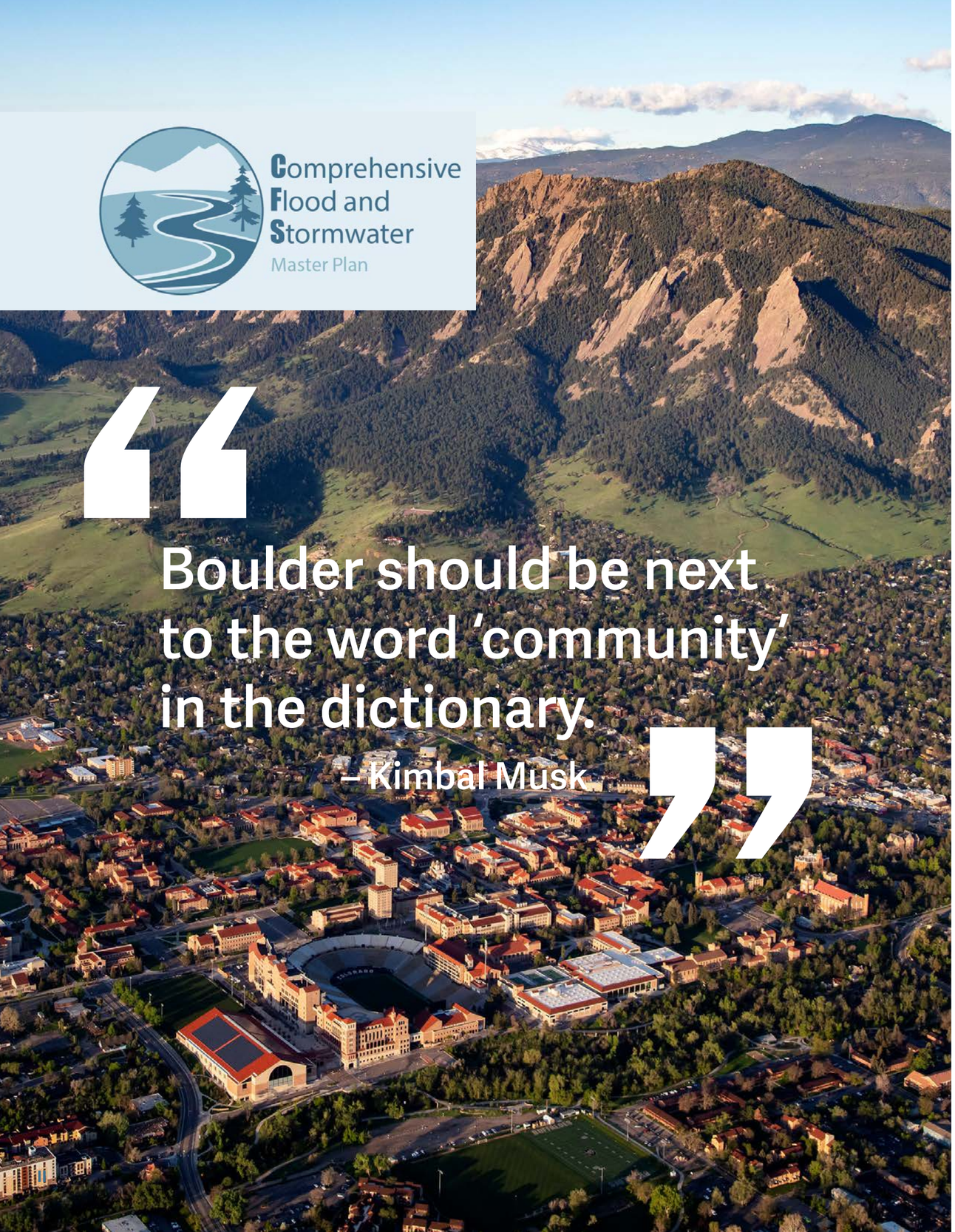
2022 Comprehensive Flood and Stormwater Master Plan

VOLUME I - Summary Plan | September 2022

In association with:
Tetra Tech
Water Resource Associates
Wright Water Engineers



EXECUTIVE SUMMARY

The Comprehensive Flood and Stormwater Master Plan (CFS Master Plan or "Master Plan") provides the policy framework for implementing programs and projects in the City of Boulder's Stormwater and Flood Management Utility (Utility). The purpose of the Master Plan is to improve the management of stormwater and drainageways to help protect people, places, property and ecosystems in a way that builds resilience and is consistent with community values. This Master Plan was informed by community input, lessons learned from the 2013 flood, Boulder's Racial Equity Plan and the increasing evidence of climate change, among other considerations.

The Master Plan outlines a long-term vision for how to complete major projects and recommends guidelines and standards for carrying out day-to-day operations of the Utility. Key activities to update the Master Plan included policy review, developing program and process recommendations and providing a framework for evaluating priorities and projects.

Because the resources needed to identify flood risk, mitigate flood damage and maintain flood and stormwater facilities are scarce in comparison with the need, an overarching objective of the policy evaluation was to assess program outcomes and impact through the following questions:

- What are the program goals and objectives?
- Which program actions drive results?
- Where are the biggest areas of concern and do the current actions move the needle to solve them?
- What data are available to determine effectiveness?
- How should the Utility prioritize construction of major flood projects?

The previous 2004 Comprehensive Flood and Stormwater Utility Master Plan identified a project cycle of floodplain mapping, flood mitigation planning, design and construction for Boulder's 16 major drainageways. Within this cycle, mapping and mitigation planning are precursors to the design and construction of large flood mitigation projects. Since 2004, Boulder has constructed flood mitigation projects and completed most of the remaining mapping and mitigation groundwork. The Utility is now positioned to begin design and construction of flood projects across ten additional major drainageways citywide. This updated plan provides a framework and decision-making tool to methodically prioritize pending flood mitigation projects in alignment with community values. The framework specifically incorporates racial and social equity as a consideration, which will function to repair systemic and institutional racial inequities.

Throughout the CFS Master Plan development, the community clearly communicated an urgent need to accelerate the construction of flood and storm projects, especially in the context of a changing climate and more frequent and intense storm events . Utility staff have heard and agree with this assessment. With that in mind, this Master Plan includes a discussion of what it would take to accelerate flood mitigation projects, including associated funding, staffing needs and the need for community and political support. In a nutshell, the "Action" and the "Vision" funding scenarios below provide the ability to move capital projects forward at a more aggressive pace.

FUNDING SCENARIO	DESCRIPTION
Fiscally Constrained	This funding level provides approximately $5M in capital funds and reflects what is needed to maintain basic Utility services over the short term. This includes minimal rate increases (that keep up with the Consumer Price Index). Minor investment is made in capital improvement projects and maintenance and operations would be a priority. The city had generally maintained this funding level prior to 2015. Under this funding scenario the CIP might take 75 or more years to complete.
Action	This funding level assumes an average of $7M annually in 2022 dollars, and accounts for annual fluctuations and associated rate increases. Some capital improvements are debt-financed so debt service is included in utility rates. In addition, this funding level includes six Engineering/Project Managers as currently approved in the 2022 Budget Book. Under this funding scenario it may take more than 50 years to complete the CIP. This is where the city funding has been since 2015.
Vision	This funding level provides approximately $11M in annual capital funds and augments resources with additional engineers, project managers and/or consultants and capital available to complete one to two major flood projects per year. This level of funding supports an acceleration of the stormwater and major flood Capital Improvement Program and Utility maintenance so that the CIP can be completed within 30 to 35 years. These funds would be realized through a combination of continued rate increases to fund bond issuances; higher than estimated Plant Investment Fees; one-time federal grants; and higher interest on investments. This level requires sustained larger rate increases and additional staffing and resources to implement the projects.

Knowing that flooding can happen anytime and occur anywhere across Boulder, the city's engagement and outreach efforts need to continually improve to reach shifting demographics, renters, those experiencing homelessness and non-English speakers. This Master Plan recognizes the role that individuals and community members have in flood preparedness and outlines specific responsibilities related to both institutions and the community.

The Master Plan also includes discussion of important community issues that impact quality of life such as greenways, operations and maintenance, groundwater and efficiency measures. The community voiced strong support for maintaining what we already have and for programs and actions that protect and enhance our creeks while enhancing water quality and the environment.

Although it was the right time to complete this Master Plan, the public engagement was done almost exclusively virtually due to the COVID-19 pandemic. Whereas the team and the community rose to the challenge and engaged in crucial and meaningful dialogue, the Master Plan recognizes the importance of in-person engagement. Nevertheless, this Master Plan achieved significant outcomes that support the Utility in expediting progress towards meeting shared community and city goals.

The CFS Master Plan contains two volumes.

Volume I provides a summary level of detail aimed at a general audience and is consistent with other city master plans in format, content and level of detail. Volume II contains more detail on background, policy and regulations, issues, system management and recommendations. Volume II provides the framework necessary for implementing programs and projects and is prepared more for an audience having or desiring detailed knowledge of the flood and stormwater system.

ACKNOWLEDGMENTS

City Council:

Matt Benjamin, Aaron Brockett, Lauren Folkerts, Rachel Friend, Junie Joseph, Nicole Speer, Mark Wallach, Tara Winer, Bob Yates

Water Resources Advisory Board (WRAB):

John Berggren, Amy Broughton, Steve Maxwell, Gordon McCurry, Trisha Oeth, Ted Rose (term ended April 2022)

City Manager:

Nuria Rivera-Vandermyde

Deputy City Manager:

Chris Meschuk

Utilities Staff:

Joe Taddeucci (Director of Utilities), Joanna Bloom, Chris Douville, Chris Douglass, Graham Clark, Brandon Coleman, Laurel Olsen, Meghan Wilson, Candice Owen, Kevin Koryto, Olivia Dawson, Shuangshuang Fan

Thank you to the staff from Water Quality, Planning and Development Services, Water Resources, Utilities Engineering, Communications and Engagement, Climate Initiatives and the City Attorney's Office for your participation and contribution.

Consultants:

Tetra Tech - Vicki Scharnhorst, Amy Murdick, Dan Christian, Bill Fullerton, Rob Flaner, Danny Hinson, Bob Mussetter

Catalyst, Inc. - Barbara Lewis

Water Resource Associates - Hector Cyre

Wright Water Engineers - Jane Clary, Andrew Earles

Community Working Group

- Matt Benjamin
- Elizabeth Black
- Dylan Blaskey
- Ana Karina Casas Ibarra (Community Connector)
- George Craft
- Bruce Feinberg
- Laurel Hodory
- Tim Holbrook
- Lillian Hoodes (Resigned)
- Joan Lutz
- Mar Matlak (Community Connector)
- Phil Michael
- RJ Pautsch
- Liz Payton
- Clancy Philipsborn
- Steve Pomerance
- Ann Quenzer
- Ted Rose (WRAB Representative)
- Mark Squillace
- Paul Wallick

TABLE OF CONTENTS

THE STORMWATER AND FLOOD MANAGEMENT UTILITY

The Stormwater and Flood Management Utility (Utility) was established in 1973 to protect the public health, safety, and welfare of the community from damage caused by stormwater runoff and floods. Additionally, the Utility is tasked with protecting and enhancing the water quality of local receiving waters. Existing stormwater and flood systems were not built as the city grew. Instead, much of the city's development happened in and around the natural floodplains prior to the establishment of the Utility.

The Utility is responsible for the administration of the city's flood management, stormwater quality and stormwater drainage programs.

The Utility's responsibilities include:

- Administration and operations
- Utility rates and finance
- Program development and management
- System maintenance and restoration
- Stormwater quality management
- Flood and stormwater regulation and compliance
- Flood prediction and warning
- Emergency preparedness and day-to-day operations
- Public education and community outreach
- System master planning and design
- Capital improvements and land management

PROGRAMS OF THE UTILITY

Flood Management Program

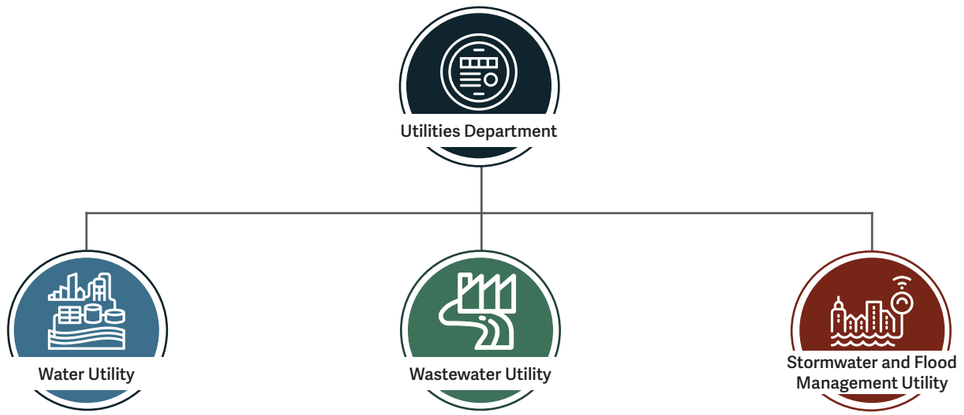
The Flood Management Program is responsible for programs and activities related to local flooding and Boulder's floodplains.

Stormwater Drainage Program

The Stormwater Drainage Program is responsible for the network of underground pipes, structures and channels that convey stormwater or surface runoff to major drainageways within the city.

Stormwater Quality Program

The Stormwater Quality Program is responsible for managing local activities to preserve, protect and enhance water quality affecting Boulder's streams and drainages.



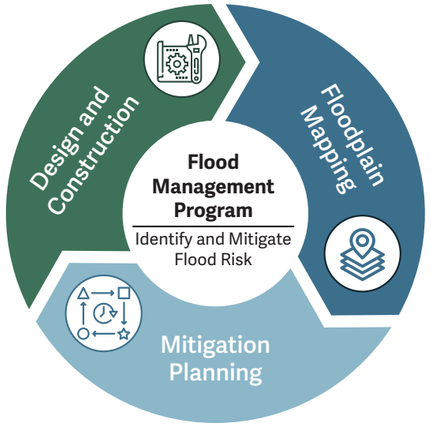
FLOOD MANAGEMENT PROGRAM

Boulder has extreme flood risk, primarily due to its location at the mouth of the Boulder Creek and its tributaries. With 16 major drainageways, about 16 percent of land within city limits - including around 2,600 structures - is located within the 100-year floodplain. The flood management program is responsible for floodplain mapping, risk assessments, regulations, flood information and insurance, emergency preparedness, property acquisition and flood mitigation capital improvements.

THE PROJECT LIFE CYCLE

Flood Mapping, Mitigation Planning, and Construction

As shown in the figure, major flood projects follow a project lifecycle. The first step is floodplain mapping, which identifies and quantifies the flood risk. Following that, mitigation planning identifies the preferred alternative for specific flood projects that mitigate the risk. The final step is to design and then construct projects. Activities completed since the 2004 Comprehensive Flood and Stormwater Master Plan include:



- ✔ Updated flood mapping for 15 of Boulder's 16 major drainageways
- ✔ Completed flood mitigation plans for 10 of the 16 drainageways:
  - Gregory Canyon Creek
  - Bear Canyon Creek
  - Fourmile Canyon Creek
  - Wonderland Creek
  - South Boulder Creek
  - Skunk Creek/Bluebell Canyon Creek/King's Gulch – in progress/90% complete
  - Upper Goose Creek/Twomile Canyon Creek – in progress/90% complete

Three mitigation plans were completed prior to 2004, and three remain to be completed for Boulder Creek, Boulder Slough and Sunshine Canyon Creek. The Boulder Creek Restoration Master Plan was completed in 2015, and some flood mitigation projects were identified for Boulder Creek and Boulder Slough.

- ✔ Constructed major flood improvements as follows:
  - Elmer's Two Mile ($9M)
  - Wonderland Creek ($30M)
  - Gregory Canyon Creek ($0.7M)
  - Boulder Creek bridge replacement ($6M)
  - Broadway Culvert at Fourmile Canyon Creek ($4M)
- ✔ Acquired seven high hazard properties from the floodplain as part of the property acquisition program.
- ✔ Added funding and staff resources for flood mitigation support, including GIS/mapping personnel.

FLOOD PREPAREDNESS, RESPONSE, AND RECOVERY

Planning and preparation play a critical role in flood safety and continuing operations after a disaster. Pre-flood readiness, ongoing monitoring, effective warning systems, trained response and post-flood recovery increase resilience in the community and mitigate the impacts of floods.

Activities completed since 2004 include:

- Enhanced the city's website, communications and informational materials for public information, including regularly updating the Community Guide to Flood Safety. Examples of typical education and outreach materials include:

Community Guide to Flood Safety	Maintenance of flood information website (www.boulderfloodinfo.net)
Direct mailings to properties in the 100-year floodplain	Flood safety classroom programs for elementary school teachers
Door hangers to University of Colorado off campus housing neighborhoods and high hazard residential properties	Temporary and permanent signage located on underpasses and along creeks
Annual utility bill inserts	Water Festival Flood Safety Presentation
Public events, open houses, workshops	Flood safety sheets for elementary students
Social media posts (Facebook, NextDoor, etc.)	Daily Camera newspaper ads
USB devices with flood safety material	Brochures and programs for stormwater outreach

- Increased the discount on flood insurance for community members from 10% to 25% by taking actions under the Federal Emergency Management Agency (FEMA) National Flood Insurance Program to lower the Community Rating System class from a Class 8 to a Class 5.
- Enhanced emergency alert capabilities in coordination with the Office of Disaster Management for City of Boulder & Boulder County (ODM) and Mile High Flood District (MHFD). Through the Integrated Public Alert & Warning System (IPAWS), area police and fire departments can now send Wireless Emergency Alerts (WEA) to cell phones within a certain geographic area without community members having to opt-in.

STORMWATER DRAINAGE PROGRAM

Stormwater runoff from urbanized areas and impervious surfaces can produce localized and downstream flooding, as well as channel erosion and increased pollution to waterways. The Stormwater Drainage Program is responsible for the network of underground pipes, structures and channels that convey stormwater or surface runoff to major drainageways within the city. Managing this infrastructure requires master planning to guide upgrades and expansion of the system, inspections, maintenance, repairs, regulatory compliance and capital improvements.

Activities completed since 2004 include:

- Updated the Stormwater Master Plan (SMP) in 2007 and 2016. This plan serves as a long-term guide to address existing and future stormwater drainage and stormwater quality issues and to alleviate current capacity and flooding problems in the stormwater drainage system.
- Completed several local drainage projects totaling over $2 million.
- Updated the Design and Construction Standards (DCS) to clarify policies, including separating stormwater drainage from irrigation ditches and detention requirements.
- Implemented a new asset management system (Beehive) and updated system mapping. Together, these tools provide a detailed system inventory and condition assessment information that supports proactive versus reactive maintenance approaches.
- Aligned drainageways and greenways management practices with MHFD guidance to optimize maintenance and increase ecosystem benefits, including discontinuing certain mowing practices.
- Centralized comment and complaint records related to storm and flood maintenance into one dataset with the Inquire Boulder system, which supports a coordinated response, enhances customer experience and identifies recurring problem areas.
- Increased staffing and equipment and reorganized Utilities Maintenance teams into two separate groups: Stormwater (crew of 11 and supervisor), which is solely responsible for the maintenance of the stormwater drainage infrastructure, and Flood and Greenways (crew of four and supervisor), which is dedicated to flood and greenways maintenance, including responding to customer complaints.
- Updated the storm system cleaning schedule from a 35-to-55 year cycle to a 15-year cycle (in other words, the entire system will be cleaned every 15 years).

STORMWATER QUALITY PROGRAM

The built urban environment negatively impacts water quality in streams and drainageways in the forms of polluted runoff, spills and excess sediment. The Stormwater Quality Program seeks to preserve, protect and enhance surface water by complying with state water quality regulations and educating the community to foster shared stewardship of this natural resource.

Since 2004 the following activities have been completed:

- Updated stormwater quality requirements and regulations in the Boulder Revised Code and Design and Construction Standards to enhance the protection of water quality from stormwater discharges.
- Constructed 60 stormwater control measures (SCMs) on city-owned properties.
- Provided maintenance for approximately 85 city-owned SCMs, including rain gardens, bioswales and other water quality features.
- Implemented the 2016 revised state municipal separate storm sewer system (MS4) permit.
- Conducted special studies and enhanced monitoring to better understand the *E. coli* Total Maximum Daily Load (TMDL) on Boulder Creek. This included the 2019 update to the 2011 TMDL Implementation Plan.
- Developed the 2019 Green Infrastructure Strategic Plan to provide strategies for building green infrastructure, including on capital projects and public land.
- Expanded the 2011 Greenways Master Plan to incorporate Boulder Creek and 14 of its tributaries.
- Designed a project with MHFD to assess urban streams using MHFD's Urban Stream Assessment Protocol to better understand relative stream health and plan for future management and projects (implementation in progress in 2022).

RELATED INITIATIVES

Sanitary Sewer Rehabilitation

Although separate from the Stormwater and Flood Management Utility, the sanitary sewer system is also affected by heavy storms and flooding events. In severe storms, rainwater can enter and overwhelm the system through defects in pipes and manholes. Since 2004, activities included:

- Lined approximately 45% of 1.3 million feet of pipe, according to a 2014 council decision to accelerate sanitary sewer rehabilitation by lining clay and reinforced concrete pipes within 20 years.
- Replaced and lined undersized and failing sanitary sewer lines near Foothills and East Pearl, completing the first phase of the Goose Creek Interceptor project. The second phase is in preliminary planning phases.
- Replaced approximately 7,300 feet of piping through the Baseline & Foothills Trunk Sewer Improvements Project (currently under construction with completion expected mid-2022).
- Designed the Main Sewer Improvements Project, which replaces the primary conveyance from the city to the Water Resource Recovery Facility (design in progress, with construction starting in late 2022 and subsequent phases planned through 2025).

Greenways Program

The Greenways Program provides an opportunity to integrate multiple objectives within important riparian areas along Boulder Creek and its tributaries. The program was created in recognition that stream corridors are a vital link in the larger urban environmental system and that each stream is a natural and cultural resource.

The Greenways Program is administered by Utilities, which works in conjunction with Planning & Development Services, Open Space and Mountain Parks, Parks and Recreation and other work groups within Public Works (Water Quality, Utilities Engineering and Transportation). Since 2004, the Greenways plan has been expanded to include all Boulder Creek tributaries. Additional Greenways Program objectives were accomplished in coordination with the Elmer's Two Mile, Boulder Creek at Eben G. Fine Park and Wonderland Creek flood mitigation projects. As of summer 2022, the city is hiring a Greenways Program Manager Position to reevaluate program needs and a path forward.

MASTER PLANNING PROCESS

This Comprehensive Flood and Stormwater Master Plan is an update to the previous document (October 2004) and provides a framework for implementing various programs and projects in the Stormwater and Flood Management Utility. The key tasks completed as part of the master planning process included a review of existing polices, development of program and process recommendations and the provision of a framwork for evaluating priorities and projects.

MASTER PLAN UPDATE KEY TASKS:

- Review policies
- Develop program and process recommendations
- Provide a framework for evaluating priorities and projects

ENGAGE

- **ENCOURAGE ALL VOICES**
- **FOSTER PUBLIC CONTRIBUTION**
- **INTENTIONALLY ENGAGE WITH UNDERREPRESENTED COMMUNITIES**

IDENTIFY

- **CURRENT POLICY GUIDANCE**
- **CURRENT POLICY INFLUENCE**

EVALUATE

- **ADHERENCE TO POLICY**
- **POLICY BASED ON NECESSARY FUNCTIONS OF UTILITY**
- **PROGRAM/POLICY EVALUATION CRITERIA**

ANALYZE

- **POLICY RECOMMENDATIONS**
- **PROGRAM & POLICY ANALYSIS**

MASTER PLANNING FRAMEWORK

The city's Community Sustainability, Equity & Resilience Framework defines community values that help set policies and priorities for the city. The Boulder Valley Comprehensive Plan (BVCP) is the city's primary policy and planning document and guides decisions about growth, development and preservation, as well as services such as utilities and flood mitigation. The CFS Master Plan is the overarching planning and policy document for the Stormwater and Flood Management Utility and guides the implementation and evaluation of programs and activities within the Utility.

***CITY WIDE STRATEGIES & COMMITMENTS**

- Multi-Hazard Mitigation Plan
- Greenways Master Plan
- Resilience Strategy
- Transportation Master Plan
- Climate, Ecosystems & Community
- Racial Equity Plan
- Keep It Clean Partnership
- Mile High Flood District

ENGAGEMENT

The Communications and Engagement Plan developed for this Master Plan update was designed to elicit and reflect public input on issues facing the community related to stormwater management and flooding, as well as how the city prioritizes projects. The engagement plan had an intentional focus on obtaining feedback from underrepresented communities and Spanish-speaking community members, in line with the city's adoption of the Racial Equity Plan.

To inform the community, the project team used a project website, project email address, Be Heard Boulder (an online community engagement tool), a video and a utility bill insert asking for volunteers for the Community Working Group (CWG). Many of the materials were translated into Spanish and delivered through neighborhood notifications and site visits.

To help ensure the community's values and priorities were fully considered in the Master Plan update, the city formed a Community Working Group (CWG) to advise staff during plan development and engage the community to learn about issues of concern. The CWG intentionally included City of Boulder residents with different perspectives from different areas of the city and with different backgrounds. The group included two Community Connectors who helped encourage engagement from typically underrepresented populations. Due to COVID 19, the majority of CWG involvement was virtual. The city project team held twelve online meetings, each of which included a 10-minute public comment period and one in-person walking tour.

As summarized below, three phases of engagement provided opportunities for community members to learn about and provide input to Master Plan development:

- Identification of Community Issues
- Project Prioritization
- Draft Master Plan

Identification of Community Issues

In this phase, the project team sought to better understand which issues and values related to flood and stormwater management were important to the community. CWG members actively engaged in these efforts by:

- Envisioning and developing two information flyers: an overview of the Master Plan and an English/Spanish one-pager on flood preparedness.
- Conducting 28 interviews with community members in different geographic areas of the city.
- Discussing the results from an issues questionnaire placed on the Be Heard Boulder website. The English site was visited 479 times with 187 responses received. The Spanish site was visited 120 times with no responses received.
- Assisting staff in hosting pop-up events to introduce the plan and receive input on issues at the National Night Out, Amazing Duck Race, Hometown Festival and Farmer's Market.

With information from these activities, the CWG defined themes and suggested topics to be addressed through the Master Plan update. These discussions influenced the scope of the technical analysis, including the addition of a chapter on financial considerations. The themes included:

- Project prioritization – maintenance, pacing/ timelines, prioritization criteria related to property, life safety, greenways, equity and need
- Funding – adequacy of funding, rates and equity concerns and communication needs
- Emergency preparedness - earlier warnings, preparation, life safety, communication needs, fears and needed support
- Stormwater quality – encampments and public health and stormwater pollution
- Stormwater drainage – maintenance, green infrastructure, irrigation and drainage ditches, sewer backups, equity, greenways and wildlife corridors
- Flood mapping – flood risk and 2013 flood area
- Flood regulation – maintenance, development regulations and enforcement
- Flood mitigation – climate change impacts, urgency for mitigation, development restrictions, protecting life and property, leveraging existing infrastructure and equity
- Other – groundwater, education and outreach and flood insurance

Project Prioritization

In the second phase, engagement focused on learning what the community considered most important in a project prioritization framework. In response to community requests to provide neighborhood-specific outreach, the project team held five virtual creek-based meetings for community members to learn about issues in their area and to provide input on criteria for prioritizing projects (Table 1). The project team also hosted a sixth session about flood issues citywide, which was conducted in English and Spanish. Approximately 50 community and CWG members attended the six virtual meetings. Staff also met with community members at the Boulder Shelter for the Homeless to discuss stream safety.

In addition, Be Heard Boulder provided an opportunity in English and Spanish to vote on criteria related to flood mitigation project prioritization. Community Connectors distributed paper copies of the survey in Spanish-speaking neighborhoods. In total, about 90 people participated in the ranking exercise, including 18 Spanish-speaking community members, 55 English-speaking community members, 12 CWG members and 4 Water Resources Advisory Board (WRAB) members. As COVID-19 restrictions lifted, staff and CWG volunteers elicited additional input on community priorities at the Farmer's Market. The project team used results from these activities to develop the proposed prioritization framework, as explained in detail in Volume II of the Master Plan.

Table 1 | Regional Creek Meetings

2021 Date	Regional Creek Meetings
Oct 20	Fourmile Canyon Creek, Wonderland Creek
Oct 21	Goose Creek, Twomile Canyon Creek, Elmer's Two Mile Creek
Oct 25	Boulder Creek, Boulder Slough, Sunshine Canyon Creek, Gregory Canyon Creek
Oct 28	Citywide Creeks: Spanish meeting option
Nov 1	Skunk Creek, Bluebell Canyon Creek, King's Gulch
Nov 3	South Boulder Creek, Bear Canyon Creek, Viele Channel, Dry Creek No. 2 Ditch

Draft Master Plan

In this phase, CWG members participated in topic-specific groups to perform detailed analysis and review draft materials on technical topics:

- Floodplain and Hazards Mapping
- Emergency Preparedness, Response and Recovery
- Outreach, Education and Engagement
- Watershed Management, Flood Mitigation, Property Acquisition, Floodplain Preservation & Restoration, Flood Insurance and the Community Rating System
- Stormwater Drainage, Irrigation Ditches and Groundwater
- Stormwater Quality

The project team reviewed and posted CWG members' comments and the resulting updates to draft documents in a log on the team's private Be Heard Boulder site.

KEY OUTCOMES & RECOMMENDATIONS

The project team evaluated current Utility programs and activities to develop goals and objectives that reflect future needs of the Utility and community values. As explained in more detail throughout this section, the following key outcomes emerged from the master planning process.

Prioritize Projects to Do the Greatest Good, First

Created a Project Prioritization Framework to prioritize the order in which major flood mitigation projects should be funded and constructed

Provide Services Equitably

Incorporated racial equity into policies, current and future outreach and education efforts and provision of services

Make Infrastructure Resilient to Climate Change

Developed proactive measures to address climate change through infrastructure resilience

Prepare for the Extremes

Clarified roles and responsibilities for city staff and community members related to flood preparedness, flood warning and emergency response

Inform the Community to Create a Prepared Community

Refined outreach and education efforts to reach targeted audiences with a focus on vulnerable populations and non-English speaking community members

Maintain the System We Have

Defined support needs and public and private maintenance responsibilities for stormwater drainage systems and major drainageways

Adequately Fund the Program | Ensure financial resources are available to carry out stormwater and flood management program

PRIORITIZE PROJECTS TO DO THE GREATEST GOOD, FIRST

The process of planning, designing and getting approval for a major flood project can take over a decade, with many projects taking 20 years from concept to construction. While this process allows for thorough community engagement and consideration of project options, these long timeframes also pose a risk to moving forward with projects if community or political interests shift. It is therefore critical to prioritize projects in a way that aligns with core community values and minimizes debate over which project should go next. Created during the Master Plan update, the Project Prioritization Framework for major flood projects provides numerous advantages, including:

- The ability to accommodate multiple stakeholders for enhanced public participation
- The ability to analyze multiple projects with complex benefits and attributes
- Showing the impact of specific criteria on the project ranking and whether adjustments to the criteria impact the ranking
- Providing a robust, defensible tool that allows fair and equitable decision making

Based on substantial community input, the project team developed a multi-criteria decision analysis (MCDA) tool ("Project Prioritization Framework") that incorporates numerous project criteria (Figure 1). Including racial equity considerations in project prioritization was one of the primary objectives of this Master Plan update. Common prioritization methods use a "losses avoided" approach to calculate project benefits. This approach frequently results in benefit/cost ratios that favor projects in affluent areas with the highest property values as opposed to where the life safety risk and community needs are the highest.

Figure 1 | Initial Project Prioritization Criteria

Criteria Selection and Weighting

Through the engagement efforts described in the Master Planning Process section, community members ranked the nine criteria shown in Figure 1. Life safety received the highest ranking, as public health, safety and welfare are fundamental goals of the city. Based on this feedback, the project team created the Project Prioritization Framework to enable sound decision-making around the effectiveness and efficiency, equity and environmental/cultural aspects of each project along with the ability to implement - attributes that are also critical to the success of the Utility and the community. The nine criteria were then combined into seven main criteria with associated sub-criteria to simplify model outputs and limit double counting of criteria. Figure 3 outlines the decision hierarchy used in the tool.

City staff will use the Project Prioritization Framework to compare new and existing projects by first assigning a score for each of the project prioritization criteria, using both quantitative and qualitative information. The score for each individual criterion is assigned a weight based on relative importance to the community, and the overall score of a project is the weighted sum of all the criteria. Established weighting factors will not change during the prioritization process to remain objective. However, criteria selection and weighting will be reevaluated as part of the next Master Plan Update. By comparing the total scores for each project, city staff can then prioritize projects based on a consistent set of criteria that directly reflects community values and project benefits.

Figure 2 provides an example of applying the Project Prioritization Framework to a set of projects. In this example, Project D received the highest score due largely to its impact on life safety and effectiveness, down to Project E1 that ranked sixth in priority . It's worth noting that Project A might rank lower than other projects were it not for racial and social equity considerations. Additional information on weighting and the prioritization process is provided in Chapter 10 and Appendix D of Volume II.

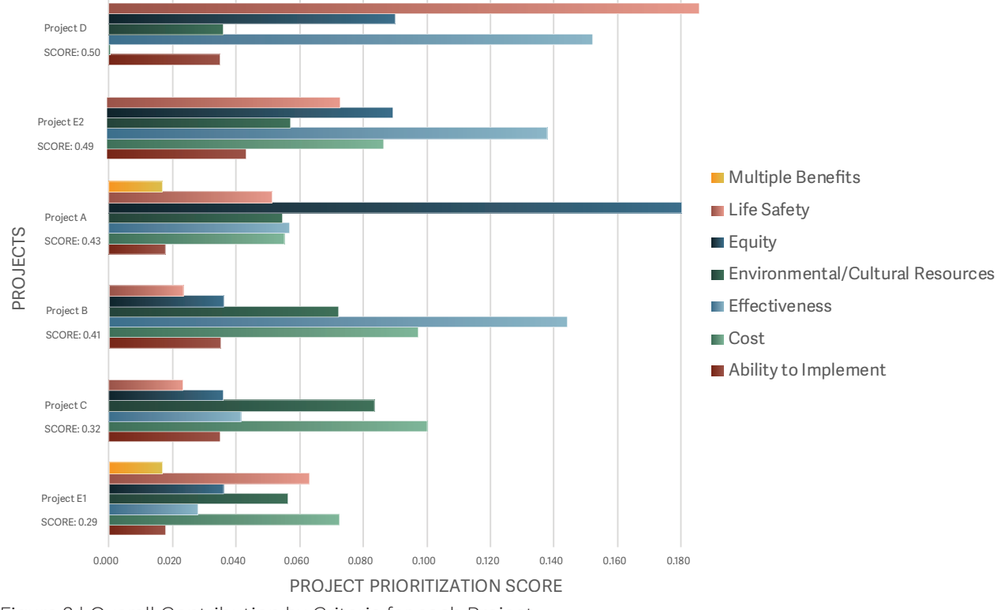


Figure 2 | Overall Contribution by Criteria for each Project

Key Recommendations:

The Project Prioritization Framework is recommended for use to rank projects in the Utility's 20-year CIP. As major flood projects are identified in the future, they should be ranked using the Project Prioritization Framework to inform the proposed CIP priorities and budget.

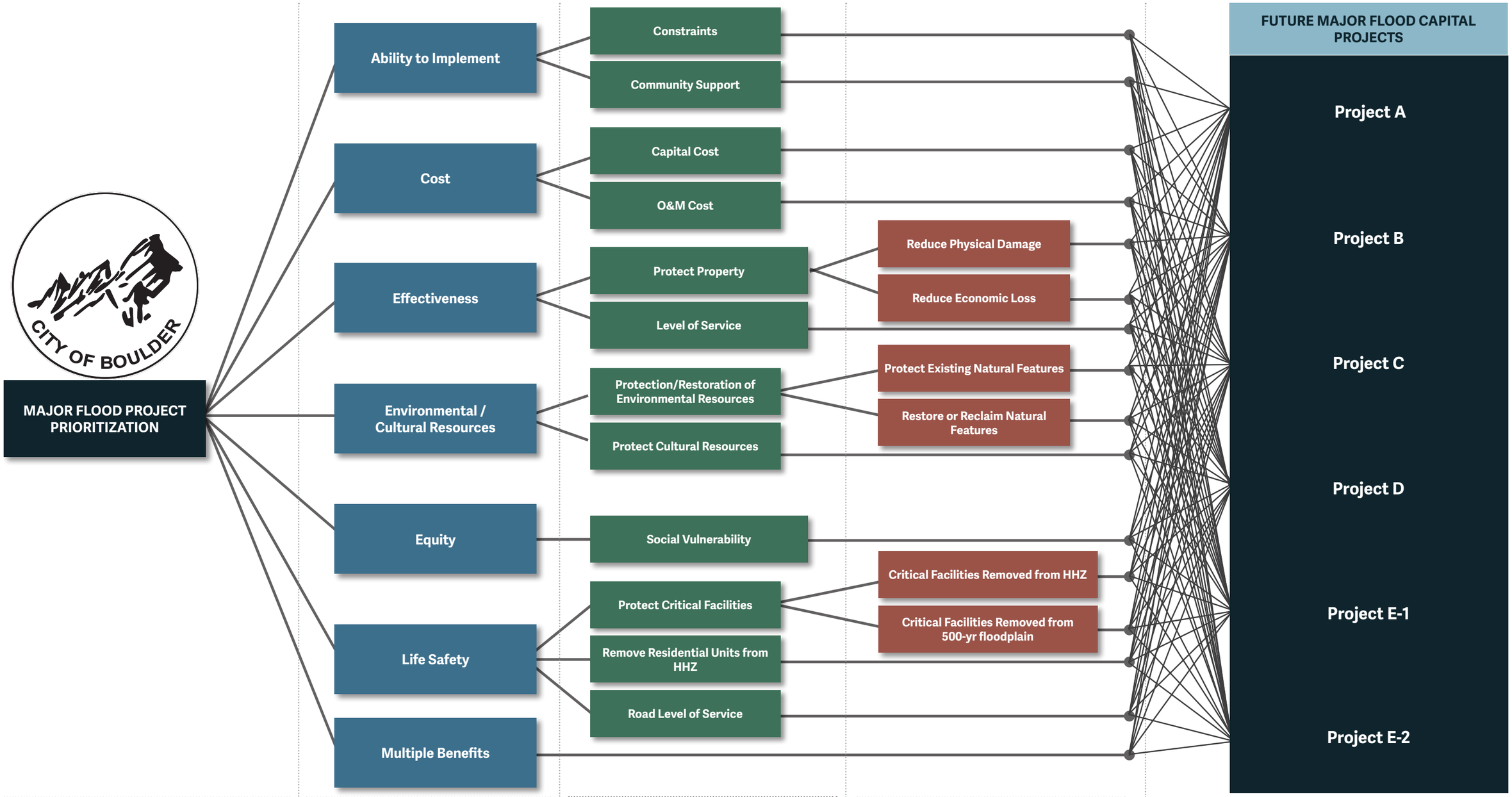


Figure 3 | Decision Model Main Criteria and Sub-Criteria

PROVIDE SERVICES, EQUITABLY

As described in the Master Planning Process section, the project team made intentional efforts to incorporate the city's Racial Equity work into the Master Plan process by engaging underrepresented communities and Spanish-speaking community members. The project team also reviewed existing policies, actions, regulations and regulatory enforcement to determine if inequitable impacts were evident (reference Volume II). This analysis and community feedback informed equitable policies, program goals and objectives that became part of the Master Plan and Project Prioritization Framework.

EQUITY IN ENGAGEMENT

- Translated outreach and engagement materials into Spanish
- Attended in-person outreach events in predominantly Spanish-speaking neighborhoods
- Held a regional creek meeting in Spanish language with the help of translators
- Hand-delivered paper copies of a questionnaire to provide non-digital engagement opportunities
- Incorporated community feedback to equitably prioritize projects by addressing systemic and institutional racism

Key Recommendations:

- Prioritize the design and construction of major flood mitigation projects in a way that incorporates racial equity through the use of the Social Vulnerability Index[1] (incorporated into the Project Prioritization Framework described in the previous section)
- Establish policies and programs that focus on equitable outcomes for minority populations
- Create emergency preparedness and post-emergency education and outreach resources that are culturally relevant for Spanish-speaking and other non-native English-speaking communities
- Enhance outreach by maintaining and growing relationships in the Spanish-speaking community and distributing information at in-person events

[1] https://www.atsdr.cdc.gov/placeandhealth/svi/fact_sheet/fact_sheet.html

MAKE INFRASTRUCTURE RESILIENT TO CLIMATE CHANGE

Climate change is causing widespread disruption in natural systems that threaten the wellbeing of communities. In Colorado, we will continue to see increases in temperatures, heat waves and drought and storm intensity. These changes can lead to an increase in wildfires and change precipitation patterns in ways that pose risks to drinking water supplies and stormwater and flood infrastructure. While the specific magnitude and timing of future rainfall and flood events are not known, a proactive approach is still needed to address future extreme events.

Constructing resilient infrastructure that is adaptive to changing conditions should become an integral part of the stormwater and major drainageway systems. To accomplish this, the performance of storm and flood systems will be evaluated over a wider range of possible storm events that are beyond the design capacity. A risk management approach will consider the consequence of flooding and adjust project designs based on the risks to people and property. Whenever possible, overflows beyond system capacity will be intentionally routed to areas that are least harmful to people and property. This approach places increased analysis and informed decision making in areas where the consequences of flooding are high and are commonly associated with critical infrastructure.

Key Recommendations:

- **Implement projects expeditiously –** Scientific studies indicate that extreme weather events such as heat waves and large storms are likely to become more frequent and more intense with human-induced climate change. The sooner projects are implemented, the better the community will be protected from frequently occurring storm events.
- **Maximize flood protection and/or storage in major flood mitigation projects –** Address uncertainty by designing resilient infrastructure and implementing projects with the highest feasible and practical level of protection to best protect the community.
- **Be a leader in implementing climate science into Utility planning and engineering work –** Continue the Utility's reputation as a leader in planning for and adapting to climate change by closely following agency guidance as climate change science is integrated into flood regulations and Boulder-specific scientific studies performed by the Utility are completed.
- **Maximize natural features such as wetlands into flood mitigation projects –** Throughout the master planning process, community input has indicated a continued need to prioritize environmental values. Implementing environmental features into projects to the extent feasible will help the city to restore creek corridors, improve water quality and offset its carbon footprint.

PREPARE FOR THE EXTREMES

Flood preparedness, flood warning and emergency response are all critical activities for life safety and property protection. Infrastructure alone cannot eliminate all dangerous flooding conditions. Therefore, the city and community members must prepare to be able to respond quickly when flooding occurs.

City and community roles and responsibilities vary according to flood conditions, ranging from a focus on awareness and preparedness under normal conditions to coordinated response and action during life-threatening flash floods. The project team identified detailed roles, responsibilities and resources as part of this Master Plan and recommends incorporating them into plans and activities as described below.

Key Recommendations:

- Review and update existing city emergency response plans to confirm and clarify Utility staff roles and responsibilities.
- Review and update emergency alert systems, emergency references available to the community and investigate potential upgrades to newer outdoor warning systems.
- Apply the city's Racial Equity Plan and Instrument to emergency preparedness and response plans and include specific strategies for reaching non-English speakers.
- Clarify and communicate the roles and responsibilities of community members, such as buying flood insurance, developing personal emergency response plans and evacuation routes, signing up for emergency alerts, ensuring contact information is up to date and taking floodproofing precautions.

AN INFORMED COMMUNITY IS A PREPARED COMMUNITY

In the preparedness phase of flooding, the Utility engages in extensive public outreach and education efforts to educate the community about flood risks. However, demographics change and the need is ongoing, particularly considering the significant number of renters and short-term community members (e.g. college students). The Be Heard Boulder survey launched at the beginning of the Master Plan update process identified the following questions and interests about flooding:

WHO IS AT RISK?

HOW BIG IS THE RISK?

PREPARATION IS KEY

A DESIRE FOR EARLIER FLOOD WARNING

The CFS Community Working Group echoed these themes by noting the importance of focusing on equity and in reaching traditionally hard-to-reach populations. The Utility will use the city's Racial Equity Instrument to inform outreach efforts and will continue to investigate effective and creative outreach strategies. Additionally, the city will evaluate the efficacy of current outreach and education efforts to continuously adapt and improve methods.

Key Recommendations:

- Annually update a flood communications plan and schedule to include lessons learned during the COVID pandemic, including effective distribution methods, guidance and guidelines on hosting in person versus virtual events, evaluation methods and associated costs.
- Periodically review and update city resources available to the community.
- Identify evaluation metrics to better gage the impact of communications methods, resources and programs to reach target audiences, with an emphasis on community members that will mostlikely require additional support before, during and after a flood.
- Develop a concrete approach for how the city and response agencies will reach non-English speaking residents with education and outreach materials, and especially when ordering evacuations.
- Identify communication channels, stakeholders and partners that can help tailor and disseminate messaging.

TARGETED OUTREACH

One of the most important aspects of the city's education and outreach program is to connect with community members that will most likely require additional support before, during and after a flood with tools and resources for flood preparedness.

Traditional outreach strategies and media can miss these populations. The city will develop and implement effective strategies such as in-person community meetings and include tools to remove language barriers, which is particularly important for the Spanish-speaking community.

MAINTAIN THE SYSTEM WE HAVE

The community consistently voiced a desire to increase and enhance flood and storm maintenance activities throughout the public engagement process. City staff have also recognized the need for increased maintenance and have been actively investigating ways to address these needs. However, flood and storm maintenance can sometimes conflict with community expectations. Routine maintenance includes the removal of trees, vegetation and sediment, which can temporarily alter the look of surrounding neighborhoods. Engagement and outreach efforts will include information on what to expect during maintenance activities for both the community and decision-makers to minimize conflict.

Boulder's Utilities Maintenance work group is responsible for the maintenance of approximately 37 miles of open drainage channels and major drainageways and 160 miles of storm sewers in conjunction with regional partners like the MHFD. In addition to pipes and drainage channels, maintenance also includes structures, floodways, greenways and private irrigation ditch maintenance obligations. Since the 2004 Master Plan, significant advances have been made to increase maintenance frequency, efficiency and response to customer complaints. However, current Flood and Greenways staffing levels only allow for partial maintenance of open channels and do not support completion of system-wide maintenance on a recurring basis with any regularity. While not specifically governed by policies within the Utility, support for the required resources to perform these maintenance functions is essential to achieving maintenance goals.

Key Recommendations:

- Define public and private maintenance responsibilities for stormwater drainage systems, major drainageways and roadside ditches and culverts to ensure both Maintenance staff and community members understand and are maintaining their portions of the system.
- Support staffing levels that provide for maintaining the 37 miles of open drainage channels and major drainageways, as well as adjacent greenways, on a regular recurrence interval.
- Be supportive of maintenance and capital improvement actions related to the city's stormwater and flood infrastructure.
- Continue to improve maintenance response, frequency and efficiency through data collection and further implementation of the Utility's asset management system.
- Clarify under what circumstances the city may conduct emergency maintenance operations in a policy.

IMPLEMENTATION AND FUNDING

Turning the policy items identified in this Master Plan into a concise roadmap, including a prioritized 20-year CIP, is the next phase of the project.

20-YEAR FLOOD AND STORMWATER CIP

Following the Project Prioritization Framework described in Key Outcomes & Recommendations, city staff will prioritize remaining projects identified in flood mitigation plans[2]. This includes approximately $350 million in about 30 projects, depending upon how and whether projects are bundled (see Table 2 below). Projects currently in design and construction will be scored using the Project Prioritization Framework for transparency but will progress as planned, as they have already incurred significant expense and are nearing project completion. Applying the Project Prioritization Framework to the project list in Table 2 will inform the CIP major flood project list presented as part of the annual budget process beginning with the 2024 budget cycle.

To use the Project Prioritization Framework, staff will gather detailed data for each of the prioritization criteria to assess the relative benefit of each project. Of the seven criteria, 70% have quantitative metrics, while two (Multiple Benefits and Ability to Implement) are qualitative and more subjective. As described in Key Outcomes & Recommendations, the final seven prioritization criteria informed by the community voting exercise are:

1. Life Safety
2. Effectiveness (protect property and infrastructure resilience)
3. Social Impact, Equity & Fairness
4. Environmental and Cultural Resources
5. Cost
6. Ability to Implement
7. Multiple Benefits

See Chapter 10 in Volume II for further discussion on how these criteria were incorporated into the Project Prioritization Framework.

MAJOR FLOOD PROJECT PLANNING AND DEVELOPMENT

The process for review and approval of individual projects is identified in the annual Capital Improvement Program (CIP) and budget approval process. Currently, various processes may be required for a specific project. For example:

Concept Plan and Site Review: Concept Plans and Site Plans are reviewed by the interdepartmental staff Development Review Committee, departmental Advisory Boards, Planning Board and City Council (call-up option).

Community and Environmental Assessment Process (CEAP): The CEAP provides a framework for balanced and thoughtful consideration of environmental and social issues in the preliminary planning and design of capital projects. It also provides a forum for public discussion of broad level project issues relative to master plans and overall community goals. It is a tool to aid in the development and refinement of project design and impact mitigation options.

Project-Specific Community Process and Design: Many projects are not required to go through concept and site review and would not benefit from a CEAP process. These typically have a project-specific design and public process to efficiently and appropriately identify community needs, concerns and preferences. Many projects have been assessed through facility studies, area or facility planning processes, mitigation plans or other studies. The processes are collaborative with multiple city and/or county departments.

[2]Mitigation plans for Upper Goose/Twomile and Skunk/Bluebell/Kings are at 90 percent complete as of spring 2022. Final approval of these plans will allow for proposed projects to be included in this prioritization effort.

Table 2 | Boulder's Major Flood and Stormwater Projects to Be Prioritized for 20-year CIP

Major Drainageway	Proposed Project	Flood Mitigation Plan
Bear Creek	Culvert Improvements Channel Improvements	Bear Canyon Creek (2016)
Bluebell Canyon Creek	Bluebell-01 Bluebell-02	Skunk Creek, Bluebell Canyon Creek and King's Gulch Flood Mitigation Plan (DRAFT 2020)
Boulder Creek		*Mitigation Plan not Completed*
Boulder Slough		*Mitigation Plan not Completed*
Dry Creek		*Mitigation Plan not Completed*
Elmer's Two Mile Creek	*Completed*	*Mitigation Plan Completed*
Fourmile Canyon Creek	Fourmile @ Broadway Fourmile @ 19th Street Safer Schools Access Fourmile Upstream of 26th Fourmile Broadway to 19th	Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning (2017)
Goose Creek	Goose-01 Goose-02 Goose-03 Goose-04 Goose-05 Goose-06	Upper Goose Creek and Twomile Canyon Creek (DRAFT 2020 – subject to change/pending approval)
Gregory Canyon Creek	*Arapahoe to Pennsylvania** Upstream of Pennsylvania	Gregory Canyon Creek Flood Mitigation Plan (2015)
King's Gulch	King's-03 King's-04	Skunk Creek, Bluebell Canyon Creek and King's Gulch Flood Mitigation Plan (DRAFT 2020 – subject to change/ pending approval)
Skunk Creek	Skunk-05 Skunk-06 Skunk-07 Skunk-08	Skunk Creek, Bluebell Canyon Creek and King's Gulch Flood Mitigation Plan (DRAFT 2020)
South Boulder Creek/Dry Creek Ditch No. 2/Viele Channel	*SBC Phase 1** SBC Phase 2 SBC Phase 3	South Boulder Creek Major Drainage Plan (2015)
Sunshine Canyon Creek		*Mitigation Plan not Completed*
Twomile Canyon Creek	Twomile-01 Twomile-02 Twomile-03 Twomile-04	Upper Goose Creek and Twomile Canyon Creek (DRAFT 2020)
Wonderland Creek	Foothills to Valmont 26th to 28th Street 19th Street	Fourmile Canyon Creek and Wonderland Creek Major Drainageway Planning (2017)
Stormwater Local Drainage Improvements	Tier I Local Drainage System CIP Projects	Stormwater Master Plan (2017)
Stormwater Collector System Improvements	Collector Storm Sewer System Tier 1 Hydraulic and Combined Hydraulic/Water Quality CIP Projects	Stormwater Master Plan (2017)

*Note: Projects currently in the design and construction phase of the project lifecycle will be shown in the context of the prioritization framework among all the other prioritized projects for transparency but will progress as currently planned without delay as they have been in progress for some time and are nearing the end of the project cycle.

The city will use the annual budgeting process in conjunction with the Project Prioritization Framework to implement project work. Storm and flood projects frequently require a longer timeframe to plan and construct than the city's typical 6-year CIP timeframe, due largely to land owner negotiations, regulatory and stakeholder engagement processes. The Project Prioritization Framework will allow staff to create a 20-year Flood and Stormwater CIP and will serve as a defensible methodology for project selection as changes occur during long project cycles. The 20-year CIP will also communicate to staff and the community the location and schedule for near-term projects. Longer-term projects will be rank-ordered for future action.

Achieving the Action or Vision Level of Funding

Master plans within the city lay out strategic objectives that will be pursued at differing levels based upon the amount of additional investment appropriated by City Council through the annual budget process. The levels of funding for most city projects fall into three scenarios: Fiscally Constrained, Action or Vision.

FUNDING SCENARIO	DESCRIPTION
Fiscally Constrained	This funding level provides approximately $5M in capital funds and reflects what is needed to maintain basic Utility services over the short term. This includes minimal rate increases (that keep up with the Consumer Price Index). Minor investment is made in capital improvement projects and maintenance and operations would be a priority. The city had generally maintained this funding level prior to 2015. Under this funding scenario the CIP might take 75 or more years to complete.
Action	This funding level assumes an average of $7M annually in 2022 dollars, and accoutns for annual fluctuations and associated rate increases. Some capital improvements are debt-financed so debt service is included in utility rates. In addition, this funding level includes six Engineering/Project Managers as currently approved in the 2022 Budget Book. Under this funding scenario it may take more than 50 years to complete the CIP. This is where the city funding has been since 2015.
Vision	This funding level provides approximately $11M in annual capital funds and augments resources with additional engineers, project managers and/or consultants and capital available to complete one to two major flood projects per year. This level of funding supports an acceleration of the stormwater and major flood Capital Improvement Program and Utility maintenance so that the CIP can be completed within 30 to 35 years. These funds would be realized through a combination of continued rate increases to fund bond issuances; higher than estimated Plant Investment Fees; one-time federal grants; and higher interest on investments. This level requires sustained larger rate increases and additional staffing and resources to implement the projects.

As reflected in the table above, the Utility has historically been operating under the Fiscally Constrained scenario. After 2015, the city increased rates by percentages in the double digits and has moved into the Action scenario and is just now starting to realize the outcomes of these rate increases and issuing of bonds.

Community feedback throughout the Master Plan update consistently expressed the desire to accelerate the pace of project completion. To do so, the city would need to adopt the Vision funding scenario for the Stormwater and Flood Management Utility. Implementing the Vision scenario would require:

1. **Staff -** Funding and filling project management and project engineering staff positions and/or provide increased consultant support.
2. **Funds -** Continued community and City Council support for funding projects via sustained rate increases and ability to bond major projects.
3. **Support -** Community support for major projects, recognizing that they benefit everyone in the city and understanding that there will be traffic, noise and aesthetic disruptions due to major project construction, sometimes within multiple drainageways simultaneously.

As shown in Figure 4, monthly service charge fees are the primary source of funding for the Utility. Current funding is adequate to carry out the Action scenario and program as approved by City Council (2022 Budget Book).

To achieve the Vision scenario for capital improvement, the Utility will need to increase customer rates and continue to issue bonds. With service fees providing over 90 percent of the Utility's revenue, these remain the most stable and robust revenue source of funding. This plan recommends that any rate and service fee increases happen gradually on an annual basis (ramping) versus over a longer time interval (stepping). Bonding to fund major capital infrastructure allows the Utility to expedite project completion, while spreading out the associated cost to ratepayers over time.

The city should also seek to maximize other sources of funding, such as cooperative cost sharing, and federal and state grants and loans. These sources include new grants that may be available through the 2021 Infrastructure Investment and Jobs Act.

While these funding sources will benefit the community by offsetting rate increases, they will not by themselves expedite project completion. Maintaining adequate staff, combined with consultant resources, is necessary to manage projects and ensure funds are spent appropriately.

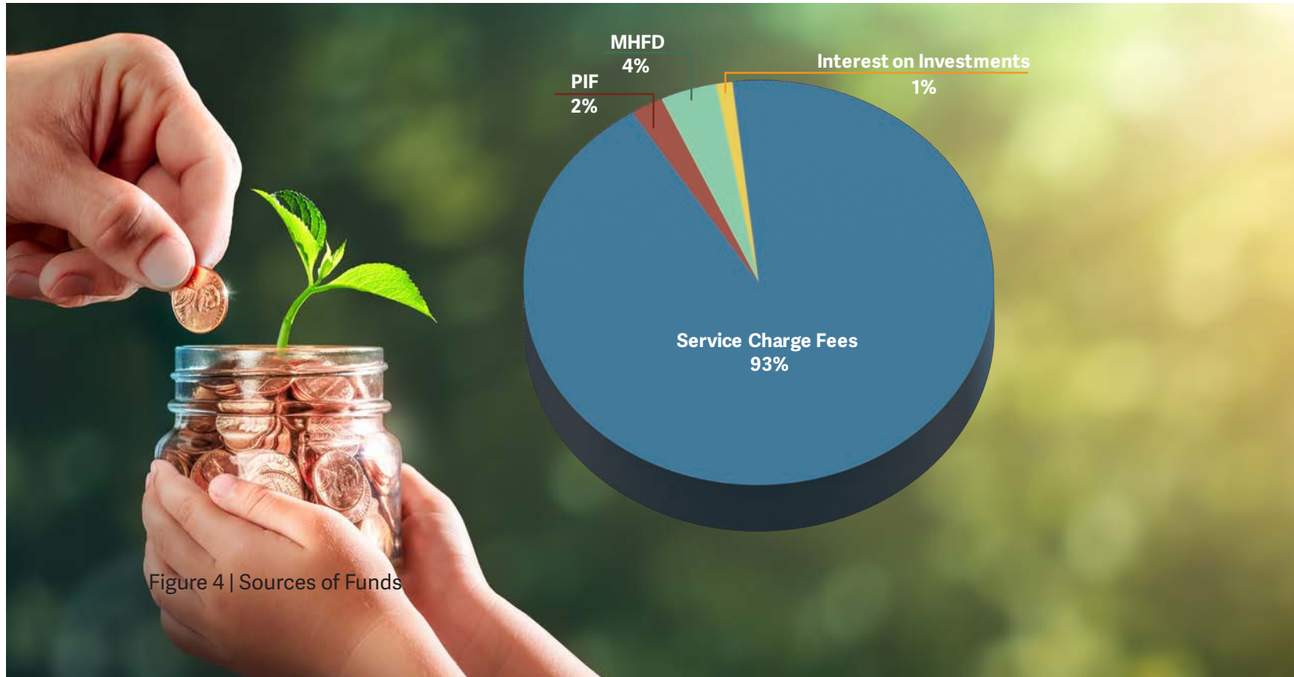


Figure 4 | Sources of Funds

PUTTING THE PLAN INTO ACTION

ANNUAL WORK PLANNING PROCESS

In 2022 the city enhanced efforts to standardize and coordinate work planning efforts across departments. These enhancements will improve the city's ability to identify opportunities to leverage and coordinate with other city work efforts. For example, aligning the timing of Transportation and underground Utility projects can decrease the number of times roads and other areas are disturbed.

Equity in Decision Making

To integrate equity into the decision-making process, projects will be prioritized for construction based on equity as an important criterion (see Project Prioritization Framework, above). In addition, the citywide Racial Equity Instrument will be used as one of the Utility's decision-making tools. Developed as part of the city's Racial Equity Plan, the Racial Equity Instrument actively inserts racial equity into decision making processes with a particular emphasis on public engagement.

While the instrument can be helpful when used at any decision-making phase, it has the most impact when used at the forefront of planning for a project alternative analysis. Using best practices from the Racial Equity Instrument, the Utility will facilitate public engagement processes that include those in the Boulder community who have been historically left out or have not participated in planning processes.

MEASURING SUCCESS

The Utility should regularly measure progress toward completing objectives identified in the 2022 Master Plan. The Utility has well-defined processes to plan and implement projects, but through this master planning process, staff realized that they can develop a framework that provides specific, measurable, achievable and relevant metrics to determine if activities are attaining the desired goals and benefits. This update to the CFS Master Plan includes an initial evaluation framework, as outlined below, to assess current programs with the intent that the goals, objectives and associated metrics will be refined to reflect the forward-looking needs of the Utility and public sentiment. Progress toward completion of Master Plan goals and objectives will be measured through a combination of approaches, including CIP project completion and asset management software. Metrics to track progress toward achieving identified goals and objectives will be developed as part of annual work planning, and highlights will be reported annually to WRAB.

Equity Metrics

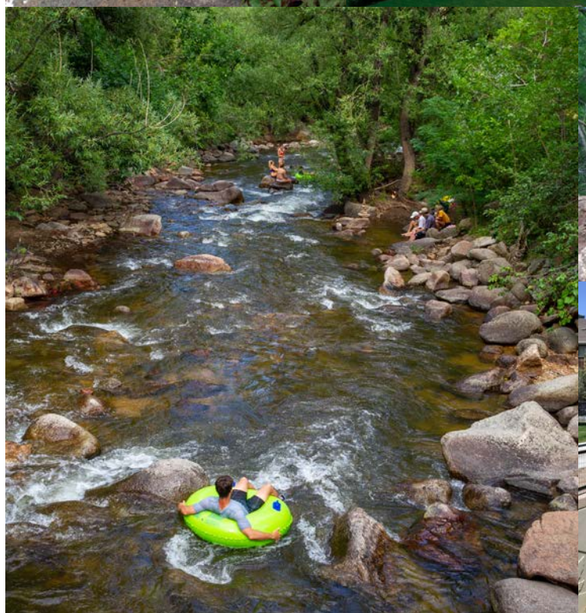
The city's Racial Equity Plan identifies goals and strategies to achieve impactful outcomes that advance racial equity. Utility staff will further define metrics to measure progress toward outcomes identified in the Racial Equity Plan, including:

- Racial equity instrument is used to establish organizational priorities, during decision making on projects and as part of all Master and Strategic planning processes
- Improved use of data and analysis tools to identify racial equity trends
- Impacted community members are engaged and provide input
- Routine evaluation, modification and addition of policies to reinforce and build racial equity at all levels
- Foster participation of historically excluded community members by designing new, inclusive engagement opportunities
- Ongoing language access needs are addressed in communication and engagement processes
- Projects and Utility funding are increased in areas that address racial equity
- Number of people of color, including women of color, are increased in leadership positions within the Utility

Resilience and Climate Change

Desired outcomes and metrics will be further defined and may include:

- Reduce the Utility's greenhouse gas emissions
- Prevent development in hazard-prone areas



- Reduce design, construction and maintenance costs as well as the cost of climate-related disasters
- Increase ability to recover quickly from storm events
- Implement adaptive management plans for the maintenance of natural systems, such as greenways and vegetated SCMs
- Increase in the number of projects constructed to further the resilience of our major drainageways

The Utility will continue to monitor updates to national codes and standards that provide for resilient infrastructure design and incorporate as appropriate. The Utility will assess innovations and design ideas as they arise. One example is to investigate the use of either "low-carbon" or "carbon-storing" concrete and measure the reduction in GHGs (see text box).

"Public works projects use a significant amount of concrete. Production of concrete's key ingredient, Portland cement, generates 7% of the world's heat trapping carbon dioxide.

"Low-carbon concrete" uses alternatives to Portland cement (such as slag, ground waste glass or new innovations such as injected carbon dioxide, creating a mix that's strong and durable, while reducing carbon emissions). "Carbon-storing concrete" incorporates limestone aggregates and fillers made using carbon dioxide or creating new, biomineralized concrete alternatives that do not contain Portland cement so that the concrete becomes a net-carbon sink."

Dr. Wil Srubar, CU Boulder

2022

Comprehensive Flood and Stormwater Master Plan

boulder colorado.gov