand the Sedalia Reservoir system capacity to capture potential free river flows. Wastewater flows contributory to the Cherry Creek Basin are captured and treated by the Pinery Water and Wastewater District, and then released back into Cherry Creek. The Town has an existing agreement with Parker Water and Sanitation District to pick up these reusable return flows at the Newlin Gulch Diversion, however, this is dictated by when Parker is able to operate this diversion from a priority standpoint. Thus, the majority of Castle Rock's reusable effluent on the

Cherry Creek side flow downstream without being recaptured. This will be an area of focus to fix in the next five years.

- Develop a plan for phased implementation of recommended projects. Key to accomplishing this is to revisit the hydraulic model regularly to identify capacity issues, and regular inspection and condition assessment of critical infrastructure, such as interceptors and force mains. Staff shall review sewer inspection information to identify pipe defects to be corrected under the Sewer Rehab Program. Staff shall particularly target the older areas of town where clay pipe predominates, but shall also tailor the phasing of the Sewer Rehab Program to be in advance of major road or pavement rehabilitation projects. Planning efforts shall also take into consideration the timing of projects to spread the costs and normalize impacts to rates and fees. Generally, 5-year capital plans are used for budgeting purposes and the annual rates and fees analysis, but are revisited annually to include any cost estimates used for budgeting purposes. CRW has completed a 10-year sewer rehab project plan that focuses on pre-1976 sewer pipes, with an emphasis on old clay sewer pipe; see Figure 5.0 in Section 5.

➢ Principle 3 – Encourage Coordination of Infrastructure Needs

Castle Rock Water works closely with other departments (Parks and Recreation, Public Works) and divisions (Stormwater, Meter Services, Operations) to ensure that major and minor capital projects are not planned or executed in a vacuum. This helps ensure that all Town monies are spent wisely. Water and wastewater rehabilitation projects are scheduled in advance of major roadway maintenance or trail projects. For example, in 2021 the Alley Improvement Project in the historic downtown area was under construction by the Public Works Department. The sewer line in the alley was original clay pipe that had been installed in about 1935. The decision was made to replace all of the clay pipe in the project area with modern PVC sewer pipe. Old, unused sewer laterals (installed on the original sewer main but never connected to a house or business), which can be a source of I/I, were not reinstated. The project was challenging due to many other utilities that had been installed over the sewer pipe over the years, but with modern redevelopment occurring in the downtown area it is imperative to not rely on infrastructure beyond its service life. Other multidisciplinary projects that Castle Rock Water is planning and implementing in cooperation with Public Works and Stormwater are the North Craig and Gould Infrastructure Improvements Project, underway in late 2021 for completion in 2022-2023. In 2021 CRW was able to partner on the Oakwood senior housing redevelopment project to proactively complete replacement of some old clay sewer pipe. The project was a win-win for all parties. The developer was able to plan for and design a relocation of the sewer that better accommodated their new building footprint, and CRW was able to incorporate the sewer replacement into the onsite infrastructure improvements, taking advantage of the

developer's contract and incurring reduced costs, and securing a larger easement for the replaced sewer pipe. Key components to coordinated project planning include:

- Evaluate capital improvement and capital replacement projects based on minimizing life cycle costs;
- Ensure the most cost effective approach to expansion of PCWRA is undertaken and that the timing of the expansion meets the needs of the Town's growth and coordinate Pinery's treatment capacity to ensure adequate capacity for growth on that portion of Castle Rock's system;
- Develop projects which minimize the operational costs of facilities in accordance with identified Key Performance Indicators (KPIs), or achieve payback in less than five years;
    - Key Performance Indicators for the wastewater program include:
        - Sewer Overflow Rate (total number of sewer overflows per miles of total collections system piping)
        - Operational Cost (total O&M costs) per average daily wastewater flow)
        - Mgd processed per employee
- Fully utilize asset management planning to maximize the life of assets and minimize the life-cycle costs;
- Continue to coordinate sewer rehab projects with the Public Works Pavement Maintenance Program (PMP), Development Services, and other Town projects; and
- Coordinate system operations and upgrades with PCWRA and Pinery to minimize operational costs of PCWRA and Pinery, and ensure best water quality effluent in order to fully utilize the Town's reusable and renewable water sources.
- Ensure changing wastewater regulatory requirements do not hamper potential reuse opportunities.

➢ Principle 4 – Operate the Wastewater Enterprise Fund as a Business, Balancing Revenue and Expenses

The Town of Castle Rock has over $850 million dollars' worth of water, wastewater and stormwater infrastructure to operate, maintain and plan for future rehabilitation or replacement. Of that, roughly $112 million is wastewater infrastructure. Overall, the Town is a fairly young municipality and new development is typically responsible for constructing the infrastructure required to support their development. However, the Town's wastewater infrastructure does date back to the early 1930's, and some of that original sewer works is still in service. Nevertheless, the Town must plan for growth, from a capacity standpoint, and replacement, from an age and condition standpoint. Annually the utility conducts a comprehensive rates and fees study for all four enterprise funds – water, wastewater, water resources, and stormwater. The purpose of the rates and fees study is to provide the Town with a thorough review of annual revenue requirements and determine cost-of-service (COS) based rates for each fund. The projection period developed for each utility financial plan is driven by the length of the

Capital Improvement Program (CIP) and currently ends in 2065. Strategies for balancing revenue and expenses include:

- Develop realistic cost estimates for both capital improvement projects and operation and maintenance programs as a basis for input into the rates and fee analyses. Revisit costs and timing each year as part of the budget process;
- Regularly revisit the hydraulic model to reassess system capacity;
- Develop a plan for phased implementation of recommended projects based on factors such as condition, capacity, risk, and coordination with other projects;
- Develop the capital plan with emphasis on avoiding large capital increases in any one year that may artificially impact rates and/or fees;
- Evaluate capital improvement and capital replacement projects based on minimizing life cycle costs understanding that the KPI for wastewater replacement for CRW was 0.7% in 2021 (placing CRW in the bottom 25th percentile) with the national median being 1.1%;
- Ensure the most cost effective approach to a future expansion of wastewater treatment capacity and that the timing of the expansion meets the needs of the Town's growth;

➢ Principle 5 – Provide for Effective Long-Term Operation and Maintenance of Collection System Facilities

The expected lifetime of many collection system assets is on the order of fifty years or more, provided that proper operation and maintenance has occurred. Pumps and motors have a shorter lifespan, but will quickly fail without routine operation and maintenance. Providing for adequate operations and maintenance dollars in the annual budget is not just the cost of doing business, it can be considered insurance for the future. Additionally, and perhaps more importantly, the utility must plan for and maintain adequate personnel to get work done. Effective long-term operation requires Castle Rock Water to:

- Institute a Sewer Rehab Program that addresses critical assets, uses tools to identify infrastructure at risk, and utilizes best available technologies at reasonable cost;
- Plan and coordinate projects with other Town departments and projects to achieve the best value;
- Proactively maintain the collection system so that sanitary sewer overflows are minimized and occur at a rate that keeps us in the top quartile nationally each year;
- Maintain the collection system with the goal of minimizing I/I to levels that ensure the sewers do not become surcharged during wet weather events, leading to SSOs, and that the peak hydraulic loading to the PCWRA or Pinery is not excessive;

- Ensure appropriate staffing levels are maintained to promote expected levels of service and achieve KPIs; and
- Ensure capacity is considered for future development, and that projects are completed in advance of capacity need.

➢ Principle 6 - Ensure Wastewater 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 2022 Water Resources Strategic Master Plan lays out how Castle Rock Water is going to meet that goal over the next 20-30 years.

Key components of the Town's water supply strategy include:

- Continue to develop a water supply portfolio that consists of 75% renewable water sources and 25% non-renewable sources by 2050. After 2050, continue development of renewable sources working towards a 100% renewable supply to complement the existing non-renewable supply.
- Implement the ideas that were delineated in the 2015 Water Efficiency Master Plan (WEMP), and as updated per the 2022 WEMP: If this plan is embraced by our customers, the Town may eventually see a per capita demand of approximately 100 gallons per person per day by 2050. This would account for an additional 18% savings in water use and would essentially act as a new source of supply.
- 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.
- 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. The Town retains the rights to the return flows from wastewater treated for the Town by The Pinery. Those return flows currently are captured in the Rueter-Hess Reservoir for future reclaim by the Town. The Town operates a surface diversion on Plum Creek and partnered with Parker on a Cherry Creek project that gives us the ability to re-capture much of these supplies for indirect potable reuse. Usage of these supplies represents about one-third of our future projected water supply. Castle Rock is also evaluating the possibility of direct potable reuse to reduce losses during drought times. Direct potable reuse regulations have been developed in Colorado as of 2022. Castle Rock Water

also created a non-potable reuse system in 2019 to provide irrigation service to the local Red Hawk golf course owned by the Town.
- Work in partnership with other entities to import additional supplies and to reduce the cost impact to our customers.
- Manage our reservoir storage program to optimize the placement of supplies during periods when they are not needed by our customers.
- Continue to maintain, develop and protect the Town's Denver Basin groundwater supply. This supply will help meet the demands of our customers in the short term and provide reliability and drought protection in the long term. This could include being stakeholder on projects outside the town's boundary that have the potential to impact overall aquifer groundwater supplies that are part of the Town's water portfolio. Continue to maintain, develop and protect the Town's surface water supplies. The Town's Source Water Protection Plan (SWPP) is a key component of this strategy, as is the Stormwater Municipal Separate Storm Sewer System (MS4) program.
- Work within a sustainable financial plan that generates the capital funds required for the transition to a sustainable, renewable supply and maintains our existing supplies and supply infrastructure.

The potential water resources available to the Town fall within four primary categories: existing Town-owned groundwater, Town-owned local surface water, imported surface water, and reusable supplies in both the Plum Creek and Cherry Creek basins. Some of the water used by the Town that is collected and conveyed to the Plum Creek Water Reclamation Authority (PCWRA) treatment plant for treatment and discharge to East Plum Creek can, by law, be treated and reused by the Town. Similarly, a portion of the water used for lawn, park, and golf course irrigation that returns to East Plum Creek [Lawn Irrigation Return Flows, (LIRFs)] can also be reused by following the proper procedures. For more details, refer to the 2022 Water Resources Strategic Master Plan (WRSMP).

One of the primary goals outlined in the WRSMP is to achieve a water supply portfolio consisting of 75% renewable water sources and 25% non-renewable sources by 2050. While both IPR and DPR can potentially be used to provide renewable water sources for the Town, there are inherent benefits (pros) and drawbacks (cons) to each source water alternative. Reusable water supplies for CRW include the treated effluent generated at both Plum Creek Water Reclamation Authority and the Pinery wastewater treatment plant.

A small portion of the Town's reusable effluent is treated by the Pinery Wastewater Treatment Plant and discharged into Cherry Creek. The Town has full rights to reuse this water. The Town captures some of these water rights at Parker Water and Sanitation's (PWSD's) Cherry Creek Diversion Structure for storage in RHR. At the end of 2021, the Town had approximately 118 acre-feet of water in storage in RHR with about 10 AF per month available for diversion. In the future, CRW anticipates the reusable flows will increase to approximately 600 acre-feet from additional growth of already zoned properties and future annexations/development of land. However, water

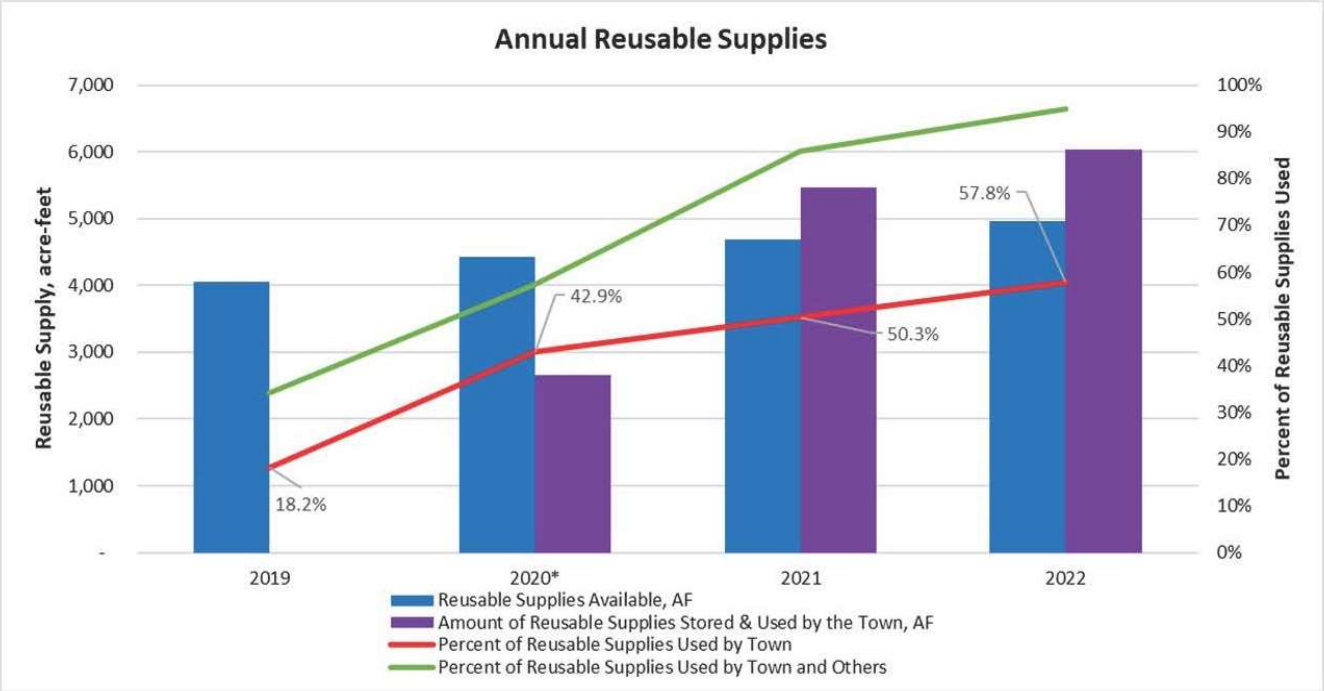
deliveries to the reservoir are dependent on the operation of the Cherry Creek Pump Station, which turns off during river calls or for maintenance, so the Town may not always be able to divert all water that is available. A goal of this plan is to find ways to ensure full capture of all reuse water. Ultimately, CRW plans to treat its water that is in storage in RHR and return it to the Town through the Water Infrastructure and Supplies Efficiency (WISE) infrastructure. This will entail an additional partnership with PWSD to expand its Rueter-Hess Water Purification Facility (RHWPF) with 12 Mgd of reserved capacity for Castle Rock.

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.

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. Reuse supplies generated at the Pinery were sent to the Rueter Hess Reservoir, in which Castle Rock owns 8,000 AF of storage, for future use by the Town. Figure 1.1 shows the Annual Reusable Supplies and amounts used and/or stored for 2019 through 2022.

In late 2020, Castle Rock Water completed the Advanced Treatment and Expansion of the Plum Creek Water Purification Facility (PCWPF), the Plum Creek Diversion Pump Station near the Plum Creek Diversion facility and reservoir in Sedalia, and the Castle Rock Water Raw Water Return Pipeline from the pump station back to PCWPF. The pump station and pipeline allow CRW to capture our eligible PCWRA treated effluent return flows, our Plum Creek LIRFs, and any free-river flows and store them in the Castle Rock Reservoir No. 1 (CRR1) or return them via the raw water pipeline to the advanced treatment facility, PCWPF, for treatment in an Indirect Potable Reuse (IPR) scheme.

Figure 1.1



Since early 2021 Castle Rock Water (CRW) has practiced, as planned, IPR utilizing water captured from Plum Creek which contains treated wastewater from the Plum Creek Water Reclamation Authority (PCWRA) effluent outfall. The IPR source water is captured through the Plum Creek Diversion via 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). As the Colorado Department of Public Health and Environment (CDPHE) works towards finalizing 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: 1) performing a qualitative and quantitative alternatives analysis comparing IPR to DPR and 2) conducting a cost-benefit and risk assessment study for DPR.

Next steps for CRW in support of moving towards a DPR strategy will involve a year's worth of effluent sampling at PCWRA according to the final rule which is expected to be issued from CDPHE in early 2023. Some samples will be every 15 minutes, others weekly or monthly depending on the constituent, pathogen or parameter of concern.

- **Principle 7: Identify and Implement Changes to the Wastewater System which will improve long term sustainability through resource recovery and net zero energy use**

Wastewater collection emerged in the middle of the 19th century in response to public health concerns that emerged when outbreaks of cholera were traced to wells contaminated by nearby releases of sewage from privies and cesspools. The response was combined collection systems that conveyed the sewage, along with stormwater flows, to local drainage ways and surface waters. This created the problem of surface water pollution, and in larger communities, the disposal soon overwhelmed the capacity of the stream or river to self-purify by biological processes. It was necessary to treat the wastewater to some degree before disposal.

The construction of centralized sewage treatment plants began in the late 19th and early 20th centuries. Instead of discharging the sewage directly to a receiving water, it was first passed through a combination of physical, biological and chemical processes (generally, conventional activated sludge (CAS) processes). Collection systems also evolved to separate the storm water from the domestic sewage to that treatment plants did not become hydraulically overloaded during wet weather events. Around the middle of the 20th century, awareness of and concern for environmental quality led to more regulation and higher levels of treatment, and industrial pretreatment programs evolved. Wastewater treatment advanced; it became possible to remove almost all pollutants. Wastewater treatment plants (WWTPs) became large, complex, energy intensive facilities.

With the rise of oil prices in the 1970s, energy conservation took on more importance in the design of new facilities. The 21st century is bringing new challenges. The global climate crisis, greenhouse gas (GHG) emissions, ever-increasing demands for energy, concerns with carbon footprint, and sustainable development goals are challenging all industries to take a harder look at how they do business, and the wastewater treatment community is not immune.

The traditional goal of wastewater treatment was to protect the public health of downstream users. Secondarily, and much later, the goal expanded to protect nature in the receiving environments. The widely used CAS technologies, while meeting legal effluent quality standards, are high energy demand processes with large environmental footprints, low resource recovery potential and low cost-effectiveness. The time has come to focus forward efforts on integrating resource oriented management and

recovery into the wastewater management and treatment processes.

Resource Recovery:

Water: The most precious resource in wastewater is water. Around 99% by weight of the matter in wastewater is water, a renewable/reusable resource. Wastewater, albeit 99% water, is not just water. Significant quantities of phosphorus (P) and nitrogen (N) are also present. Wastewater has significant energy potential due to its temperature and chemical oxygen demand (COD). Large scale centralized WWTPs also represent potential collection points for the resources contained in wastewater, namely water, energy, nutrients and other products. PCWRA is not just a wastewater treatment plant; it is a water reclamation facility (WRF) as the name intends. Water reuse from WRFs, either thru IPR or DPR to the water treatment plant, or 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 with high energy demand pumping.

Phosphorus: Globally, about 17% of all mined phosphorus ends up in human waste; almost 100% of the phosphorus eaten in food is excreted. Cities are "P" hotspots, and urine is the largest single source of phosphorus coming from them. Other sources of P in wastewater are household detergents, lawn fertilizers, and industrial effluents. The typical concentration is about 6 mg/l. Phosphorus is a finite resource with project scarcity. Mining for P has a huge environmental impact. Recovery from a central collection/treatment location such as a WWRF both reduces mining for new P, reuses a resource, reduces the environmental concentration of a pollutant that is known to promote algal blooms in surface waters, exerts an oxygen demand on receiving waters, and can cause ecological destruction.

Nitrogen: Estimates are that 30% of global nitrogen (N) fertilizer demand could be met through N recovery efforts at WWRFs. Another estimate suggests that more than 1% of manmade global greenhouse gas emissions and energy demand is due to fertilizer production, generally by the high energy demand electro-chemical Haber-Bosch process. It is not efficient to produce more of it, then to destroy it again in the biological nitrification and denitrification processes in the WWTPs, which also consume large amounts of energy.

Energy: In 2020, the treatment of municipal wastewater accounted for approximately 4% of the electrical demand in the United States. There are two types of energy inherent in wastewater: chemical energy and thermal energy.

The chemical energy in typical wastewater is about 18 kJ/g, which is about 5 times the electrical energy needed to operate the CAS process, although much of the chemical energy content is lost as heat during microbial metabolism of the activated sludge process. Theoretically, chemical energy may be recovered by means of bioelectrochemical systems (BES) by which the COD is oxidized by microorganism and the electrical potential generated is used to produce energy or other products, such as

biofuels, high value chemicals, inorganics and fertilizers.

In the near term, the thermal energy potential of wastewater may be the more likely candidate for recovery. Municipal wastewater contains 2.5 times more thermal energy than the theoretical maximum chemical energy stored in the COD. The thermal energy in wastewater stems mostly from household and industrial water heating, and from heat gained during microbial processes. Since the wastewater shows relatively small seasonal variations by comparison with atmospheric temperatures, it can serve as a stable source of heat that is recoverable using heat pumps. For example, at PCWRA, 2022 effluent temperatures varied from a low of 60.6 F in February to a high of 75 F in August. Thermal recovery via heat exchange has much potential to reduce energy consumption as part of reducing the facility's carbon footprint. Heat pumps use electricity to extract low-temperature thermal energy from the wastewater and usually provide 3–4 units of heat energy per unit of electrical energy consumed. Potential uses of thermal energy recovery in the WWRF environment could be heating or cooling of buildings, or potentially to offset energy in the sludge drying processes. In 2023, PCWRA is investigating the potential to run a heat exchange loop through the ATAD heat exchanger for building heat, which will decrease the need for natural gas in some of the facility.

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.

2. Master Plan Elements

Collection System

The Town has over 314 miles of wastewater collection pipes, ranging in size from 4 inches to 54 inches, and over 10,300 manholes, some dating back to the 1930's. More than 40 miles of 8" sanitary sewer main has been installed since 2017, a clear reflection of the growth in Castle Rock since the last master plan update. Table 2.1 provides a summary of the sizes and types of collection system pipes in the Town's wastewater system. In older parts of the Town where the pipes, mostly VCP (clay) may have reached the end of their useful life (typically 40-50 years depending on pipe material), aggressive rehabilitation and replacement efforts may be required to ensure continuity of service and the desired level of service. The Town has a program to video inspect the collection pipes to identify pipe deficiencies that may warrant rehab or replacement. Staff consider the age of pipe, the pipe material, a pipe condition score based on visual inspection by CCTV, and whether there are planned street and pavement improvements that warrant sewer pipe replacement and/or rehabilitation. Development upstream of existing pipes can contribute flows that exceed the capacity of collection pipes, necessitating replacement to a larger size. The Town uses a criterion of 75% of capacity at peak wet event to determine if a pipe is a candidate for upsizing.

Table 2-1
Collection System Pipe Summary

Gravity Mains Pipe Material	Size, Inches	Length, Miles
DI	6 to 12	0.57
(Ductile Iron)	24	0.58
PVC	4 to 6	1.66
(Poly vinyl chloride)	8	266.7
	10	10.9
	12 to 18	27.71
	21 to 27	4.01
	>27	0.67
VCP	6, 8	6.83
(clay)	10 to 12	1.86
	15 to 21	1.04
CIPP (cured in place liner)		5.87
Total Miles		314+

Force Mains, linear feet, by size, inches	4"	6"	8"	10"	12"-15	16" - 21"
Ductile Iron (DI)					2,680	
PVC	7,948	5,919	9,645	11,147	12,674	12,162
					Total	62,175 feet (11.78 Miles)

* Note: there have been no changes in force mains since the 2016 Master Plan.

Wastewater Facilities

Lift Stations

Lift Stations are wastewater pumping facilities. If wastewater flow from a service basin cannot flow by gravity to the downstream treatment facility, then it must be collected and pumped to a gravity point that flows to the wastewater treatment plant. Lift stations are generally discouraged because of the high initial costs to build and the ongoing operating and maintenance costs associated with building facilities and pumping wastewater to a higher point in the collection system. As development in the Town's service area extends to the more challenging areas to serve, more lift stations are likely due to topographical constraints, unless other options can be developed. For example, the Plum Creek Ridge development (at Gilbert St.) installed an elevated hanging sewer main over Sellars Creek. This was preferable to a lift station for a small service area or an inverted siphon with insufficient flushing flows. Castle Rock Water levies a cost of service payment from areas served by lift stations to compensate for the additional operations and maintenance costs incurred over a 20-year period. There are currently 9 lift stations, with several more anticipated in future undeveloped areas of Town, such as Bella Mesa (Founders Village F24), Macanta (formerly known as Canyons South; two to three lift stations proposed, with flows to the Pinery) and Dawson Trails (1 to 3 lift stations potentially). If the Town partners with Douglas County on the SH-85 Sewer Collection System, another 1 to 3 lift stations might be required to support that project. See Figure 2.1 for the Town's current lift station basins, lift stations, grinders, flumes and odor control facilities. Table 2.2 summarizes the Town's existing wastewater facilities. See Figure 5.2 in Section 5 for general locations of proposed developer lift stations and other improvements.

OBJECTID_1	Facility Type	Location
1	Lift Station	Castle Oaks Lift Station
2	Lift Station	Mitchell Creek Lift Station
3	Lift Station	Maher Ranch Lift Station
4	Lift Station	Sellars Gulch Lift Station
5	Lift Station	Castlewood 2 Lift Station
6	Lift Station	Meadows 17 Lift Station
7	Lift Station	Meadows 5 Lift Station
8	Lift Station	Meadows 15 Lift Station
9	Lift Station	Castlewood 1 Lift Station
10	LS-Abandoned	Ray Waterman Lift Station
11	Flow Splitter Box	North Flume
12	Odor Control	Woodlands Odor Control
13	Odor Control	Maher Ranch Odor Control .
14	Grinder	Meadows Grinder
15	Siphon/Grinder	Mitchell Street Depressed Sewer & Grinder
16	Connection/Flow Station	Cobblestone to Pinery
17	Treatment Facility	PCWRA
18	Connection/Flow Station	Canyons South to Pinery
19	Siphon	Perry St
20	Siphon	Under I-25 @Wolfesnberger

VICINITY MAP

Legend

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

CASTLE ROCK Qwater
Securing our future drop by drop

0 2,350 4,700 9,400 14,100 Feet

1 inch = 4,667 feet

CASTLE ROCK WATER
FIGURE 2.1

Date: 11/3/2022 Document Path: J:\B. PLAN & ENG\13.0 Engineering\13.8. Planning\Master Plans\2022 Master plan update\WW Master

Town of Castle Rock
Utilities Department
Wastewater Facilities Inventory **Table 2.2**

Design Report

Lift Stations

ID	Year Built	Capacity (mgd)	Wet Well (gallons)	Wet Wells	Pumps	HP	GPM	Total Dynamic Head (ft)	Ultimate Capacity (mgd)	Total Dynamic Head (ft)	Force Main Size	Force Main Length (ft)	Flume	Discharge Flow Meter	Standby Power	Type	Standby Power (kW)	Standby Power LS Capacity	Overflow Basin (gal)	Comments	SFE Capacity	2016 SFE Used	2022 SFE Used	Build Out Capacity	Peak Flow (gpm)	Average Flow (gpm)	Overflow Time Peak (min)	Overflow Time Avg (min)
Maher Ranch Lift Station	2003	0.85	2,800	8' dia x 23.2'	2	60	590	174	0.85	174	8" PVC	4,857	No	Yes	Yes	Diesel	140	Full Flow	None		870	844	848	870	590.00	132.00	NA	NA
Mitchell Creek Lift Station	2004	4.30	75,500	(1) 16.8'x24.8'x16.1' (1) 12.2'x16.8'x16.1'	3	125	2986	152	4.30	152	10" PVC 16" PVC	11,296 11,296	No	Yes	Yes	Diesel	400	Full Flow	128,000	Trimmed impellars may need to be replaced to pump build out flows.	2495	2054	3843	5700	1,298.61	381.90	99	335
Seller's Gulch Lift Station	2005	2.56	3,100	(1) 6'x16'x18' (1) 24'x37.5'x11.3'	3	30	1800	54	2.56	54	12" DIP	2,480	Yes	Yes	Yes	Natural Gas		Full Flow	55,000		3021	419	1485	3021	1,777.78	461.50	31	119
Meadows Filing 5 Lift Station	1989	0.24	424	6' dia x 23.1'	2	10	167	81	0.24	81	6"	1,150	No	No	Yes	Diesel	45	Full Flow	12,351	The head is estimated from 35 feet of elevation head and an additional 15% for the dynamic head.	111	143.5	142	111	105.00	23.00	118	537
Meadows Filing 15 Lift Station	2005	0.31	1,672	(1) 7' dia x 14.9' (2) 8' dia x 17.8'	2.00	15	215	81	0.31	81	4" PVC	670	No	Yes	Yes	Natural Gas		Full Flow	7,520		223	223	225	223	218.00	43.70	34	172
Meadows Filing 17 Lift Station	2005	1.18	21,127	(2) 11.5'x21'x14'	2	50	820	95	1.18	95	8" PVC	1,526	No	Yes	Yes	Natural Gas		Full Flow	83,000		1346	688	609	1346	821.20	187.10	101	444
Castle Oaks Lift Station	2005	1.18	16,400	(2) 8'x14'x19.25'	4 - 2 pair in series	55	820	331	2.28	386	12" DIP	11,719	Yes	Yes	Yes	Diesel	350	Full Flow	380,000	Initial SFE capacity of the pumps is 1250. The pumps will need to be replaced with larger pumps beyond 1250 SFES.	1250	921	1659	2760	1,583.00	382.00	240	995
Castlewood Ranch Lift Station #1	2004	0.15	885	5' dia x 14.7'	4 - 2 pair in series	15.00	105	177	0.15	177	4" PVC	2,875	No	Yes	Yes	Natural Gas		Full Flow	None		110	94	115	110	100.80	27.50	NA	NA
Castlewood Ranch Lift Station #2	2004	0.54	1,400	8' dia x 15.2'	2	26	315	95	0.54	95	8" PVC	1,237	No	Yes	Yes	Natural Gas		Full Flow	None		505	477	491	505	373.00	75.00	NA	NA
Total Capacity		**11.30**							**12.40**												**9931**	**5864**	**9417**	**14646**				

Flow Measuring Stations

The Town has three flow measuring stations that measure and monitor flows from three main areas of the Town, as summarized in the table below. There are also flow meters in many of the lift stations. The Pinery Water and Wastewater District (Pinery) also has flow measuring stations to monitor flow from the Cobblestone Ranch area and the Macanta development. The flow measuring stations and meters are essential elements of the Town's data collection efforts. The data collected from the stations is invaluable in the calibration of the wastewater hydraulic model and understanding the influence that infiltration/inflow (I/I) has on the capacity of the collection system and the PCWRA and Pinery wastewater treatment plants. Monitoring of the data can also indicate changes in the collection system that may warrant further investigation. Meter volumes are reported daily through the supervisory control and data acquisition (SCADA) equipment installed in Town facilities, and monitored for changes or issues. CRW will work with the Pinery to incorporate their SCADA into our system.

Table 2-3
Flow Measuring Stations

Name	Local Measured	Type	Install Date	SCADA
Town North	Founders, Woodlands	Parshall	1987	Yes
Town Main	Downtown, Plum Creek, Crystal Valley, Citadel	Parshall	1990	Yes
Meadows	Meadows	Parshall	1987	Yes
PCWRA	All of Castle Rock except Cobblestone Ranch, Silver Heights*, Castleton District*, and Macanta (aka Canyons South)	Parshall	1989	at PCWRA in 2017
Pinery WWD	Cobblestone Ranch	Parshall	2007	at Pinery
Pinery WWD	Macanta (aka Canyons South)	Parshall	2022	at Pinery
	*No flow measuring device; wastewater flows are assumed based on water use			

Grinder Facilities

Typically, the Town has grinder facilities upstream of lift stations and siphons. The grinders comminute solids in the wastewater that could potentially clog wastewater pumps or settle out in siphons, potentially blocking flow. They also eliminate the need for bar screens, which require manual cleaning, upstream of the lift station or wastewater plant. The Town has two grinder facilities upstream of wastewater siphons. Siphons are collection pipes that use accumulated pressure head in the pipe to force the wastewater through a pipe against gravity. Siphons are discouraged because of the tendency of solids to collect in the low

point of the siphon and the increased maintenance that results if an adequate flushing velocity can't be achieved.

Table 2-4
Grinder Facilities

Facility	Location	Year Installed
Mitchell Creek LS	Lift Station	2003
Mitchell Street	Siphon	2009
Meadows	Siphon	2005
Castlewood LS #1	Lift Station	2009
Sellers Gulch LS	Lift Station	2005
Meadows 17 LS	Lift Station	2005
Castle Oaks LS	Lift Station	2005

Odor Control Facilities

The Town has several facilities dedicated to mitigating the odors from sewer mains and lift stations. All of the Town's lift stations have facilities for chemical addition to control odors and mitigate corrosion potential in the collection system. In 2006, the Town constructed the Woodlands Odor Control Facility with a proprietary granular media and carbon adsorption to neutralize and reduce odors from a gravity sewer main situated along a popular walking trail near homes. In this case, the gravity sewer predated the trail and the homes, and could not be relocated. Castle Rock Water staff routinely monitor the facility for maintenance purposes, and samples are collected in order to gauge treatment efficacy and determine when the media is no longer neutralizing odors and should be replaced. Despite this odor control facility, Castle Rock Water is still seeing odor issues along the trail and behind the homes. Additional odor control options will be evaluated during the next planning period.

There is also the Maher Ranch biofilter for odor control in the Sapphire Point neighborhood, installed downstream of the force main outfall to gravity sewer. That facility relies on a natural bioremediation process to treat hydrogen sulfide in off-gases from the wastewater and reduce the odor potential.

Table 2-5
Odor Control Facilities

Location	Type	Process	Year Installed
Woodlands Odor Control	Forced Air Media Treated	Sulfa Treat Media and GAC	2007
Maher Ranch Biofilter	Biofilter, Forced Air	Biologically Treated Wood Chips	2002

Treatment - Plum Creek Water Reclamation Authority (PCWRA)

The PCWRA is a regional water reclamation facility that serves the Town of Castle Rock, Silver Heights, Castleton Metro District, Castle Pines and Castle Pines North. The Town is a board member of the Plum Creek Water Reclamation Authority. Based on October 2022 measurements, the Town currently contributes approximately 83% of the total wastewater load to the facility, and therefore is responsible for its proportionate share of expenses for expansion, operations, maintenance and upgrades. The Town is growing much faster than the other members so this share is expected to increase over time. The existing wastewater treatment plant (WWTP) was expanded in 2005 and again in 2021 to accommodate growth, and the Town contributed to the expansion projects. Presently the PCWRA has total treatment capacity for 9.44 Mgd (Town's share is approximately 7.14 Mgd), compared to the 2022 Town average daily flow of 4.47 Mgd. PCWRA is required to prepare a Utility Plan (UP) which functions as a master plan for the authority. The PCWRA UP was last updated in 2015 (Plum Creek Water Reclamation Authority, Utility Plan Update and Preliminary Engineering Services, Technical Memorandum No. 1, Treatment Analysis, February 2015; Technical Memorandum No. 2, Energy Recovery Feasibility Analysis, February 2015). More detailed information concerning wastewater treatment, capacity analysis and future capital investment can be found in the plan. The PCWRA plans to update the Utility Plan again in 2023.

A project was completed in 2017 to outfit a third oxidation ditch at the PCWRA. This did not increase overall treatment capacity, but improved firm treatment capacity from 4.2 Mgd to 6.44 Mgd. Due to rapid growth in the PCWRA service area, anticipated changes in regulatory limits, and peak loading levels, a design project to revise treatment processes and expand overall treatment capacity expansion was begun in 2017. Construction was started in late 2018 and included significant improvements to the plant headworks, tertiary filtration, ultra violet disinfection, and solids handling systems. Construction was completed in 2021 and expanded firm treatment capacity from 6.44 Mgd to 9.44 Mgd. The Town is allocated 7.14 Mgd of the total plant treatment capacity. Additional future expansions will be required as the Town continues to grow and if the Town proceeds with plans to provide extraterritorial service to areas of Douglas County along the Highway 85 corridor, but timing is based on the pace of growth.

The cost for treatment is included in the annual rates and fees analysis and shows up for the customer in the monthly service fee and the volumetric unit cost for treatment. Currently, Castle Rock Water doesn't plan to increase either monthly service fee or volumetric fees in the 2023-2027 timeframe; refer to Table 7-1 in Section 7 for more details. See Table 2-6 below for the estimated annual PCWRA treatment budget estimates for Castle Rock. Annual O&M fees for Castle Rock ($830,000) added to the annual treatment fees ($4.47M), divided by the annual average gallons treated (4.47 Mgd x 365), results in a KPI for Total

O&M Cost per MG of $3,248, which places Castle Rock between the 25th quartile and the median for the 2022 AWWA benchmarking.

Table 2-6
5-Year PCWRA Treatment Fee Estimates for Castle Rock

	2023	2024	2025	2026	2027
Cost per Thousand Gallons Treated	$ 2.90	$ 2.84	$ 2.89	$ 3.01	$ 3.06
Monthly Fee	$ 395,840	$ 406,609	$ 432,685	$ 469,459	$ 495,595
Annual Fee	$4,750,080	$4,879,308	$5,192,220	$5,633,508	$5,947,140
% Increase in Annual Fee	6.3%	2.7%	6.4%	8.5%	5.6%

Plum Creek Watershed

The Plum Creek Basin watershed is managed by the Chatfield Watershed Authority (CWA). The Authority is charged with protecting beneficial uses through the control of phosphorus and chlorophyll-a in Chatfield Reservoir. Phosphorus is a nutrient found naturally in sediment and also in manmade products such as fertilizers and detergents, and has the potential to contribute to algae blooms in the reservoir. Chlorophyll-a is the measurable substance in algae and is an indicator of water quality in the reservoirs. CWA's regulatory authority is established through the Water Quality Control Regulation No. 73 through the State.

Prior to 2016, the CWA was governed by a board made up of 22 paying membership entities, counties, municipalities, water and sanitation districts, and other public and private entities that have material impact on the watershed or a vested interest in the Authority. A governing agreement was adopted in 2016 that establishes a five-member board of local elected officials including Douglas County, Jefferson County, Castle Rock, and two at-large board seats for water and wastewater districts and other paying members. The CWA developed a Chatfield Watershed Plan in 2015 that is a living document to guide watershed efforts and decision-making to promote water quality protection in the Chatfield Watershed. This document will be revised from time-to-time as the watershed develops and new management techniques become necessary.

The mission of the CWA is to promote protection of water quality in the Chatfield Watershed for recreation, fisheries, drinking water supplies and other beneficial uses. To protect these beneficial uses, the CDPHE, Water Quality Control

Commission, adopted Control Regulation No. 73 which includes water quality standards for phosphorus and chlorophyll-a (CWA Website). The Town has been involved with the Authority for over 25 years and plans to continue participation as a means to help protect the Town's drinking water supply.

Treatment - Pinery Water and Wastewater District

Although the Town provides water service to the Cobblestone Ranch neighborhoods, the wastewater flows are treated by the Pinery Water and Wastewater District (Pinery). The Cobblestone Ranch developer invested in infrastructure improvements and treatment capacity with Pinery to cover their requirements through build-out. Cobblestone Ranch reserved capacity is 0.29 Mgd, annual average, and 0.32 Mgd, max monthly average. The Town of Castle Rock and The Pinery have an Intergovernmental Agreement (IGA) that covers system development fees, rates, return flows and reimbursement for treatment. There is also an agreement for the operation of a water interconnect between the two entities, to be used in times of emergency water crisis by either party. This interconnect is planned to become a regular location for CRW to get its Cherry Creek Project Water Authority water supplies from the Pinery. Castle Rock provides extraterritorial service to the Macanta (Canyons South) development. This development also sends all wastewater flows to The Pinery for treatment under similar IGAs. Macanta has reserved capacity of 0.24 Mgd, annual average flows, and 0.27 Mgd, max monthly average flows. The Pinery began accepting flows from Macanta in 2021.

A small portion of the Town's reusable effluent is treated by the Pinery Wastewater Treatment Plant and discharged into Cherry Creek. The Town has full rights to reuse this water. The Town captures some of these water rights at PWSD's Cherry Creek Diversion Structure for storage in RHR. At the end of 2021, the Town had approximately 118 acre-feet of water in storage in RHR with about 10 AF per month available for diversion. In the future, CRW anticipates the reusable flows will increase to approximately 600 acre-feet on an annual basis from additional growth of already zoned properties and future annexations/development of land. However, water deliveries to the reservoir are dependent on the operation of the Cherry Creek Pump Station, which turns off during river calls or for maintenance, so the Town may not always be able to divert all water that is available. A goal of this five-year plan is to identify a solution to ensure capture of all of CRW's reusable effluent. Ultimately, CRW plans to treat its water that is in storage in RHR and return it to the Town through the WISE infrastructure. This will entail an additional partnership with PWSD to expand its Rueter-Hess Water Purification Facility (RHWPF) with 12 Mgd of reserved capacity for Castle Rock.

Cherry Creek Watershed

The Cherry Creek Basin is managed by the Cherry Creek Basin Water Quality Authority (CCBWQA). The Authority is charged with protecting beneficial uses through the control of phosphorus and chlorophyll-a in Cherry Creek Reservoir.

Their regulatory authority is established through the Water Quality Control Regulation No. 72 through the State.

The CCBWQA's focus is protecting, preserving, and enhancing beneficial uses and water quality needed to support the beneficial uses in Cherry Creek Reservoir and Cherry Creek watershed (CCBWQA Annual Report, 2015, pg. ES-1). Currently there are fifteen members of the CCBWQA. Castle Rock is one of the members and is represented on the Board and Technical Advisory Committee. The CCBWQA "develops water quality strategies to (1) minimize point, nonpoint, and regulated stormwater pollutant source nutrient contributions; (2) implement pollutant reduction programs; and (3) monitor water quality to evaluate progress. Together, these strategies create an effective water quality management approach" (CCBWQA Annual Report, pg. 1-1).

CRW is supporting these strategies in several ways. From a wastewater standpoint, CCBWQA ensures compliance with the 0.05mg/l discharge limit for wastewater within the cherry creek basin and/or remove wastewater discharges to the Plum Creek basin. Through the planning process, CRW requires wastewater customers to connect to the wastewater collection system, only allowing OWTS in rare occasions. CRW implements emergency storage volume at all wastewater lift stations to reduce the risk of stream contamination during a lift station power outage. CRW may implement differential flow metering on future force mains/lift stations to identify major leaks in the system promptly to reduce potential contamination of the watershed.

CRW has a robust sanitary sewer video inspection and maintenance program to reduce the number of SSOs within the basin.

From a Stormwater standpoint, CRW partners with CCBWQA on stream channel improvements on McMurdo Gulch to reduce phosphorus transport in the watershed. Water quality samples are collected up and downstream of the McMurdo Gulch improvements to measure nutrient reductions which average approximately 30% reduction from year to year. The Town has implemented several detention pond retrofits to incorporate full-spectrum detention on existing regional Stormwater detention ponds to incorporate water quality capture volume and reduce development impacts to downstream receiving waters.

Moving forward, the Town has implemented a no-turf ordinance for all new development which will drastically reduce the need for fertilizer application within the basin.

Waste Water Effluent Quality

Being a conjunctive use water system, CRW's water supplies naturally have variable raw water chemistries. It is important to evaluate the quality of each source, whether it is already treated (i.e. WISE water) or whether it is a raw water source that CRW will treat. It also is critical for CRW to review and understand

the blended water quality and how each source interacts in our system. Since treated wastewater effluent will ultimately make up 1/3rd of our water supply, it is critical to understand the water quality coming from our wastewater effluent.

Total Organic Carbon and Disinfection By-Products
Currently, the Town samples for dissolved organic carbons (DOC), total organic carbons (TOC), and light transmittance (at a wavelength of 254 nanometers) to determine if any disinfection by-product precursors exist in the water supply. These values likely will increase as the water sources transition to include more surface water supplies such as WISE and reusable water. The Town will need to monitor these values in the future to determine if additional treatment processes are necessary.

Total Dissolved Solids (TDS)
CRW staff monitors the concentration of TDS in the various water sources that are blended at PCWPF with the goal of having a finished water quality that does not exceed 450 mg/L TDS. At times, raw water within East Plum Creek (at the CR-1 Diversion) and at the Plum Creek Diversion can far exceed 500 mg/L. At those times, CRW operations staff will cease diversions until TDS concentrations have decreased. Elevated TDS in East Plum Creek is attributed to the application of road salt within the watershed during the snow season. Efforts are being made to optimize the use of road salt to decrease the impact to water quality.

Phosphorus and chlorophyll-a
Phosphorus is a nutrient found naturally in sediment and also in manmade products such as fertilizers and detergents, and has the potential to contribute to algae blooms in the reservoirs. Chlorophyll-a is the measurable substance in algae and is an indicator of water quality in the reservoir. CWA is the regulatory authority for the Chatfield Reservoir, in which CRW has storage rights, while CCBWQA is the authority for the Cherry Creek Reservoir and the overall Cherry Creek Watershed, which includes reservoirs that CRW has storage in. Managing nutrient levels in the watersheds is key to minimizing the potential for algal blooms in the reservoirs which can directly impact the amount of water that can be returned for reuse.

Indirect Potable Reuse and Direct Potable Reuse

To date, the current IPR practice at PCWPF has met all primary maximum contaminant levels (MCLs) in the finished water. 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 compared to current planned IPR practice. Contaminants of Emerging Concern (CECs), such as polyfluoroalkyl 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 and destruction 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. Disinfection byproduct (DBPs) precursor concentrations such as bromide will 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.

3. Hydraulic Modeling

Modeling Update Effort

During the course of updating the 2010 Wastewater Master Plan, Castle Rock Water invested a substantial amount of effort into developing the comprehensive wastewater model for the Town. By creating and updating the model with in-house staff, Castle Rock Water is now much less reliant on outside consultants for its models and is now much more self-sufficient. This allows Castle Rock Water to be better situated to respond to changing growth and demand scenarios. For instance, successful water conservation efforts drive down the average daily winter use rates on which demand curves are based, yet more sensitive flow metering devices better capture low flow and very high flow water usage that may drive up average winter demand readings. Castle Rock Water can now more quickly identify system deficiencies that may result from growth, and can perform multiple "what if scenario" analyses when presented with new planned developments. As a result, Castle Rock Water can better plan for future capital improvement projects with the goal of providing adequate and reliable service to the Town's residents without investment in unnecessary infrastructure.

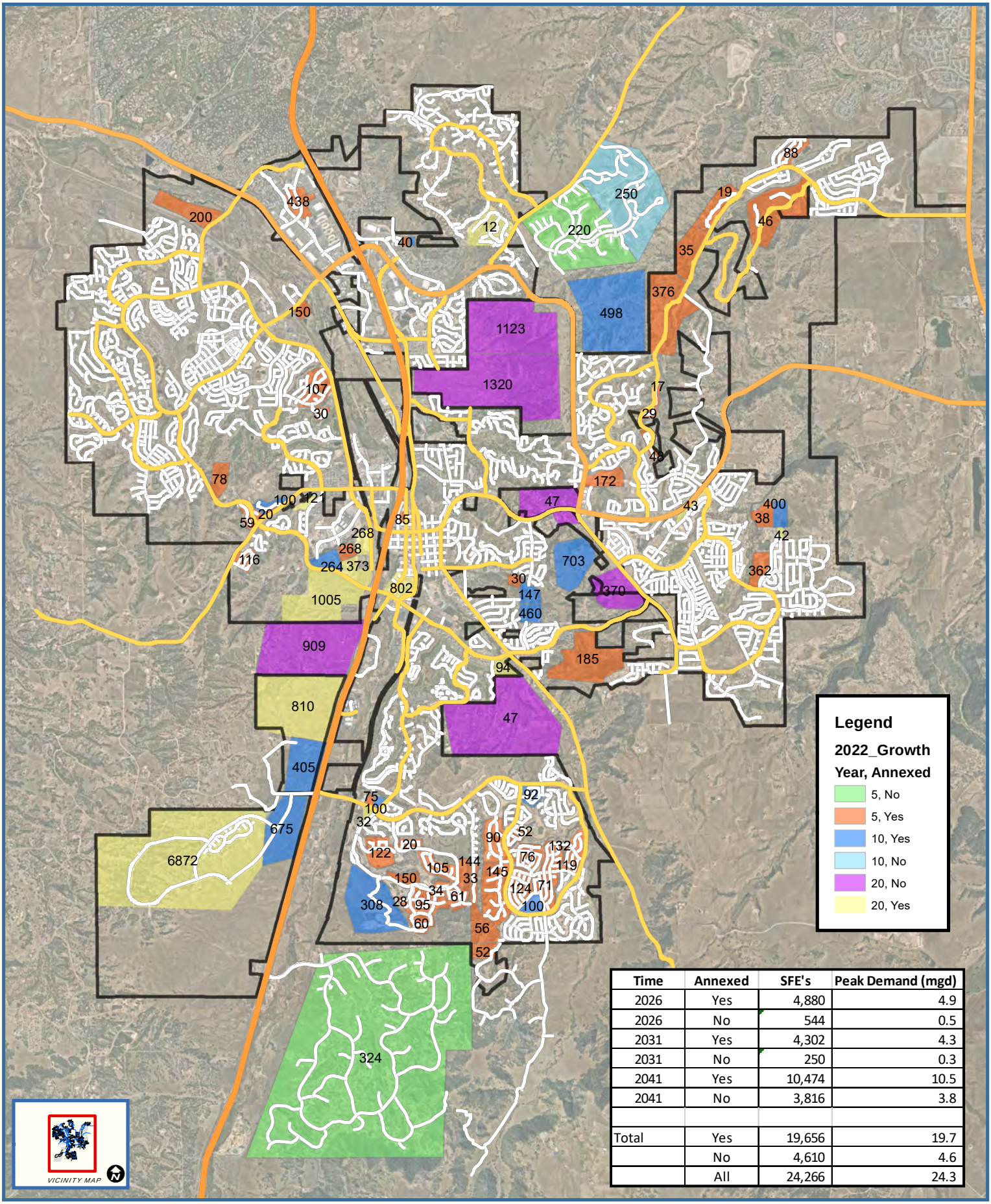
The Town's sanitary sewer hydraulic model was created in 2009 using Innovyze InfoSewer software. The model is designed to estimate the flow rates of wastewater using diurnal curves and wastewater loading estimates based on actual winter use, with loading applied to nodes in the model that represent sub-basins. The curves show the estimated high and low flow rates in the system in a 24-hour period. Future loading estimates are determined using Single Family Equivalent (SFE) projections for building in the sub-basins. Since the pace of growth varies, growth projections are generally updated annually. Refer to Figure 3.0 for anticipated growth rates in planning areas and anticipated time frames for development; these planning numbers were used in the hydraulic modeling estimates for future flows.

Wastewater Demand Rates

Demand per SFE is based on actual average winter use for developed parcels, and is based on 200 gallons per day per SFE for undeveloped parcels. The graph below shows the historic average daily wastewater demand per account for 2007 through 2021. The average is 196 gallons per day per SFE, which provides good support for the planning criterion of 200 gallons per day per SFE. For future residential development, the planning number is expected to decrease. Review of the average per account winter usage for homes built since 2017 (122.6 gal/day/account) versus homes built prior to 2017 (144.5 gal/day/account) shows a decrease of 15%. For future industrial or commercial parcels, the Town's land use planning criteria and parcel size were used, or an estimate of 200 GPD/SFE for the number of SFEs expected is calculated based on land use expected and square footage of facilities. All demands within a sub basin are totaled and the demand applied to a logical manhole (node) in the model. As land development occurs and better data becomes available (demand based on

actual use), revisiting the hydraulic model on a regular basis helps determine the needed capital improvement projects, their timing, and their criticality. As water conservation goals are met, particularly with respect to indoor water saving fixtures and consumption patterns, decreasing average wastewater flows per capita are realized. The use of graywater systems starting in some homes in 2022 could have an impact on wastewater flows if more systems are installed over time. Similarly, improvements in reducing the amount of inflow and infiltration into the collections system from groundwater and storm runoff reduce the hydraulic loading on the system. The result is that collection system mains that, in past modeling efforts, were predicted to reach capacity and need upsizing, no longer show up in the model as having capacity issues, require smaller upsize diameter, or are pushed farther out in the planning period. The planned capital projects go away. However, additional future unplanned developments, or changes in density or consumption, that would place additional loading on these sewer mains would prompt revisiting these projects.

The shape of the curve does indicate that infiltration/inflow (I/I) is contributory to flows to the PCWRA during wet years. The 2009 high (wet) year wastewater demand of 206 gal/day-SFE is 110% of the low (dry) year 2013 demand of 187 gal/day-SFE. This, too, provides support for the planning criterion of accounting for an additional 10% of wastewater flow due to I/I. See Figure 3.1 for historical average day wastewater demands. Figure 3.1 does indicate that rainfall has an impact on infiltration, as expected. Scrutiny of the data indicates that intensity (for example, a weeklong wet period) has more impact than an increase in annual average. The data also seems to support that sewer line rehab and lining since 2010 has had a measureable impact on infiltration.



Time	Annexed	SFE's	Peak Demand (mgd)
2026	Yes	4,880	4.9
2026	No	544	0.5
2031	Yes	4,302	4.3
2031	No	250	0.3
2041	Yes	10,474	10.5
2041	No	3,816	3.8
Total	Yes	19,656	19.7
	No	4,610	4.6
	All	24,266	24.3

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 2020, Town of Castle Rock Utilities Mapping.

CASTLE ROCK 2022 WASTEWATER MASTER PLAN FIGURE 3.0

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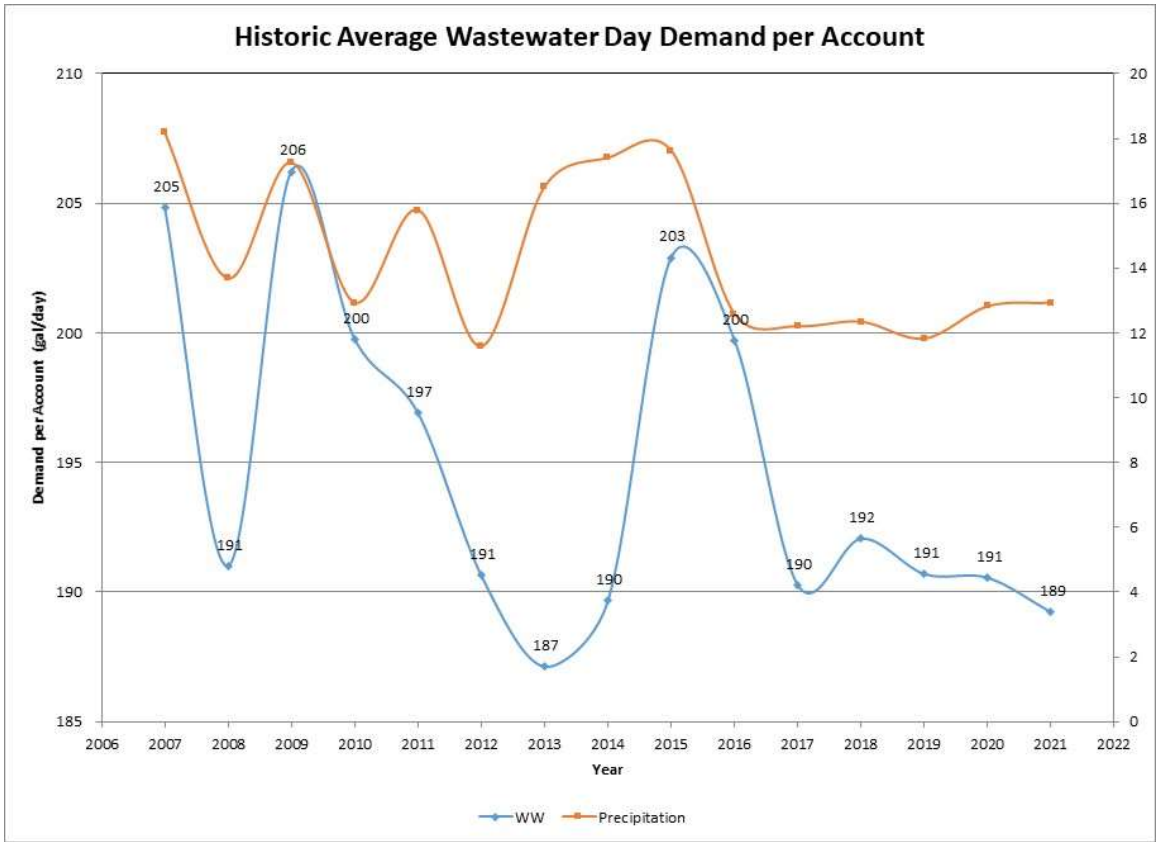
Figure 3.1


Historic Average Wastewater Day Demand per Account
Demand per Account (gal/day)
Year
WW
Precipitation
205
191
206
200
197
191
187
190
203
200
190
192
191
191
189

The Diurnal Curve

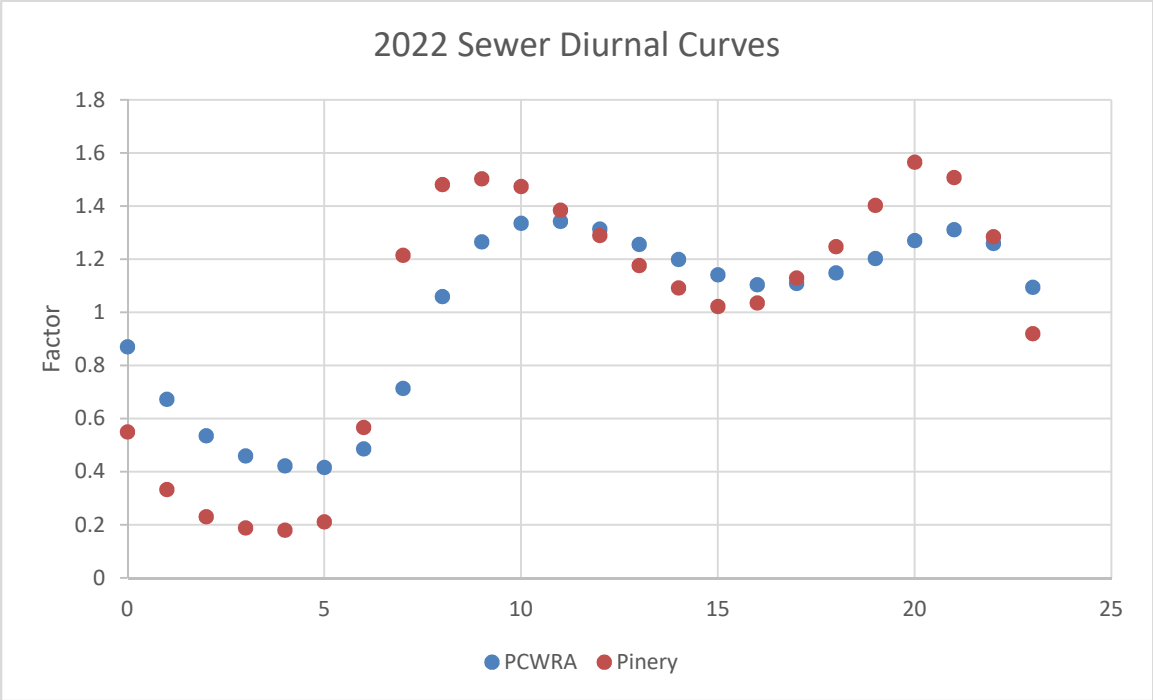
The diurnal curve was developed using data from the winter of 2009 to develop a typical maximum day demand. Typical demands in the Town were developed using winter 2009 customer billing information. This data represents a realistic distribution of demands throughout Town. Next, the December 2008, January 2009, and February 2009 SCADA data was used to generate a dry weather diurnal curve. Diurnal curves for each of the Town's three flumes (Meadows, Town Main and Town North) were generated using the data collected from the SCADA system.

A wet weather intensity curve was generated using operational SCADA data from June 2009, which was a wet month, and a 2009 maximum day flow rate of 4.14 Mgd. This operational data was combined with the estimated dry diurnal curve to generate the wet weather intensity curve.

The estimated inflow loading was evenly distributed throughout the Town's collection system. Calibration was completed by matching the model output with the operational data collected. This method accounts for the effect of inflow/infiltration (I/I) on the collection system. The hydraulic model used for this master planning effort was based upon the calibrated maximum day-peak wet hour demand model. The model is an extended period model using the diurnal curve shown above and simulating a maximum day demand over 37 consecutive days. The diurnal was reevaluated for the 2022 modeling effort but did not significantly change, so changes to the diurnal pattern in the hydraulic model were not required. The resulting curves, calculated for both PCWRA and the Pinery are shown in Figure 3.2.

For the 2022 update, the diurnal curve was revisited. Castle Rock Water staff did observe that during the 2020 COVID pandemic, with many people working from home and students remote, the diurnal curve flattened out and had much less pronounced mid-morning and evening peaks, indicating that people were using water more consistently throughout the day, not really using less water. If the trend continued well into the future and became more of a normal pattern, it could have implications on sizing of collection system infrastructure because the peak flows could be smaller, requiring smaller pipes. However, the 2022 diurnal curve is very similar to the 2016 curve and Castle Rock Water will not be changing its model criteria or design criteria based on this unusual condition.

Figure 3.2 Diurnal Curve



Historical Wastewater Flow

In 2009 the winter average flow rate was 2.8 Mgd and the 2009 overall average was 3.0 Mgd. The 2009 minimum and maximum flow rates were 2.6 Mgd, and 4.1 Mgd respectively. In 2016, the winter average flow rate was 3.51 Mgd and the overall average was 3.73 Mgd. The 2016 minimum and maximum flow rates were 3.23 Mgd and 5.37 Mgd, respectively. In 2022 the minimum flow day to the PCWRA occurred on January 11 with a total daily flow of 3.89 MG. In 2022, the peak hour, average day and peak day wastewater flow rates to the PCWRA were 8.26 Mgd, 4.47 Mgd and 6.42 Mgd, respectively, and occurred on May 6th after almost a week of daily precipitation. The increase in wastewater flow on May 6th, and on other days when there was significant precipitation, indicates that infiltration and inflow (I/I) are significant contributors.

Based on February 2021 billing data for 22,313 accounts, the calculated wastewater demand is 154 gallons per day per SFE and the calculated infiltration/inflow (I/I) rate is 11%. The changes in total wastewater flows reflect growth in the Town, newer infrastructure, sewer rehabilitation to reduce I/I, and changes in water use and conservation efforts. The 2022 ratio of maximum to minimum is 1.65 while the 2016 ratio of maximum to minimum was 1.66, and the 2009 ratio was 1.58. The 2022/2016 ratios of minimum to minimum and average to average were both equal to 1.20. The ratio of 2016 max to 2009 max was 1.31 and the ratio of 2022 max to 2016 max is 1.19. This would seem to indicate that hydraulic loading is increasing proportional to population, as would be expected. Castle Rock Water has been able to trace significant I/I events back to new development where uncapped collection system points allow rainwater runoff to drain to the collection system. New development in Town was very high in 2016, compared to the weak growth that was the case in 2009. Growth in 2021 was still very high, but late 2022 saw a weakening in demand for new permits.

Pipe Sizes

In the new model, all gravity sewer mains greater or equal to 10 inches in diameter were included. Additionally, select 8-inch diameter sewer mains were included if they served a fairly large sub basin or if there was a reason to suspect that future development upstream could create capacity issues. The criterion for determining if a pipe segment needs upsizing remains at greater than 75 percent capacity during a peak wet event.

System Diurnal Curve and Peak Wet Day

Based on flow data collected from the Town's SCADA system, a single diurnal curve for the Town and a wet weather intensity curve were developed; these curves were applied to average day demands and then extended period simulations were run in the model for both existing conditions and future conditions for the different planning horizons.

Reconciling Record Drawings/Model Data and Filling in the Gaps

To update the model, new mains are added; all 10-inch diameter and larger pipes are included in the model. Typically, smaller pipes only serve cul-de-sacs or older, smaller sub basins. However, an 8-inch pipe could be susceptible to surcharging during a peak wet event, so the model includes smaller 8-inch pipes where it makes sense (serves a larger sub basin or could have significant upstream development). Smaller pipes are often excluded from the modeling effort because they significantly increase the number of pipes in the model. In the 2010 model development, data was manipulated so that data discrepancies were eliminated and information was converted to a new uniform vertical datum. Additionally, survey data from the 2002 Glosso-Murray Sanitary Sewer Survey effort was used to verify invert and pipe slope data. GIS specialists keep the utilities mapping up-to-date as new development occurs, and new development information is included in the hydraulic model for regular updates. Castle Rock Water revisits the hydraulic model each year in support of developing the Capital Improvement Plan, and for annual updates to the rates and fees model. Castle Rock Water may revisit the model throughout the year as utility plans and/or development agreements for newly planned developments are being reviewed. This allows Castle Rock Water to determine if a development is responsible for the upsizing of existing infrastructure to serve their project, in line with the principle that growth pays for growth.

4. Capital Improvement Program

The hydraulic model of the collection system is used to identify capital improvements based on the projected growth. These improvements generally consist of sanitary sewer replacements/upsizing to accommodate future growth. Other improvements consist of replacing aging infrastructure, repairing failed components of the system, and addressing problems associated with inflow and infiltration. The CCTV Inspection Program and Asset Management Program are both useful for identifying areas for rehab based on condition and not capacity. Using the updated model, revised growth estimates, and criteria for upsize and/or replacement, the extended period simulation hydraulic model was run for three planning horizons. Within each planning horizon, capital improvement projects were identified for sections of the system where the capacity criterion of 75 percent was violated. Table 4-1 compiles CIP projects that have been completed since the 2003 Wastewater Master Plan.

As new development occurs in the Town, the development community routinely constructs new wastewater facilities required to serve the proposed development. These improvements are accounted for in the Town's wastewater model and categorized as developer contribution projects. Upon completion, these improvements are then conveyed to the Town. Based on planning numbers, utility reports and hydraulic modeling, several projects have been identified as necessary to support future development. See Figure 4.1 for the general location of the proposed or anticipated developer CIP projects.

This section contains a summary of work that has been completed by the Town since the adoption of the 2003 WWMP. This includes a review of program development, capital project construction, and maintenance. Table 5-1 provides the status of Town projects completed since the 2003 Master Plan.

Table 4-1
2004-2022 CIP Completed Projects

CIP Name	Construction Description	Year	Actual Cost
Kellogg Ct. Expansion	946 LF of 8"; 1,176 LF of 12"	2004	$343,700
North Front St. Bottleneck	1,500LF of 12"	2004	$469,000
Sellars Gulch Lift Station/Force Main/S. Gilbert St. Relief Gravity Main	5,596 LF 15" PVC; 2,686 LF 12" FM; 2.65Mgd LS; 1,430 LF of 18" gravity main	2004	$3,900,000
East Plum Creek Interceptor	8,120 LF of 18" PVC	2005	$2,300,000
Craig & Gould Infrastructure Improvements	Craig & Gould from South to Fifth, Gilbert to Front; replace/rehab sewers	2005	$2,086,710
Woodlands Interceptor Phase I and Phase II	4,459 LF of 24"; 1466 LF of 24" with I-25 Bore; Liggett Rd Bore	2007	$2,500,000
Gilbert St. South Relief Main Phase I and Phase II	3875 LF of 18" PVC	2007	$1,010,406

CIP Name	Construction Description	Year	Actual Cost
Founders Parallel Force Main Phase I and Phase II	11000 LF of 16" Force Main	2008	$2,016,300
Plum Creek Interceptor Upsize	1739 LF of 54"	2008	$800,000
Kinner St. Phase I Upsize	83 LF of 21" PVC	2008	$25,000
N. Gilbert St. Sewer Replacement	Replace 1,020 LF of old clay pipe with new 8” PVC pipe, 6 manholes and 10 service connections	2009	$205,600
Turnstone Sewer Upsize	Upsize 80 LF of 8in sewer to 12”	2010	$45,510
Manhole Rehab Sapphire Point	Rehab 6 manholes to reduce I/I	2010	$19,100
Craig and Gould Ph1	Replace 1,000 LF of old clay pipe with new 8” PVC	2010	$256,320
Sewer Rehab	2,450 LF of CIPP in Young American and Downtown, replace drop structures; Hillside Sewer	2010	$95,000
Sewer Rehab	Various point repairs around Town	2011	$257,000
Sewer Rehab	Fifth St. Sewer Replacement	2012	$72,000
Front St. Railroad/7th St Sewer Replacement	Install 120 LF of casing pipe and new 8” sewer main under railroad from Front St. to 7th Street	2012	$78,000
Meadows 5 LS Overflow	Construct emergency overflow	2012	$149,000
Sewer Rehab	Emergency Point Repairs and 10,000 Linear feet of CIPP Glovers area	2013	$326,690
Sewer Rehab	Point Repairs, Castle North	2014	$172,000
Plum Creek Interceptor Upsize at NM Extension	Replace 2,913 LF of 27” with new 36” Pipe, 10 new manholes as part of North Meadows Extension Road Project	2014	$700,000
Meadows 5 LS Panel Upgrades	Replace old electrical and control panels	2015	$43,000
MCLS Mixing System	Install mixing system in wetwell	2015	$45,000
Meadows 5 LS Pump Replacement	Replace worn pumps and corroded header pipes	2016	$41,947
Sewer Rehab	9,200 Linear feet of CIPP in the Castle North neighborhood; Barbi Ct. point repair	2016	$225,990
Maher Ranch Lift Station	Bioxide Addition	2017	$20,000
Castle Oaks Lift Station	Mixer System Addition	2017	$39,000
Old Caprice Dr WWTP	Demolition of old WWTP	2017	$147,748
East Plum Creek Exposed Sanitary	Sanitary Sewer Repaired	2017	$61,000
Meadows 17 Lift Station	Addition of Mixing System	2018	$10,000
Terrain Founders Gravity Sewer	Eliminated temp lift station; cost shared with developer	2018	$333,882

CIP Name	Construction Description	Year	Actual Cost
Castle Oaks Lift Station Pump Improvements, Phase 1	New impellers, shaft seals and wear rings	2018	$37,029
Sewer Rehab	Gordon Drive sewer improvements	2019-2020	$501,330
Castle Oaks Lift Station Pump Improvements, Phase 1	Rehabilitate pump impellers, shaft seals and wear rings	2019	$71,924
Sewer Rehab	Over two miles of sewer pipe CIPP Oman Sewer and Wolfensberger 15” Sewer Repair	2020	$300,963
Mitchell Creek Lift Station Pump Replacement, Phase 1	Replaced pump #3	2019	$55,000
Mitchell Creek Lift Station Pump Replacements, Phase 2	Replaced pumps #1 and #2	2020	$99,499
Jerry Street Downtown Alley Sewer Replacement	Replaced 380 Linear feet of 90-year old clay sewer pipe in downtown; replaced 2 manholes and 11 service connections	2021	$203,213
Sewer Rehab	Woodlands Manhole Rehabilitation, Phase 1	2020	$403,370
Mitchell Creek Lift Station	Replaced obsolete pumps	2019, 2020	$99,449
Mitchell Creek Lift Station	Added VFDs, reducing peak flows and reducing odors/chemical costs	2020, 2021	$3,982
Mitchell Creek Lift Station	Replaced aeration system with Wet Well Wizards	2020	$43,904
Sewer Rehab	Glovers Sewer Rehab and laterals replacement, Phase 1	2021	$588,000
Castle Oaks Lift Station Mixing System	Installed Wet Well Wizards	2021	$22,295
PCWRA Plant Expansion	Increased plant treatment capacity from 6.44 to 9.44 Mgd, with Town’s share of capacity at 7.14 Mgd	2021	$36,166,532 (Town’s share:$30.8M)
Village North-Malibu Sewer Upsize	Replaced 1,172 linear feet of old, undersized clay pipe; joint project with Stormwater Division	2021-2022	$398,487
Oakwood Apartments	Replaced and upsized 440 LF of old clay sewer pipe and two manholes; collaborated with developer	2021	$178,000
Craig and Gould North Infrastructure Improvements, Phase II	Replace 1,480 LF of old clay pipe and sewer laterals; joint project with Stormwater and Public Works	2021-2023	$507,000
Sewer Rehab	Glovers Sewer Rehab and laterals replacement, Phase 2	2022	$478,050
Sewer Rehab	Woodlands Interceptor Manhole Rehabilitation, Phase 2	2022	$960,095
		TOTAL	$54,546,493

In some instances, projects were not completed as identified in the original 2003 WWMP because a cost saving alternative was constructed instead, or updated

hydraulic modeling indicated the project was no longer needed, or the scope had changed. Table 4-2 provides a list of Town projects that were not completed since the 2003 Master Plan. A description of the project alternative follows.

Table 4-2
2004-2021 CIP Not Completed

CIP Name	Construction Description	Estimated Cost from 2003 MP
South Castleton Drive Upsize	2170 LF of 15"	$606,000
Kinner St. Bottleneck	2394 LF of 30"; 58LF of 36"	$982,000
Lanterns Heckendorf Ranch LS	2000 LF of 8" FM, 1.43 Mgd Lift Station	$804,000
Plum Creek Interceptor Emergency Upsize	848 LF of 36" PVC: 250 LF of 30" PVC	$461,000
Mikelson Boulevard Upsize	2000 LF of 8” and 10” sewer to 12”	$493,000

The South Castleton Drive Upsize was a project to replace 2,170 linear feet of 12-inch sewer pipe with larger 15-inch diameter pipe. This project would have started near the Douglas County Justice Center and terminated at State Highway 85. Based on the Town’s 2015 modeling effort, this project dropped completely out of the CIP list due to changes in the wastewater flow rate from the Justice Center used in the 2010 modeling effort. Previous estimates of the Justice Center flow rates were based on water use meter calculations that were too high due to incorrect meter size in billing records. Once water use for the Justice Center was corrected in the hydraulic model, the sewer capacity was no longer an issue. The project is no longer needed and has been eliminated from the capital plan.

The Kinner Street Bottleneck project, with almost 2,500 linear feet of 30 and 36-inch pipe, was not completed. A 95 percent design was completed for the project and then growth substantially slowed. Castle Rock Water staff reassessed the project and identified a cost saving alternative to alleviate the near-term capacity issue. A short 84 linear foot (Kinner Street Phase 1) project was constructed to alleviate the immediate bottleneck situation in the Kinner Street sewer segment. This fix was completed for $25,000 instead of $982,000. However, due to the age of this sewer line, its location, and its criticality in the interceptor system, risk and consequence of failure is considered high and it has been identified as a future CIP for evaluation in year 2026, and for rehabilitation in 2027-28, if needed, at a budgetary cost of $2.245 Million. Timing of the project will be reevaluated each year as part of the budgeting process and/or based on new condition assessment information.

The Lanterns-Heckendorf Ranch Lift Station project was replaced by the *East Plum Creek Interceptor Project* that was completed in 2005 at a cost of $2.3 million. The Gravity Interceptor Project was much more desirable than a lift station from a long term operations and maintenance costs perspective, and is much more reliable.

The Plum Creek Interceptor Emergency Upsize project was only partially completed, but has evolved into the scope of other projects. A portion was constructed in coordination with the construction of the Lowe's Home Improvement Center complex to minimize future disruption from the sewer project construction. Another segment, the Plum Creek Interceptor Upsize at North Meadows Extension, was completed in 2014 as part of the North Meadows Extension (Castle Rock Parkway) roadway project at a cost of $700,000. The Plum Creek Interceptor at PCWRA project is north of this completed section and is planned in the future beyond 2037. This segment will be coordinated with PCWRA and any future plant expansion, or even roadway improvements. The portion of the interceptor north of the Lowe's section and south of the North Meadows Section (Plum Creek Interceptor North Upsize) is planned for buildout beyond 2037. Accelerated development or major roadway projects could affect timing of either of these remaining projects.

Mikelson Boulevard Upsize – In the 2003 Master Plan, this project was identified to upsize almost 2,000 linear feet of 8 and 10-inch sewer to 12-inch. The revised 2010 modeling effort indicated that less than 100 feet of 8-inch gravity sewer pipe, at the force main outfall, needed to be upsized to 10-inch. The modeling indicated that a short stretch of sewer was only surcharging when pumps at the Castlewood Ranch Lift Station #2 ran. This project was ultimately renamed the Turnstone Sewer Upsize Project and was completed in July 2010. The total actual project costs were $45,359 instead of $493,000. This project particularly emphasizes the value that a calibrated hydraulic model and professional staff add to the capital planning effort.

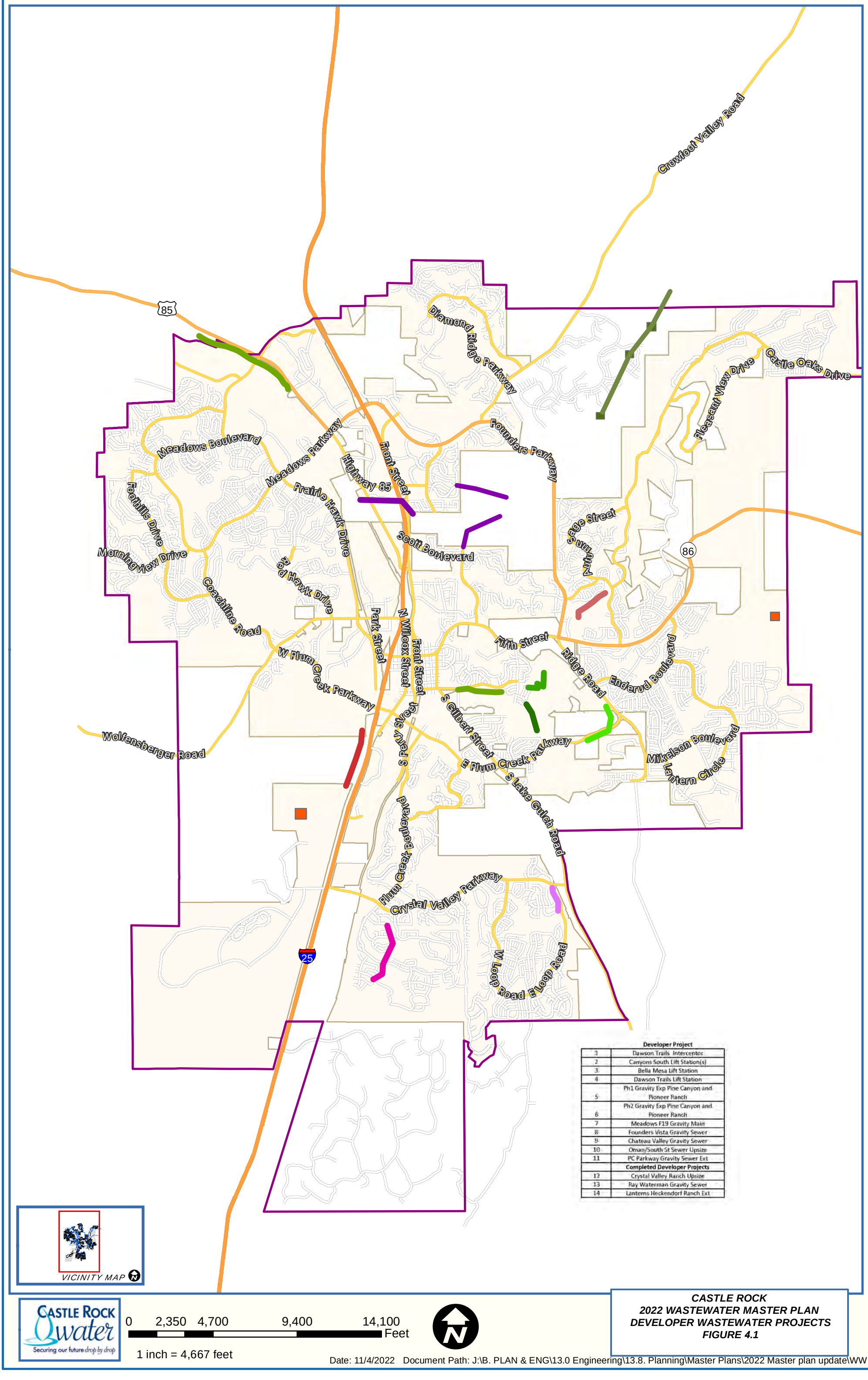
As new development occurs in the Town, the development community routinely constructs new wastewater facilities required to serve the proposed development. These improvements are accounted for in the Town's wastewater model and categorized as developer contribution projects. Upon completion, these improvements are then conveyed to the Town. Many developer contribution projects have been completed since the 2003 WWMP. Table 4-3 provides a list of developer contribution projects completed since the 2003 Master Plan. Based on planning numbers, utility reports and hydraulic modeling, several projects have been identified as necessary to support future development. Table 4-4 provides a list of anticipated developer projects to be completed in the future in support of future development. See Figure 4.1 for completed and future developer wastewater CIP projects.

Table 4-3
Completed Developer Wastewater Projects 2004-2022

CIP Name	Construction Description	Year Completed
Castle Oaks Expansion – Phase I	2.3 Mgd Lift Station	2005
	13,500 LF of 12-inch DIP Force Main	2005
	1,890 LF of 8”; 2,900 LF of 15”; 7,165 LF of 18” gravity pipeline	2005
Lanterns-Heckendorf Ranch Expansion	4,530 LF of 10”; 1,980 LF of 12”; 4,530 LF of 8” gravity pipeline; 50 LF of 21”	2005-2006
Crystal Valley Ranch Expansion – Phase I	4,430 LF of 10”; 5,620 LF of 12” gravity pipeline	2006
Meadows Expansion – Phase I	3,063 LF of 12”; 6,560 LF of 21”; 1,990 LF of 24” gravity pipeline	2005
Meadows Expansion – Phase II	0.5 Mgd Liftstation	2005
	200 LF of 10” Force Main	2005
	1,900 LF of 8” Gravity Pipeline	2005
Meadows Expansion – Phase III	2,270 LF of 12” gravity pipeline	2005
Castle Oaks Expansion – Phase II	2,870 LF of 8” gravity pipeline	2007
Crystal Valley Ranch Expansion – Phase II	1,510 LF of 8” gravity pipeline	2007
Crystal Valley Loop Road sewer expansion	1,900 LF of 12” upsized to 15”	2019
Ray Waterman Treatment Plant (RWTP) Gravity Sewer Main	1,680 LF of 10” sewer to replace old temp lift station; developer cost shared. Upon completion, the temporary lift station serving the RWTP and the King Soopers/Founders Marketplace was abandoned.	2018
Macanta (aka Canyons South)	Interceptor to the Pinery and Collection System Pipes, as phases develop	2020
Lanterns Heckendorf Ranch Expansion	Collection system pipes complete and ongoing as phases develop	Ongoing in 2022

Table 4-4
Future Developer Wastewater Projects: 2022-Future

CIP Name	Project Description
Meadows Filing 19 - Highway 85 Sewer Main	8” and larger gravity pipelines to PCWRA; originally identified in previous master plans as a lift station, force main and gravity mains to serve the area
Pine Canyon/Pioneer Ranch: Gravity Expansion at SMH261 – Phase I	4,270 LF of 8" gravity pipeline; dependent on approval of Pine Canyon and Pioneer Ranch
Pine Canyon/Pioneer Ranch: Gravity Expansion at SMH261 – Phase II	1,700 LF of 10” gravity pipeline; dependent on approval of Pine Canyon and Pioneer Ranch
Founders Filing No. 24: Bella Mesa Lift Station and Force Main	Proposed lift station and associated force mains/gravity mains are anticipated
Macanta (formerly known as Canyons South)	Two to three proposed lift stations and associated force and gravity mains
Lanterns Heckendorf Ranch Expansion	Additional gravity pipelines to serve the area as development progresses (underway).
Dawson Trails: Interceptor Upsize (formerly known as Dawson Ridge)	Modeling indicates that should Dawson Trails eventually develop to its fully anticipated density, 2,921 linear feet of 12-inch sewer will need to be upsized to 15-inch, and 3,133 linear feet of 15-inch will need to be upsized to 24-inch.
Dawson Trails: Lift Station and Force Main	Preliminary Utility Reports indicate that a future lift station(s) may be required to serve portions of the development.
Brisco/Fair St. Alley: sewer upsize	Redevelopment in the downtown central Castle Rock may warrant upsize of the sewer main in the alley; the condition of the sewer main is very poor and may be addressed with a sewer rehabilitation project despite the potential for future redevelopment.
Founders Vista: Gravity Sewer	Gravity sewer to connect to existing sewer mains in the Valley Drive/Oman Street area
Chateau Valley: Gravity Sewer	Gravity sewer to connect to existing sewer mains in the Valley Drive/Oman Street area
Founders Vista/Chateau Valley: Oman/South St. Sewer Upsize	Oman Street interceptor may require upsizing to support the Founders Vista and Chateau Valley projects
Villages at CR/Memmen parcels: PC Parkway Gravity Sewer Ext	Gravity sewer extension expected to be required to support future Memmen Parcels and Villages at Castle Rock development along Ridge Road; portions may need to be completed in advance of development due to the Plum Creek Parkway Roadway Widening Project



	Developer Project
1	Dawson Trails Interceptor
2	Canyons South Lift Station(s)
3	Bella Mesa Lift Station
4	Dawson Trails Lift Station
5	Ph1 Gravity Exp Pine Canyon and Pioneer Ranch
6	Ph2 Gravity Exp Pine Canyon and Pioneer Ranch
7	Meadows F19 Gravity Main
8	Founders Vista Gravity Sewer
9	Chateau Valley Gravity Sewer
10	Oman/South St Sewer Upsize
11	PC Parkway Gravity Sewer Ext
	Completed Developer Projects
12	Crystal Valley Ranch Upsize
13	Ray Waterman Gravity Sewer
14	Lanterns Heckendorf Ranch Ext

VICINITY MAP

CASTLE ROCK Qwater
Securing our future drop by drop

0 2,350 4,700 9,400 14,100 Feet

1 inch = 4,667 feet

CASTLE ROCK
2022 WASTEWATER MASTER PLAN
DEVELOPER WASTEWATER PROJECTS
FIGURE 4.1

Date: 11/4/2022 Document Path: J:\B. PLAN & ENG\13.0 Engineering\13.8. Planning\Master Plans\2022 Master plan update\WW Master

A major factor that impacts the wastewater program is the growth rate for new housing. When the 2003 plan was developed the Town was experiencing explosive growth in single family residential housing. At its peak, the Town issued 1,500 single family building permits in 2005. This resulted in the need for an aggressive Capital Improvement Program that could respond to the increase in homes and subsequent wastewater flows. From 2004 – 2010 the wastewater program generally budgeted approximately 2.1 Million dollars per year for CIP projects. However, beginning in about 2006 there was a decline in growth in the Town and in 2009 the Town only issued 275 single family building permits. That decline necessitated the reduction of the annual CIP budget to approximately less than $860,000 per year for the 2011 – 2015 planning horizon. 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 4-5.

Table 4-5
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	845

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

The projected 2022-2027 growth projections are shown in Table 4-6 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 4-6
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

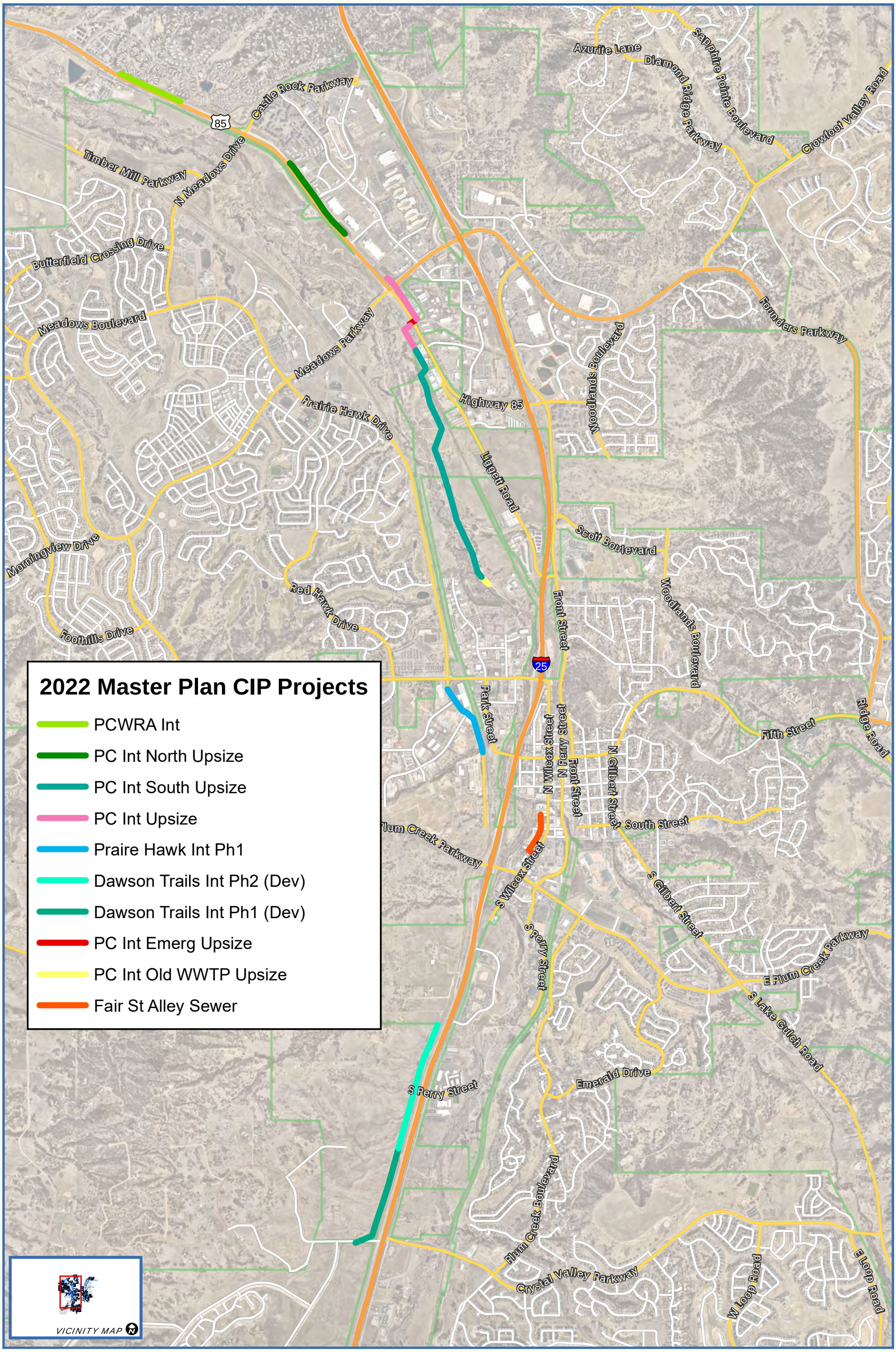
Since the 2003 Master Plan, several Town projects that were previously identified in the 2010 - 2015 planning horizon were either modified in scope or dropped out of the CIP altogether. This is primarily due to the incorporation of revised growth estimates, and an extensive effort to resolve inconsistencies and errors in the wastewater system model through field verification and calibration to SCADA data. As a result, in 2016 the updated model supported a scaled-back Capital Improvement Program that eliminated almost $8 Million in expenditures over the planning period of 2011 to 2025, with almost $5 Million saved in the 5-year planning period of 2011-2015. Similarly, the latest capital plan update indicates that several projects previously identified for the 2021-2025 Planning Horizon may be shifted to beyond the 2028 timeline to a future build-out timeline.

In most cases the remaining capital improvement projects are very similar to those identified in the 2003 Master Plan, with revisions to the overall length of the project and/or the ultimate size of the pipe required to meet build-out projections. Typically, the most significant change to a CIP was in the timing of the project due to changes in growth rates, but also due to successful water conservation efforts that have reduced the daily per capita consumption (see figure 3.1). Because of the slower growth rate many projects have now been delayed well into the future, with many projects occurring in the 2028 – build-out planning horizon. Successful water conservation efforts to minimize and reduce indoor consumption result in reduced sizes for future projects, and delay the timing of upsizing. Additional indoor water consumption conservation could impact future projects, underscoring the importance of revisiting the hydraulic model and the capital plan on a regular basis.

In addition to project specific capital improvements to the system, the Town also has several recurring programs that are funded annually, as well as continuing obligations for PCWRA improvements. Table 4-7 shows the recurring programs, capital improvement projects and PCWRA obligations for the next 5-year planning period. Note that costs shown are just estimates for budgeting purposes and are likely to change as projects develop from concept to construction. See Figure 4.2 for a map of Castle Rock Water CIP project locations.

Town of Castle Rock
CIP Project List
CIP Projections thru 2065

	F	O	P	Q	R	S	T	W	AB	AC	AD	AE	AF
1													
2							2023-2027		2028-2055	2056-2060	2061-2065	Total CIP Budget 2023 - 2065	
3	**Wastewater Fund Capital Improvement Program**	**2023**	**2024**	**2025**	**2026**	**2027**	**Subtotal**		**Subtotal**	**subtotal**	**subtotal**	**Total**	**Planned Year?**
4	**Collection Lines**												
5	Lift Station Rehab/Replacement	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 250,000		$ 1,400,000	$ 250,000	$ 250,000	$ 2,150,000	
6	Lift Station Pump and Motor Replacements	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 500,000		$ 2,800,000	$ 500,000	$ 500,000	$ 4,300,000	
7	Castle Oaks Lift Station Upgrade	$ 500,000					$ 500,000					$ 500,000	
8	Lift Station Mixing Improvements				$ 50,000		$ 50,000		$ 300,000	$ 50,000	$ 50,000	$ 450,000	
9	WW Facility VFD replacement	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 1,100,000		$ 6,160,000	$ 1,100,000	$ 1,100,000	$ 9,460,000	
10	Brisco Fair Alley sewer replace								$ 755,764			$ 755,764	2037+ buildout
11	Malibu Street Upsize (Village N), Ph 2						$ -		$ 812,010			$ 812,010	2028+
12	**AMI projects**	$ 902,689	$ 848,477	$ 849,927	$ 50,494		$ 2,651,587					$ 2,651,587	
13	Security Improvements	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 25,000	$ 125,000		$ 700,000	$ 125,000	$ 125,000	$ 1,075,000	
14	***SCADA System Improvements (Existing Improvements in SCADA Div)***	*$ 347,000*	*$ 204,000*	*$ 285,000*	*$ -*	*$ -*	$ 836,000		*$ 2,800,000*	*$ 500,000*	*$ 500,000*	$ 4,636,000	
15	Sewer Line Rehab/Replacement	$ -	$ 2,400,000	$ 2,400,000	$ 2,400,000	$ 2,400,000	$ 9,600,000		$ 67,200,000	$ 12,000,000	$ 12,000,000	$ 100,800,000	
16	Prestwick Sewer Laterals	$ 450,000					$ 450,000					$ 450,000	
17	Kinner Street Sewer				$ 200,000		$ 200,000		$ 2,245,000			$ 2,445,000	2027+
18	**INTERCEPTORS**												
19	**Plum Creek Interceptor Upsize (additional funding for revised scope)**	$ 4,000,000					$ 4,000,000		$ -			$ 4,000,000	
20	Plum Creek Int PCWRA Upsize						$ -		$ 940,722			$ 940,722	2037+ buildout
21	Plum Creek Interceptor North Upsize						$ -		$ 1,276,391			$ 1,276,391	2037+ buildout
22	Plum Creek Int South Upsize - Phase I						$ -		$ 1,411,024			$ 1,411,024	2031
23	Plum Creek Int South Upsize - Phase II						$ -		$ 2,054,850			$ 2,054,850	2031
24	Plum Creek Int Old WWTP Upsize						$ -		$ 269,226			$ 269,226	2031
25	Prairie Hawk Interceptor						$ -		$ 907,074			$ 907,074	2037+ buildout
26													
27	**TREATMENT**												
28	Rehab/Replacement at PCWRA	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 480,000	$ 2,400,000		$ 13,440,000	$ 2,400,000	$ 2,400,000	$ 20,640,000	
29	PCWRA Capital Buy-in (Debt Service + Capital Exp/Replacement)	$ 73,465	$ 73,106	$ 75,845	$ 75,845	$ 76,000	$ 374,262		$ 2,100,000	$ 375,000	$ 375,000	$ 3,224,262	
30	**PCWRA Capacity Expansion**						$ -		$ 35,000,000			$ 35,000,000	2035-2041
31	**OTHER PROJECTS**												
32	Lift Station Paving projects	$ 50,000					$ 50,000		$ 225,000	$ 75,000	$ 75,000	$ 425,000	
33	Meadows 17 Lift Station Access Road paving (1060x15x4)						$ -		$ 225,000		$ 75,000	$ 300,000	
34	Castlewood Lift Station #1 Access Road Paving (200x15x4)						$ -		$ 54,000		$ 18,000	$ 72,000	
35	Castlewood Lift Station #2 Access Road Paving (450x15x4)						$ -		$ 96,000		$ 32,000	$ 128,000	
36	Mitchell Creek Lift Station paving						$ -		$ 90,000		$ 30,000	$ 120,000	
37	Sellars Gulch Lift Station paving						$ -		$ 90,000		$ 30,000	$ 120,000	
38	Maher Lift Station Access Road Paving (500x15x4)						$ -		$ 120,000		$ 40,000	$ 160,000	
39		**2023**	**2024**	**2025**	**2026**	**2027**	**2023-2027**						
40	**Total Sewer Fund**	$ 7,198,154	$ 4,400,583	$ 4,485,772	$ 3,651,339	$ 3,351,000	$ 23,086,849	$ -	$142,572,060	$17,300,000	$17,300,000	$200,208,909	


Azurite Lane
Diamond Ridge Parkway
Sapphire Pointe Boulevard
Crowfoot Valley Road
Castle Rock Parkway
85
Timber Mill Parkway
N Meadows Drive
Butterfield Crossing Drive
Meadows Boulevard
Meadows Parkway
Prairie Hawk Drive
Highway 85
Liggett Road
Woodlands Boulevard
Founders Parkway
Scott Boulevard
Mornigview Drive
Red Hawk Drive
Foothills Drive
Front Street
25
Park Street
N Wilcox Street
N Perry Street
Front Street
N Gilbert Street
Fifth Street
Ridge Road
South Street
Plum Creek Parkway
S Wilcox Street
S Gilbert Street
S Perry Street
E Plum Creek Parkway
S Lake Gulch Road
S Perry Street
Emerald Drive
Plum Creek Boulevard
Crystal Valley Parkway
W Loop Road
E Loop Road
2022 Master Plan CIP Projects
PCWRA Int
PC Int North Upsize
PC Int South Upsize
PC Int Upsize
Praire Hawk Int Ph1
Dawson Trails Int Ph2 (Dev)
Dawson Trails Int Ph1 (Dev)
PC Int Emerg Upsize
PC Int Old WWTP Upsize
Fair St Alley Sewer
VICINITY MAP
CASTLE ROCK Qwater
Securing our future drop by drop
0 1,150 2,300 4,600 6,900
Feet
1 inch = 2,337 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
2022 WWMP
FIGURE 4.2
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2016-2021 Planning Horizon – Status of Capital Improvement Projects from the 2016 Wastewater Master Plan:

- ***Craig and Gould North Infrastructure Improvements*** – This project is to rehab and replace the aging infrastructure in the Craig and Gould North neighborhood, north of Fifth Street, in conjunction with storm and topside public street improvements. This project was under construction in 2021 for completion in early 2023; Cost: $507,000.

- ***Plum Creek Interceptor Upsize*** – see 2028-Buildout Planning Horizon

- ***Gordon Drive Sewer Improvements*** – This project rehabbed or replaced 1,450 linear feet of old clay pipe in conjunction with a major stormwater and street improvement project. Construction was completed in 2020. Project costs: $501,330.

- ***PCWRA Projects –*** see previous section under Treatment
  - Ditch Three – completed in 2017
  - Manganese Control – incorporated into Treatment Plant Expansion completed in 2021
  - Rehab and Replacement – projects completed as needed
  - Capital Expansion – completed in 2021 at a cost of $36,166,532; Town's share of costs: $30.8M.

- ***Glovers Sewer Rehab and Sewer Lateral Replacement, Phase I***: In coordination with a major waterline replacement project that required complete road reconstruction, 90 sewer laterals and two manholes in the affected project area were replaced to the edge of the right of way. Project was completed in 2021. Projects costs: $588,000.

- ***Malibu Street Upsize Phase 1*** – This project replaced 1,172 linear feet of existing 15-inch old clay sewer pipe to 21-inch diameter new PVC sewer main. This project was originally in the 2021-2025 Planning Horizon but was completed in 2022 in coordination with a major stormwater upgrade in the project area. Project costs: $398,487.

2022 – 2027 Planning Horizon - Capital Improvement Projects:

Five projects have been tentatively identified as required in this timeframe to meet build-out conditions, or due to area-wide infrastructure projects, or as shown on the rehab plan. Growth rates in the next decade will largely determine the timing for these projects, and several could be driven by road improvement projects and/or commercial development. Other capital projects are often identified for major rehabilitation or replacement of existing facilities.

- ***Glovers Sewer Rehab and Sewer Lateral Replacement, Phase II***, under way in 2022; Scope: replace all sewer laterals, estimated at 131, within project area; Cost: $554,900.

- ***Prestwick Sewer Rehab and Sewer Lateral Replacement***: Scope: replace all sewer laterals within the project area; No cost estimate but expected to be similar to Glovers Sewer Lateral Replacement, Phase II; to be funded under Sewer Rehab program; $450,000 has been budgeted.

- ***Plum Creek Interceptor Upsize –*** This project incorporates the State Highway 85 crossing at Castleton (see Section 2) into a larger capital replacement project. The project was designed and taken to bid in January 2019 but bid proposals far exceeded the budget reflecting the difficulty with completing the project per the design in the current alignment, due to existing utilities, topography, and private facilities. Alternative alignments and other options are being reevaluated, timing has shifted to 2023, and the budget adjusted to reflect the complexities of the project. A total of 2,400 LF of 27” sewer to be installed; estimated costs: $4,000,000.

- ***Kinner St. Sewer*** – This project is to upsize nearly 3,000 linear feet of existing 18 and 21-inch sanitary sewer main to 21 and 24 inches, respectively. This project involves a crossing of Interstate-25, East Plum Creek, and Wolfensberger Road. Hydraulic modeling does not indicate that the existing Kinner St. sewer needs to be upsized to accommodate buildout flows. However, given the age, location (under I-25 and the East Plum Creek) and critical nature of the interceptor, condition assessment should be performed to determine if rehabilitation is warranted in the near term Development in and around Kinner Street and Wolfensberger Road could dictate that any rehabilitations be completed sooner than anticipated. Estimated costs: $200,000 for evaluation to be completed in 2026, with rehab or replacement deferred to the buildout planning horizon beyond 2028.

- ***Brisco/Fair St. Alley Sewer*** – move from buildout and complete sooner with water rehab project. This has also been identified as a potential developer CIP should a commercial project be planned for the project area, but given the age and condition of both the water and sewer pipes, has been identified as a CRW capital project. Scope: replace 950 linear feet of old 6” clay pipe with new 12” PVC pipe; estimated costs $714,175.

2028 – Build-out Planning Horizon - Capital Improvement Projects:

- ***Plum Creek Interceptor PCWRA Upsize*** – This project upsizes 2,270 linear feet of the existing 27-inch interceptor to 36 inches in the area east of State Highway 85, beginning north of Castlegate Parkway and continuing to the PCWRA influent manhole. Estimated Costs: $940,722.

- ***Plum Creek Interceptor North Upsize*** – This project upsizes over 2,415 linear feet of existing 27-inch diameter gravity main to the ultimate size of 36 inches. The project begins near the Atrium Drive entrance to the Factory Shops and ends north of Castlegate Drive. This project was investigated in 2015 for fast track completion due to the Promenade development; however, a lack of information surrounding CDOT plans for the corridor led to the decision to delay, since hydraulic capacity is not an issue. Modeling indicates the project could be delayed to beyond 2026; however, State Highway 85 improvements could force the project to be completed sooner, although it is in the build-out phase for planning purposes. Estimated costs: $1,276,391.

- ***Plum Creek Interceptor South Upsize Phase 1*** – This project upsizes over 1,500 linear feet of existing 24-inch gravity main to 27 inches. A parallel gravity main to complement the existing interceptor may be an option. Estimated costs: $1,411,024.

- ***Plum Creek Interceptor South Upsize Phase II*** – This project upsizes over 4,300 linear feet of existing 24-inch gravity main to the ultimate diameter of 36 inches. The project includes a probable bored crossing of the railroad. Estimated costs: $2.055 Million.

- ***Prairie Hawk Interceptor*** – This project is to upsize over 1,600 linear feet of 12-inch sewer to 18 or 21 inches. The project begins at manhole SMH1362 and ends at manhole SMH1249, near Atkinson Way. Modeling indicates this project could be delayed to the future; however, development in the area could drive completing sooner. Estimated costs: $907,074; timing in buildout phase beyond 2028.

- ***Plum Creek Old WWTP Upsize*** – This is a project to upsize almost 300 linear feet of sewer main from 18 inches to 27 inches, which runs through the old WWTP, and replace/rehab four manholes. The project is required to gain extra capacity in sections of gravity main that are at minimum slope. Estimated costs: $269,226.

- ***Future PCWRA Plant Expansion –*** $35 Million is included in the long-term capital plan budget for a future expansion of the wastewater treatment plant. Should the town wastewater service area population exceed roughly

105,000 people, expansion of wastewater treatment capacity will be required. Timing of the expansion is heavily growth dependent, but planning and design should begin 2-3 years before the need materializes.

SH-85 Regional Wastewater Project-This is a project to implement a regional wastewater system in Northwest Douglas County along the SH-85 corridor. The Town is potentially partnering with Dominion Water and Sanitation District, the Plum Creek Water Reclamation Authority and Douglas County to provide a viable and sustainable wastewater collection system solution for existing and future customers along the Highway 85 corridor. Long term benefits include improving the environmental and water quality challenges along Plum Creek and ultimately the Chatfield Reservoir by reducing the number of Onsite Wastewater Treatment Systems (OWTS) along the corridor. Other benefits include keeping valuable reusable water supplies in Douglas County for use by Douglas County residents. The project could help improve the economic viability of the corridor for existing and future residences, businesses and property owners.

The possibility of expanding the service area to include the SH-85 corridor would most likely necessitate that the treatment plant capacity expansion proceed sooner. See Figure 4.3 for an exhibit of the potential SH-85 Sewer Collections project. CRW would own and operate this infrastructure, providing extraterritorial service.

Regional Water/Wastewater Planning

TITAN RD

TITAN PKWY

Existing DWSD Lift Station

Sterling Ranch

Plum Creek

~14,000 LF 12" Force Main

~12,000 LF

Proposed Lift Station B

Louviers

~15,700 LF

N US HIGHWAY 85

~20,200 LF 12" Force Main

~3,000 LF Gravity Main

Sedalia

Proposed Lift Station C

Plum Creek Water Reclamation Authority Facility

West Plum Creek

East Plum Creek

Castle Rock

ERP Outlet
Storage Tank
Proposed Louviers Supply A
Proposed Louviers Supply B
Lift Station
Proposed Core Electric Gravity Sewer
Proposed Sewer Force Main
Eastern Regional Pipeline
Potable Water Main
Raw Water Main
Ravenna Pipeline

N

0 0.5 1 2 Miles

Figure 4.3
SH-85 Sewer Collection System Project

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5. Recurring Capital Improvement Projects

Several programs are funded yearly. A description of each follows:

- ***Plum Creek Water Reclamation Authority (PCWRA) Projects –*** The PCWRA is a regional reclamation facility that serves the Town of Castle Rock, Silver Heights, Castleton District, Castle Pines, and Castle Pines North. The Town's share of the capacity is currently 7.14 Mgd. The Town currently contributes approximately 83 percent of the total wastewater load to the PCWRA facility, and therefore is responsible for its proportionate share of expenses for expansion, operations, maintenance and upgrades. For 2023 thru 2027, approximately $550,000 per year is budgeted for Rehab/Replacement and debt service obligations. Planning and budgeting for PCWRA projects are performed by the authority.

- ***Lift Station Upgrades*** – This is a program to cover improvements to existing lift stations, and lift station pumps, motors, mixers, and variable frequency drives (VFD) replacements, as well as lift station access drive paving and maintenance. This program is funded at almost $500,000 in 2023 thru 2027; larger capital improvements may be funded as CIP projects.

Old pumps at the Mitchell Creek Lift Station were replaced with new Gorman Rupp pumps.

Example of a Wet Well Wizard in action. Similar system was installed at the Mitchell Creek Lift Station.

Wet Well Wizard and the blower/motor system that runs it.

- ***Sewer Line Rehab and Replacement*** – A program to cover the repair, rehabilitation and replacement of aging infrastructure, this program is funded at $2.4 million per year starting in 2024 in recognition that all pipes in the collection system eventually need rehabilitation or replacement. The 2021 System Renewal/Replacement rate for CRW was reported as 0.7%, placing CRW at the 25th percentile of utilities reporting on the AWWA benchmarking survey. The reported value for the top percentile is 2.6%, indicating that CRW needs to increase its investments in rehab and replacement. A priority of the Rehab and Replacement Plan is to identify and prioritize pipes by project area, in order to coordinate projects with water rehab or street rehab projects.

  There are active sewer collection system pipes that date to the 1930's in Town. Typical rehab projects include point repairs; cured-in-place pipe (CIPP) lining of old or damaged sewer mains; manhole lining, repairs and replacement; and complete replacement of sewer mains that can't be rehabilitated. Pipes that are anticipated to need upsizing are generally deferred to the CIP plan but are otherwise repaired if needed. A draft rehab and replacement criteria manual has been developed with criteria for consequence of failure (COF) and likelihood of failure (LOF) for both water and wastewater infrastructure. This manual has been used to develop the rehab plan for sewer lines going forward.

  The wastewater plan was developed around all pre-1976 sewer pipes since most clay pipe still in service is from this period and this older pipe is approaching or has already exceeded 50 years of service life. Criteria for scoring were based on age of pipe, material of pipe, size of pipe and a structural score based on North American Society of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) CCTV standard scoring. Based on the scoring of the pipes, and the proximity of pipes to each other, projects and associated priorities have been developed into a 10-year rehab and replacement plan to guide the expenditure of the rehab funds.

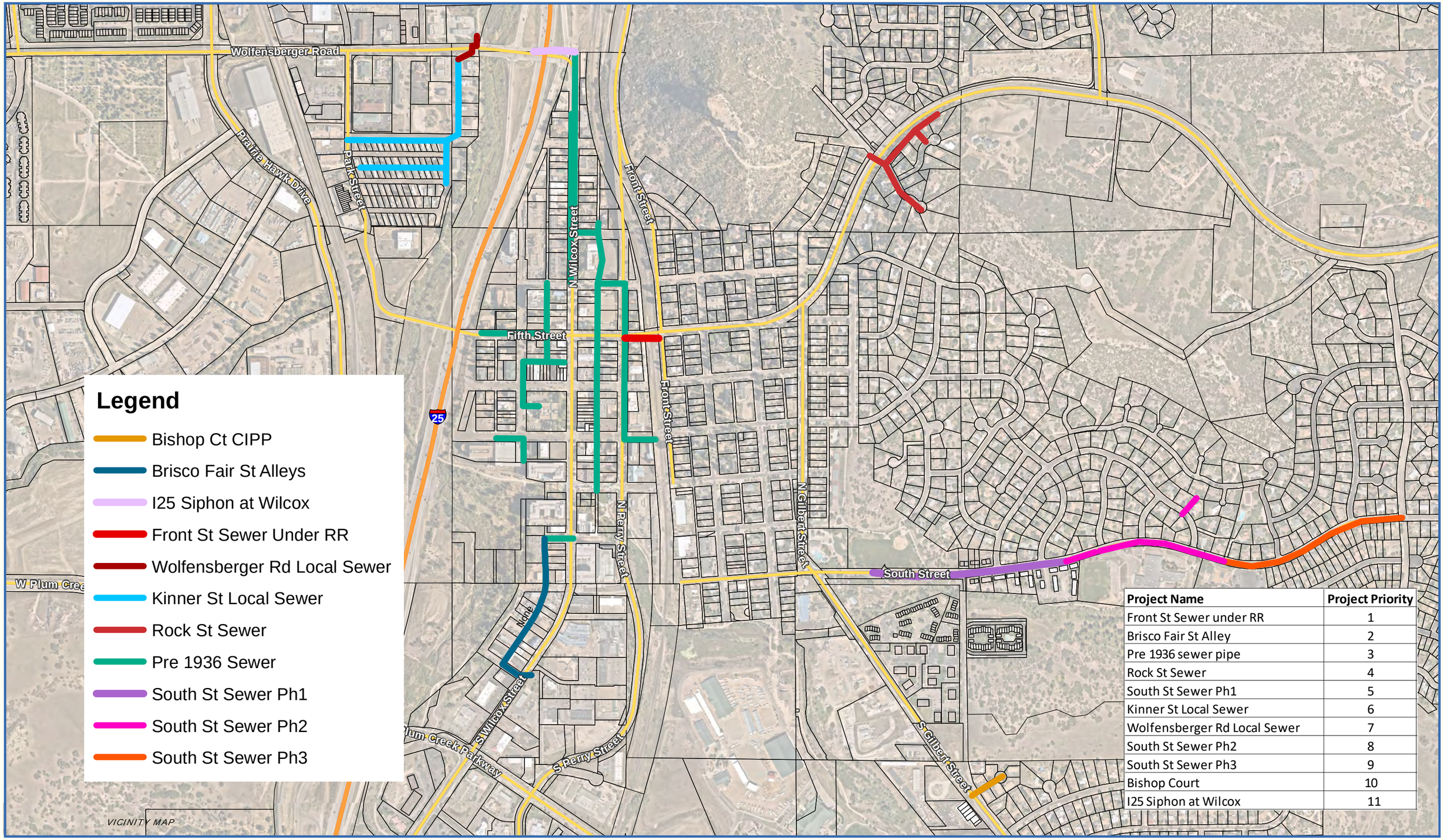
  The 2023-2032 Rehab Capital Plan (DRAFT) proposes expenditure of $12,269,451 in water, and $25,997,100 in wastewater during the ten-year period. The 2023-2032 capital plan's projected expenditures in water replacement are reduced to about $600,000 until 2029 due to the need to fund the SCADA Master Plan projects; after 2029, annual expenditures for waterline rehab and replacement are slated to increase to $2,000,000 per year. Water infrastructure replacement projects account for 33 percent of the total proposed expenditures for the ten-year period while wastewater rehabilitation expenses account for roughly 67 percent. The wastewater fund was less affected by the SCADA master plan costs, so the target budget for wastewater rehab is almost $2.4 million per year, which represents 2.0% of the wastewater collection system valuation of

$112 Million. A replacement/renewal rate of 2% would place CRW in the top percentile for replacement among reporting utilities to the AWWA survey. Refer to Table 5-1 for proposed capital rehab expenditures for the 10-year time-frame of 2023 to 2032. Refer to Figure 5.0 for the identified projects and recommended priority.

Table 5-1

PROPOSED CAPITAL REHAB EXPENDITURES 2023-2032			
Year	Water	Sewer	Totals
2023	$1,269,451	$4,450,000	$5,719,451
2024	$600,000	$2,400,000	$3,000,000
2025	$600,000	$2,400,000	$3,200,000
2026	$600,000	$2,600,000	$3,000,000
2027	$600,000	$2,400,000	$3,000,000
2028	$600,000	$3,212,000	$3,812,000
2029	$2,000,000	$2,400,000	$4,400,000
2030	$2,000,000	$2,400,000	$4,400,000
2031	$2,000,000	$1,680,250	$3,680,250
2032	$2,000,000	$2,054,850	$4,054,850
TOTALS	$12,269,451	$25,997,100	$38,266,551

The service life of clay pipe can be extended many years by the in-situ method of CIPP lining, which has a minimum expected life of 50-75 years. The lining effectively seals joints and is a very effective deterrent to root intrusion. Rehabilitation now by the installation of a CIPP liner, before the pipe deteriorates to a failed condition that might require a street-cut to repair, is more cost effective, can be completed with minimal disruption to service and results in less future maintenance. Since 2010, over 31,000 linear feet of old clay pipe have been rehabilitated with CIPP lining. Over 11,000 linear feet was lined in the Young American neighborhood under the 2019 Sewer Rehab Program. The remaining CIPP work in out years will be in the Downtown area (east and west of I-25) and the Young American and Castle Heights area. Any clay pipe that is to be upsized, such as the Prairie Hawk Sewer, will be replaced instead of rehabilitated. See Figure 5.1 for a location map of existing clay pipe and pipe that has been rehabilitated with CIPP.



Project Name	Project Priority
Front St Sewer under RR	1
Brisco Fair St Alley	2
Pre 1936 sewer pipe	3
Rock St Sewer	4
South St Sewer Ph1	5
Kinner St Local Sewer	6
Wolfensberger Rd Local Sewer	7
South St Sewer Ph2	8
South St Sewer Ph3	9
Bishop Court	10
I25 Siphon at Wilcox	11

CASTLE ROCK water
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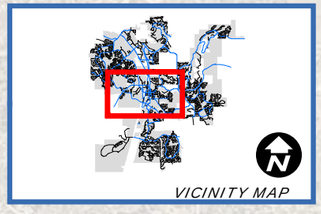
CASTLE ROCK WATER

FIGURE 5.0

Date: 1/10/2023

Legend

- Glovers CIPP
- CIPP Pipe
- 2022 Active VCP



Legend

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

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0 650 1,300 2,600 3,900 Feet

1 inch = 1,333 feet

Date: 11/30/2022

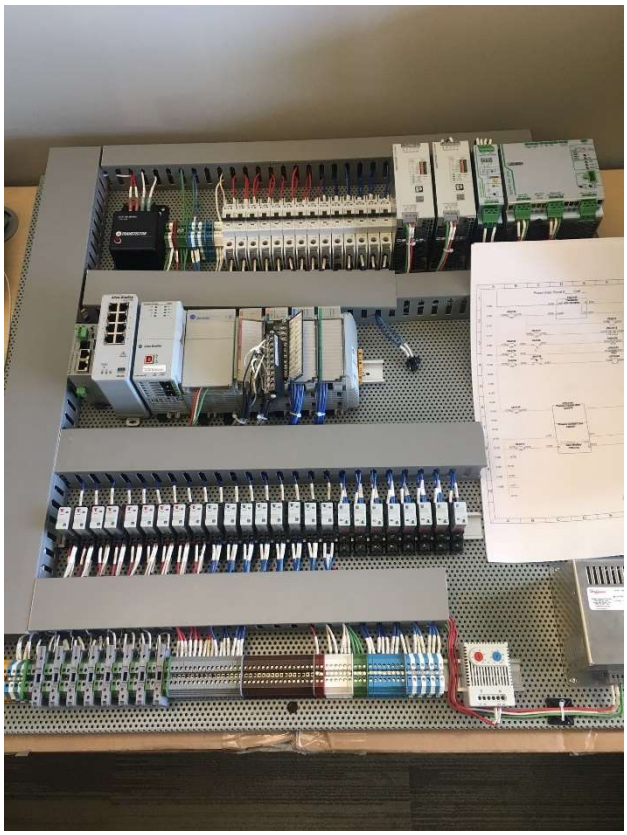
CASTLE ROCK
2022 WASTEWATER MASTER PLAN
FIGURE 5.1

Document Path: J:\B. PLAN & ENG\13.0 Engineering\13.8. Planning\Master Plans\2022 Master plan update\WW Master Plan 2022\2022 CIPP map updated.mxd

Glovers Sewer Lateral Replacement using saddle tap on existing CIPP lined sewer pipe.

Post CIPP: Pipe after rehab with cured in place pipe; the liner seals cracks and joints and eliminates I/I and future root intrusion.

- ***Security and SCADA Improvements*** – A program to cover security and Supervisory Control and Data Acquisition (SCADA) installations/improvements, such as fences, gates, alarms, and communications, at wastewater facilities. This program is generally funded at $50,000 per year, except for projects as identified in the SCADA Master Plan and included in the CIP budget as separate projects.
    - Proposed SCADA over the next five years include upgrading/replacing all old, obsolete Human Machine Interface (HMI) controllers at wastewater facilities with new Programmable Logic Controllers (PLCs). Older HMIs were often proprietary software inclined and not easy to upgrade; new PLCs better support programming changes and integration with other communications equipment.
    - Fiber Optic (FO) cable improvements to wastewater facilities would enhance reliability of data transfer and communications between water/wastewater facilities. Many facilities still rely on telephone infrastructure for communications and data transfer and are slow, old and obsolete.
    - Security improvements at facilities include:
        - Add chain link perimeter fencing around every lift station.
        - Add slide gates instead of two -bar swing gates.
        - Install a block wall around the transformers to hide and protect them.
        - Add hatch intrusion alarms to the outside grinder and wetwell basins.
        - Add cameras with analytics to every lift station.



A photo of what the new designed and installed wastewater flume panels will look like after SCADA upgrades per the approved SCADA Master Plan.

6. Operations and Maintenance

Operations and Maintenance Costs

Total operations and maintenance (O&M) costs for wastewater collections and treatment activities for 2017 thru 2021 are shown in Table 6.1. Also shown is the average daily wastewater treatment flow for PCWRA over the same period. These annual costs and flows result in an average key performance indicator (KPI) of $2,681 per Mgd of wastewater collected and treated, which puts the Town near the national median. O&M costs are heavily influenced by energy costs at both the PCWRA and at the nine lift stations.

Table 6.1
Annual Operations and Maintenance Costs

	2017	2018	2019	2020	2021
Ave Daily WW Mgd	3.70	3.74	3.94	4.10	4.30
Total O&M Costs	$3,358,004	$3,709,482	$3,984,346	$4,206,754	$4,111,998
$$/Mgd	$2,486	$2,717	$2,771	$2,811	$2,620

Manpower/Staffing

The wastewater fund has 5.0 full-time equivalents (FTEs) in the Field Services Division of Castle Rock Water. These positions are responsible for the day-to-day operation and maintenance of nine lift stations, and over 314 miles of sewer pipe that serve more than 22,300 wastewater service accounts. One additional collection system operator is planned to be added in 2023, for a total of 6 dedicated collections system operators. The Facilities Maintenance (plant mechanics) division of Castle Rock Water has 2.16 FTEs dedicated to the wastewater fund. Plant mechanics are responsible for most preventive maintenance and repair of electrical/mechanical equipment at lift stations and other wastewater facilities. The wastewater fund also funds 3.2 FTEs in the Engineering/GIS Division. Engineering provides support to operations and manages the capital programs and projects. GIS provides mapping, asset management support and utility locates. Customer Relations, Billing, SCADA and Administration are also partially funded from the wastewater fund and total 5.67 FTEs. Overall, there are 16.03 FTEs funded from the wastewater fund. In 2022, based on average daily wastewater flows (4.47 Mgd) and total wastewater funded employees (16.03), and the 18 FTEs at the PCWRA, the Town scores a KPI of 0.13 for Mgd processed per employee, placing the Town in the bottom quartile nationally based on AWWA performance tracking programs.

Should CRW and PCWRA participate in the SH-85 Collection System Project, additional staffing would be warranted, equivalent to a new collections crew (4 to 5 FTEs). The possibility of 7-10 new lift stations (Macanta, Bella Mesa, Dawson

Trails, SH-85) in the future would also warrant a dedicated Lift Station Crew (also possible 3-4 FTEs) to ensure adequate coverage for the increased O&M effort involved with lift stations. The focus on rehab and replacement projects could also require an additional dedicated project manager. CRW updates our long term staffing plan every year. Options to improve efficiencies for manpower will be addressed over the next planning periods.

Energy

In 2021 wastewater energy costs averaged just over $11,128 per month, compared to $8,097 per month in 2017 (over 7% increase per year in costs), and do not include any energy costs incurred at the wastewater treatment plants. Energy demand has actually outpaced costs, with electricity demand up 53% from 2017 to 2021, and gas demand up 35% over the same period, but has actually slightly decreased the last two years. Flows to PCWRA have increased overall 14% in the same time period.

The pace of rising energy demand may reflect that much growth is occurring in areas served by lift stations, such as Castle Oaks, Crystal Valley Ranch and Founders. Wastewater energy costs are due mostly to the pumping costs and heating/cooling costs incurred at the nine lift stations. The lift stations are heated in the winter to ensure pipes don't freeze. Heating is either natural gas or electric heating. The pumps and other electrical components generate heat that must be offset in the summer months by air conditioning and cooling. Several lift stations have backup generators that are supplied by natural gas; other lift stations have diesel backup generators. Figure 6.1 shows the energy demand (electrical in KWh and gas in MBTU) and costs by month for 2021.

Figure 6-1
Energy Demands and Costs for 2021

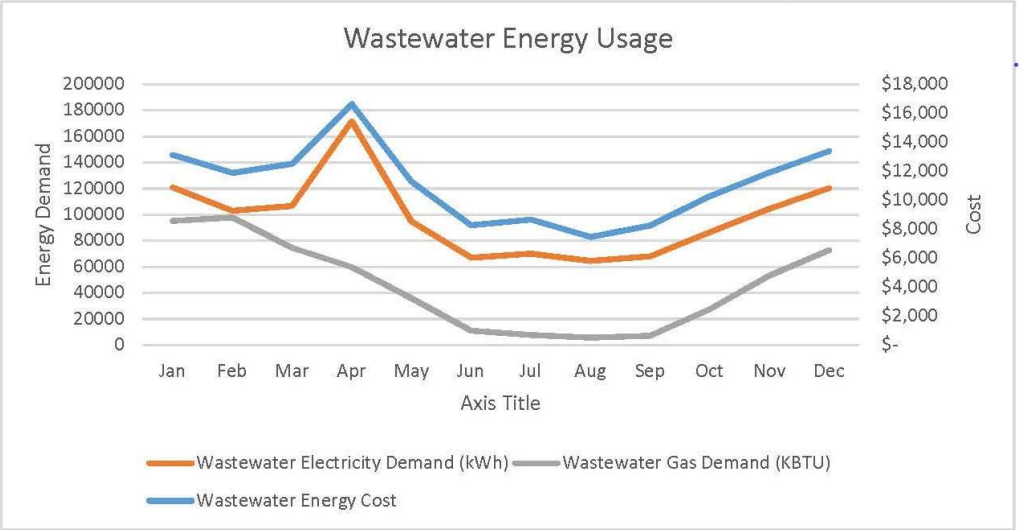
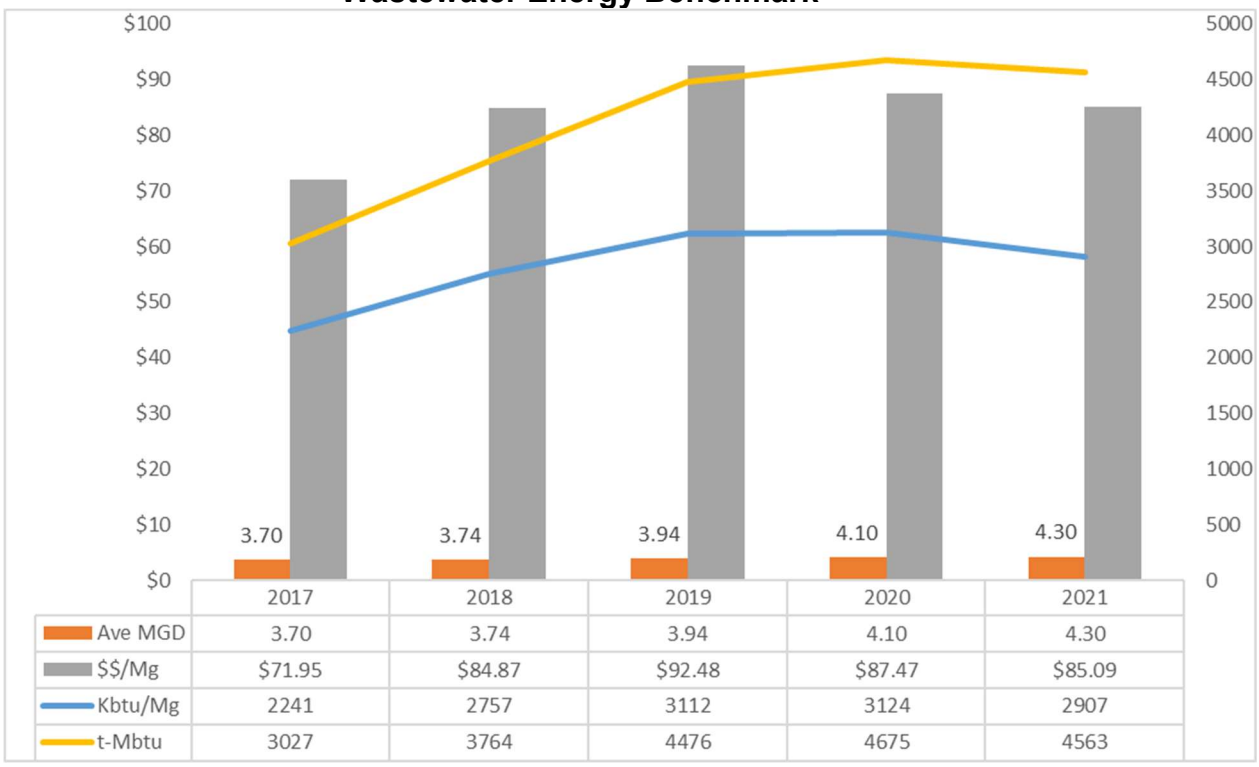


Figure 6-2 shows the average energy expenditure in KBtus (Kilo-British Thermal Units), average million gallons per day (Mgd) treated, and average energy cost per million gallons (Mgal) treated, and total energy demand in equivalent Million British Thermal Units (MBtus) for the time period of 2017 thru 2021. The resultant annual KPI for energy costs per million gallons ($$/Mg) is also shown.

Figure 6-2
Wastewater Energy Benchmark



	2017	2018	2019	2020	2021
Ave MGD	3.70	3.74	3.94	4.10	4.30
$$/Mg	$71.95	$84.87	$92.48	$87.47	$85.09
Kbtu/Mg	2241	2757	3112	3124	2907
t-Mbtu	3027	3764	4476	4675	4563

Equipment

In the 2010 master plan, Castle Rock Water identified a need for CCTV equipment to allow for increased capability to clean and inspect the wastewater infrastructure. In 2012 the business case was developed and funding approved for the purchase of a new van, CCTV equipment and software, at a cost of $185,000, to do all CCTV inspections in-house. An additional full-time staff member was also approved and hired to complement that staffing level. The goal in funding the CCTV truck is to meet the target of fully inspecting the collection system every five years. In 2015, a tracked wheel easement machine was purchased to improve the ability of staff to reach manholes located in open space and off road areas. The easement machine can safely traverse slopes that trucks can't safely or easily maneuver along. This allowed staff to perform maintenance and inspections on out of the way sewer mains without taking the large vactor truck out. In 2018 a second vactor truck was purchased at a capital expense of $450,000, with the funding split three ways among Water, Wastewater and Stormwater Funds. Wastewater and Stormwater departments use the large vactor trucks to keep sewer mains and storm pipe clear of blockages. The Water fund uses the large vactor truck when responding to main breaks and to perform soft digging. The two vactor trucks are scheduled for capital replacement in 2024 and 2033. The CCTV truck is not scheduled for capital replacement until 2032. A second CCTV truck unit is not currently in the capital equipment plan but needs are reassessed each year as part of the budget

process. Castle Rock continues to add more sewer mains each year and either more equipment/staff will be needed to meet service level expectations for cleaning and inspection, or more contractor assistance may be needed to meet the gap. Future equipment needs for the possibility of the SH-85 Sewer Collection Project have not been identified yet.

Vactor truck, purchased in 2018, used for pipeline maintenance and line break repairs.

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 active 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. Additionally, the software is ideal as a permanent repository for the vast amounts of data collected from the yearly cleaning and CCTV effort and assists in prioritizing the allocation of rehabilitation funds for the collection system.

Cartegraph OMS, CUES GraniteNet CCTV inspection software and Innovyze InfoAsset Planner inspection analysis software used by CRW staff, work in concert to generate sewer pipe scores based on classification of defects as well as other attributes such as pipe age and material. This integration is currently being implemented by CRW staff and will assist in identifying and prioritizing sewer rehabilitation projects. The asset management program is also being used to track lift station operations and maintenance, physical assets (installation cost, service life and replacement costs) and work-order histories.

Capacity Management Operation and Maintenance, otherwise known as CMOM, is a highly structured program of best management principles, tools, and goals to manage the collection system to best prevent sanitary sewer overflows (SSOs). At this time, the program has not been formally promulgated by the EPA as a federally mandated requirement, but guidance has been available for several years. An asset management system is a critical component of a successful CMOM program.

Operations and Maintenance Policy and Programs

Several policy and programs drive the Operations and Maintenance costs. Foremost, levels of service drive day-to-day operations. Expected levels of service are that less than one percent of customers will experience a sewer service backup or failure on a monthly basis. The expectation that one fifth of the collection system is adequately cleaned and inspected each year is the target goal for the CCTV inspection program. Table 6-2 shows the sewer jetting (cleaning) and closed circuit televising (CCTV) linear feet (LF) statistics for the years 2017 to 2021. Generally, the jetting operations are succeeding at meeting the one-fifth to one-third target each year. The CCTV operations, which actually provide the best information on pipe condition and from which pipe scores can be generated to target maintenance and/or rehabilitation, are averaging about 12% of the system annually. The KPI for the system inspection rate of 8% in 2021 placed CRW just below the national median as reported on the AWWA survey.

The collections staff has been particularly challenged the last five years with staff retention, and by extension, with adequate training on the CCTV tasks. Staff performing CCTV tasks undergo a rigorous certification class. Continued growth has also resulted in, on average, an additional 13 miles of gravity pipe (about 5%) added to the system each year. Targeted cleaning and inspection of the system to the older areas of Castle Rock and those areas known to have recurring maintenance issues (such as root intrusion), is the current best use of the collection staff's time.

Table 6-2
Sewer Jetting and CCTV Statistics for 2017-2021

Year	Length of Main Jetted, LF	Length of Main CCTV'ed, LF	Total Length of System, LF	% of System Jetted	% of System CCTV'ed
2017	454,961	265,775	1,401,508	32%	19%
2018	309,151	117,552	1,477,254	21%	8%
2019	553,189	181,605	1,530,857	36%	12%
2020	355,697	180,175	1,599,999	22%	11%
2021	362,497	129,687	1,676,630	22%	8%

An additional full-time collections staff person is to be added in 2023. In 2021 the employee turnover rate for the wastewater collections crew was 25%, placing

CRW near the bottom of staff retention on the AWWA survey. Better retention of staff, perhaps additional staff, or more contracting for cleaning and inspection services may all be required to reach a target of one-fourth to one-third of the collection system each year. Fortunately, much of the collection system is fairly new (almost 60% installed since 2002) and system problem areas are being addressed with the Sewer Rehab Program.

PCWRA has requirements to minimize slug-loading at the treatment plant, which has implications for the manner in which the lift stations, water treatment plants residuals, and collection system are operated and maintained. CRW has a policy of replacing old sewer laterals within the right of way (ROW) when major water main or sewer main replacement projects are undertaken. In 2021, CRW also instituted a Grease Interceptor Assistance Program to provide loans and/or grants to commercial businesses, primarily established restaurants and bakeries, to assist with the installation of grease interceptors to bring them into compliance with PCWRA discharge regulations and to reduce the potential for fats/oils/grease (FOG) in the collection system. The program is a combination loan and grant. Customers can receive up to a total of $15,000 in assistance ($7,500 grant and $7,500 loan). CRW will pay 50% or $15,000, whichever is less, of their project. To date a total of 3 customers have taken advantage of the program. One customer had a project small enough that they only received grant money and the other two have active loans in place. The fourth customer has been approved, but has not yet finished the project and not submitted receipts for reimbursement. FOG in the collection system creates maintenance issues by clogging sewer mains, often downstream from the actual source, and can be a primal causal factor for an SSO.

In 2022 CRW utilized the services of a contractor to acoustically survey all 12” and smaller sewer pipe in the system to look for blockages that could cause a sanitary sewer overflow (SSO). Over 1,216,496 linear feet of gravity sewer mains were inspected. Inspections revealed 34 sewer mains that had blockages of a severity factor of 3 or less (“poor”, on a 1 to 10 scale with 10 being the best) were found and addressed for maintenance by collections staff. This accounted for 0.43% of the gravity collection system that was inspected. Over 95% of the mains inspected were rated “good” (score of 8-10). 265 sewer mains were rated “fair” (score of 4-7) and will be addresses systematically by the collections staff. Average cost for linear foot was $0.18/LF. CRW is considering future acoustic surveys of 33 to 50% of the collection system each year as an option to replace the goal of 20 to 33% video inspection every year.

In 2023 Castle Rock Water plans to inspect all gravity mains 15” and larger. There is a total of 107,381 linear feet of larger sewer mains (6.3% of all active mains). These larger interceptor mains are not amenable to inspection using the Town’s CCTV equipment, and may require inspection at night when flow volumes are lower. Figures 6.3 and 6.4, respectively, show the areas of town that were jetted and inspected (CCTV’ed) each of the last five years.

Sewer Main Jetting Tasks Completed between 1/1/2017 &12/31/2021

Year	Length of Main Jetted (feet)	Total Length of System (feet)	Percentage of System
2017	454,960.38	1,401,508.43	32.5%
2018	309,150.63	1,477,254.28	20.9%
2019	553,189.16	1,530,857.52	36.1%
2020	355,696.66	1,599,998.58	22.2%
2021	362,497.18	1,676,630.37	21.6%

Jetting_2021
Jetting_2020
Jetting_2019
Jetting_2018
Jetting_2017
Gravity Main

0 1,000 2,000 4,000 6,000 Feet

1 inch = 1,369 feet

Figure 6.3 Sewer Jetting Statistics

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Document Path: J:\GIS\Map Requests\2022\Internal_Requests\Sewer_Tasks_Update\SewerMains_Jetting_2017_and_2021_Update.mxd

Sewer Main CCTV Tasks Completed between 1/1/2017 &12/31/2021

Year	Length of Main CCTV'd (feet)	Total Length of System (feet)	Percentage of System
2017	265,775.37	1,401,508.43	19.0%
2018	117,552.11	1,477,254.28	8.0%
2019	181,604.64	1,530,857.52	11.9%
2020	180,175.25	1,599,998.58	11.3%
2021	129,687.13	1,676,630.37	7.7%

CCTV_2017
CCTV_2018
CCTV_2019
CCTV_2020
CCTV_2021
Gravity Main

0 1,000 2,000 4,000 6,000 Feet

1 inch = 1,369 feet

Figure 6.4 Sewer CCTV Statistics

Castle Rock Water
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Castle Rock Water has scheduled Operations and Maintenance (O&M) for all nine of the force mains. Each of these force mains are cleaned (pigged) once a year, with the exception of Castlewood Lift Station #1, which is pigged quarterly or when flow decreases to an unacceptable level. Associated with each force main is a lift station, two of which have odor control facilities downstream. The odor control facilities are inspected three times weekly. There are injection points for Bioxide (a chemical odor neutralizer) at five of the nine lift stations: Castle Oaks, Mitchell Creek, Meadows 17, Maher Ranch and Castlewood LS#1. Castle Rock Water has three siphons, two with grinders, that receive scheduled cleaning, maintenance and inspection.

In recent years the use of flushable wipes has created maintenance issues at the lift station facilities because the wipes are very resistant to the shredding action of the grinder mechanical teeth; the wipes pass through (or bind) the grinders and can clog lift station pumps and piping. This is a problem almost all collections systems are dealing with. Persuading customers to refrain from using the flushable wipes is a challenge. CRW is considering supporting legislation that will help address this issue on a statewide basis. Grinder manufacturers are redesigning the teeth to better shred the flushable wipes; CRW will be testing the new teeth mechanisms at one of its facilities in 2023; if successful, routine replacement of the grinding teeth at all of the grinder stations would occur. Additionally, the Town has identified 61 stream crossings by sewer mains or force mains; these stream crossings are inspected annually for integrity.

The Collections O & M budget for 2023 to 2027 is approximately $830,000 per year, distributed as shown in Table 6-3, and excludes personnel costs, energy costs, and treatment costs.

Table 6-3
Collections O&M Budget 2023-2027

	2023	2024	2025	2026	2027
Operating Supplies	$37,500	$37,500	$37,500	$37,500	$37,500
Parts	$58,000	$58,000	$58,000	$58,000	$58,000
Machinery and Equipment	$55,000	$55,000	$55,000	$55,000	$55,000
Facility Repair and Maintenance	$140,500	$140,500	$140,500	$140,500	$140,500
Purchased Equipment Repair Services	$115,000	$115,000	$115,000	$115,000	$115,000
Purchased Line Repair Services	$435,000	$435,000	$435,000	$435,000	$435,000

These expenditures, along with the resources of the vactor-truck, the CCTV van, and collections staff full-time personnel, combine to keep the O & M Collections

Program effective and productive. The Town's 2021 sanitary sewer overflow rate of 1.3 SSOs per 100 miles of pipe puts the Town in the top quartile nationally based on AWWA key performance indicators.

7. Financial Management Plan

Starting in 2015, CRW prepared a Financial Management Plan (FMP) which has since been updated on an annual basis as part of the budget process. The FMP was completed to assist CRW in achieving the following goals:

1. To minimize future rates at or below the 2013 Hybrid Model levels
2. To minimize debt carrying costs at or below industry standards
3. To minimize risk by balancing fixed and variable revenues with expenses as appropriate
4. To keep costs at or under budget for capital and operational budgets each year by fund and to continuously strive towards more efficient operations
5. To keep our rates and fees competitive with surrounding communities
6. To keep adequate reserves and maintain fund balances between minimums and maximums
7. To keep our rates and fees affordable within various national affordability indices
8. To develop regional partnerships to provide economies of scale to reduce total costs of infrastructure to our customers
9. To be an industry leader in the application of financial management benchmarking ourselves against others locally and nationally

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 7-1.

Table 7-1

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

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. The guidelines for wastewater ratemaking are established by the Water Environment Federation (WEF) in the Manual of Practice No. 27. Refer to the 2022 Rate and Fee Study for more detail.

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

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.

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. So far this year, 544 single family home permits have been issued through July, down from the 752 issued through July 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.

This is reflected in the significant increase in SDFs for 2023 to 2027, and into the future, that are needed to fund a future wastewater treatment expansion when the PCWRA service area population in Town reaches 105,000.

Revenue Requirements

Wastewater rates are based on the Town's projected revenue requirements to operate and maintain the Town's wastewater system, along with the wastewater CIP. The CRW 2022 Rates and Fees Report projects that Castle Rock Water's 2023 total wastewater revenue required from rates is estimated to be $12.1 Million. The wastewater fund financial plan projects the fund's sources and uses of funds. The wastewater utility financial model includes three sub-funds:

- Operating Reserve
- Capital Reserve
- Catastrophic Failure Reserve

Fund Balances

The wastewater fund was projected to have a reserve of approximately $4.2 million at the beginning of 2022, not including capital reserve funds. Each of the sub-funds in the financial plan have a minimum balance requirement to help mitigate financial risk, which is in line with the FMP goal to keep adequate

reserves and maintain fund balances between minimums and maximums. The requirements by sub-fund are:

- Operating Reserve – 60 days of O&M; averaging $1.2 million in the study period.
- Capital Reserve – Obligated reserves vary from year to year; depending on the CIP. The fund maintains a minimum unobligated reserve of $1.0 million throughout the study period.
- Catastrophic Failure Reserve – Approximately 2% of original fixed asset value averaging about $2.5 million in the study period.

The financial plan calls for maintaining these balances above and using net available capital reserve fund balance to offset short-term capital needs. 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. The 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.

Uses of Funds

The major assumptions for uses of funds are shown below. For detailed definitions see Appendix B of the Rates and Fees Study.

- Operating Costs – For the wastewater fund most operating costs are fixed.
- Personnel Services – CRW reviews 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 new FTEs for all CRW enterprise funds for the 5-year period is 13 new FTEs, with only one in the Wastewater Fund.
- Energy Costs – Over the five-year study period these are expected to increase at an average rate of approximately 3%. This may need to be reevaluated as an analysis of the last five years indicates that energy demand and costs are rising much faster than 3% each year.
- Capital Improvements – Total wastewater system capital improvement costs from 2023-2027 are expected to be $22.7M in today's dollars. The long-term capital plan is estimated at $200M through 2065. Only improvements or replacements that provide benefits to existing customers are included in revenue requirements. Improvements to serve growth are funded from SDFs.
- Transfers Out – These include the costs for the vehicle replacement fund which is transferred to the fleet department and is about $1.1 million over the 5-year study period.
- Fund Balances – For the study, it is assumed that the fund balances will not drop below the requirements presented in the above section.

- Debt Service – The fund currently has the 2012 revenue bond, which is a refinancing of a 2004 revenue bond series with final payments in 2023. The principal and interest payments equal approximately $331,000 in 2023.
- 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 $398,400. This is a bond requirement.

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 wastewater 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.

Wastewater Monthly Service Charge

An important rate design feature that directly affects the rate results is the policy decision to include 20 percent of annual capital costs in the monthly service charge. By doing this, revenue stability is increased and all customers are required to pay a portion of debt service and other capital expenses strictly on an equivalent water meter basis rather than on a wastewater volume basis. This also reduces the volumetric rate and recovers a portion of the PCWRA debt service costs from users who require more capacity in the wastewater system. The demand charge component on the monthly service charge recovers the 20 percent of annual wastewater system capital costs not including the capital costs needed to serve new growth.

Water meter size is closely related to the amount of water a customer can potentially use and therefore discharge into the wastewater system. Accounts with larger meter sizes potentially use more capacity in the system (potential demand). With this rate design feature, accounts with larger meters pay a higher proportionate share of the capital costs as part of the monthly service charge.

CRW currently charges wastewater customers a fixed monthly service charge that consists of a customer charge and a demand charge, plus a uniform volumetric rate for wastewater flow. An account's flow is estimated using its Average Winter Monthly Consumption (AWMC). The proposed 2023 wastewater rates consist of a monthly charge that includes the demand charge by meter size, plus a uniform volumetric rate for all customers. The Town's proposed wastewater fixed charges and wastewater volumetric rates for 2023 through 2027 are shown in Table 7-2.

Table 7-2
Proposed 2023 – 2027 Wastewater Monthly Service Charges and Rates

Water Meter Size	*Existing 2022*	*2023*	*2024*	*2025*	*2026*	*2027*
5/8”	$8.57	$8.57	$8.57	$8.57	$8.57	$8.57
¾"	$8.57	$8.57	$8.57	$8.57	$8.57	$8.57
1"	$13.64	$13.64	$13.64	$13.64	$13.64	$13.64
1½"	$19.78	$19.78	$19.78	$19.78	$19.78	$19.78
2"	$28.53	$28.53	$28.53	$28.53	$28.53	$28.53
3"	$47.66	$47.66	$47.66	$47.66	$47.66	$47.66
4"	$111.11	$111.11	$111.11	$111.11	$111.11	$111.11
6"	$173.53	$173.53	$173.53	$173.53	$173.53	$173.53
Wastewater Volumetric Rate ($/1,000 gallons)						
	Existing 2022	***2023***	***20124***	***2025***	***2026***	***2027***
All Customers per Kgal	$6.079	$6.07	$6.07	$6.07	$6.07	$6.07

Wastewater System Development Fees

CRW applied a combined approach for calculating the Town’s System Development Fees (SDFs) for its wastewater system. The equity buy-in component; however, is divided into buy-in for the Town’s existing wastewater system and a buy-in for treatment-related assets by the Plum Creek Water Reclamation Authority (PCWRA). PCWRA is the primary treatment entity for the Town’s flows and has invested significant capital in plant expansions. The Town owns 71 percent of the capacity at PCWRA but currently contributes 83% of the total flow demand and fees, and actively participates in its management through the Board of Directors. The Pinery Water and Wastewater District provides for wastewater treatment of flows from the existing Cobblestone Ranch and Canyons South areas of town, and may provide service for future annexations. The Town collects wastewater treatment fees from residents in The Pinery service areas of Town and reimburses The Pinery for treatment. For a more detailed description of the full rates and fees analysis, please see the 2022 Utilities Rates and Fees Study.

Table 7-3 shows proposed system development fees (SDFs) based on meter size for 2023-2027. The proposed increase in 2023 for both the Plum Creek Basin (served by PCWRA) and the Cherry Creek Basin (served by the Pinery) is $491 per SFE, a 10% increase over 2022 approved SDFs.

Table 7-3
Existing and Proposed Wastewater SDFs

Meter Size	SFE	Meter Capacity (GPM**)	Existing 2022	Proposed 2023	2024	2025	2026	2027
7/16x3/4"	0.60	20	NA	$3,240	$3,337	$3,437	$3,540	$3,647
5/8" x ¾"	.67	20	$3,279	$3,607	$3,715	$3,827	$3,941	$4,060
¾" x ¾"	1.00	30	$4,909	$5,400	$5,562	$5,729	$5,901	$6,078
1"	1.67	50	$8,173	$8,990	$9,260	$9,538	$9,824	$10,119
1.5"	3.33	100	$16,299	$17,929	$18,467	$19,021	$19,591	$20,179
2" C2	6.67	200	$32,646	$35,911	$36,988	$38,098	$39,240	$40,418
2" T2	8.33	250	$40,772	$44,849	$46,195	$47,581	$49,008	$50,478
3" C2	16.67	500	$81,592	$89,751	$92,444	$95,217	$98,074	$101,016
3" T2	21.67	650	$106,065	$116,672	$120,172	$123,777	$127,590	$131,315
4" C2	33.33	1,000	$163,137	$179,451	$184,834	$190,379	$196,091	$201,973
4" T2	41.67	1,250	$203,957	$224,353	$231,083	$238,016	$245,156	$252,511
6" C2	66.67	2,000	$326,322	$358,954	$369,723	$380,815	$392,239	$404,006
6" T2	83.33	2,500	$407,867	$448,654	$462,113	$475,977	$490,256	$504,964

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2022 Water Resources Strategic Master Plan

2022 Water Efficiency Master Plan

2022 Rates and Fees Study