C Proposed Work Plan

Our Philosophy can best be described as:
Listen, Think, Act, Adjust.

We organized this section by major services offered. We start with an overview of our project management philosophy followed by more detailed descriptions of the technical discipline approaches. Tetra Tech anticipates that the City will contract directly for material testing services, but we have relationships with these firms should the City desire us to subcontract these services.

PROJECT MANAGEMENT

A. Staffing & Personnel

Staffing and personnel were discussed in Section A. Additional thoughts on our vision for working with the City of Ann Arbor are provided below.

Project Management

Tetra Tech delivers our commitment to be available 24/7 to the City. Tetra Tech's approach to each project has the same bottom-up methodology—we complete each service entirely focused around the needs and constraints of our clients.

Listen: Each project Tetra Tech completes is a custom project soley focused on meeting the specific needs of each client. Therefore, we will initiate each project by listening to the needs of the citizens, businesses, elected officials, and staff who will be using the completed project. We recognize that these individuals will be using the completed project long after the consulting engineer has finished. Therefore, our project execution must be based on the needs of the project users.

Think: A successful project must be properly conceived and studied or designed only once. Therefore, we must carefully plan the work and work our plan. Each project begins with a detailed work plan prepared by a senior discipline leader. This way the proper, most efficient procedures can be implemented throughout the development of the project. While most projects we envision for the City will be completed by Michigan-based staff, this could involve the use of national experts if the project is especially complex or unique.

Act: This step involves the study, design, or construction of the project. Each engineering step is done under the guidance of a senior engineer. Although we do use junior engineers to help lower costs, the supervision of a senior engineer ensures the completed project is technically sound, on time, and within budget. We have also included a description within this submittal outlining Tetra Tech's quality assurance and project management approach.

Adjust: This is the step that separates Tetra Tech from our competitors. The adjustment involves team members listening to the client throughout the project to ensure what we are delivering meets the City's needs. It also involves oversight by senior management to ensure our team is on track. This takes the form of a few periodic interviews with City staff responsible for the project and subsequent corrections. Most of the project references provided have gone through these interviews and can attest to their effectiveness at delivering final projects that exceed expectations.

Additional details of these interviews are described in the QA/QC write-up elsewhere in this submittal.

B. Communication & Coordination

Tetra Tech tailors our communication to the needs of each client and project. We will review the approach desired by the City prior to starting any assignment. Our communication norms are listed below:

- Monthly progress meetings with written agendas and minutes documenting the status of every assignment
- Conduct/Attend pre-construction and progress meetings and prepare minutes for distribution, which are transmitted within 24 hours to ensure accurate information and a timely review.
- Attend/Participate in public information meetings.
- Daily Construction Progress Reports e-mailed at the conclusion of each business day.
- Client staff interviews to ensure our project team is meeting client expectations.

C. Compatibility with City's Standards, Goals, & Objectives

As an Ann Arbor-based company, we follow the standards and goals of our hometown. A few City initiatives and how we may assist are described below.

Environmental Commitment

Tetra Tech has long focused on helping its clients address water, environment, infrastructure, resource management, energy, and international development needs. We lead and support programs that minimize our collective impacts on the environment—through the solutions we provide for our clients; through our procurement and subcontracting practices; by the processes we use within the Company to promote sustainable practices, reduce costs, and minimize environmental impacts; and through employee-supported activities such as volunteer work and fundraising campaigns.

Our vision of the future is to incorporate the concepts of sustainability more fully into our daily operations and to follow the United Nations World Commission on Environment and Development goal to "meet the needs of the present without compromising the ability of future generations to meet their own needs." Tetra Tech is in a unique position to further this vision and has the ability to provide innovative solutions to meet pressing global challenges. On a daily basis and on a global scale, our work plays a direct role in helping to achieve the balance that will allow future generations to access the necessary resources to meet all of their needs. The focus of Tetra Tech's Sustainability Program is to sustain the growth of its business, reduce greenhouse gas emissions, and provide an exceptional employee work environment, while providing better solutions for its clients.

Ann Arbor Vision Zero

This vision is to eliminate deaths and serious injuries on City streets by 2025. As one of MDOT's most widely used consultants, Tetra Tech is familiar with all safety design standards, including speed management tools.

We also believe this design consideration extends to such practices as green stormwater infrastructure which can impact vehicular safety if not properly completed.

Ann Arbor Zero Carbon-Neutrality Goal

Tetra Tech is excited about a 2030 Ann Arbor that is carbon neutral. Brian Rubel, an Ann Arbor resident, voted for the millage assisting in funding this program. As one of the largest solar and wind consultants, Tetra Tech is ideally suited to assist Ann Arbor reach this goal. On our current project for the Midtown Booster Station, Tetra Tech recommended the building use electric heat, a renewable energy source and thus comply with Ann Arbor's electrification ordinance.

Commitment to Sustainability

On the 40th anniversary of Earth Day in 2010, Tetra Tech formalized our Sustainability Program to advance our environmental, social, and governance (ESG) goals through our projects, operations, and employee-supported charitable activities and volunteer work. Tetra Tech has long focused on providing our clients with industry-leading sustainable solutions that support development of safe water supplies, net zero energy programs, and biodiversity protection through habitat preservation and restoration

Tetra Tech established a Sustainability Council to help coordinate and track our Sustainability Program, oversee development of an annual corporate Sustainability Report, and support communication of best practices across the Company. Our Sustainability Program focuses on supporting Tetra Tech's mission to be a premier worldwide consulting and engineering firm, focusing on water, environment, sustainable infrastructure, renewable energy, and international development.

1 BILLION PEOPLE CHALLENGE

Our goal is to improve the lives of 1 billion people by 2030. Because our biggest impact on the world is through the projects we perform for our client, we are tracking the total number of lives improved from our projects. We align our project impact analysis with the Global Reporting Initiative (GRI) standards and the UN Sustainable Development Goals (SDGs), which measure social benefit and aim to reduce poverty in communities around the world.

MEASURE	2021 BASELINE
Lives Improved	411 million people
PROJECT METRICS / SDG	
Water/SDG 6	328,000 mL/year of water treated, saved, or reused
Renewable Energy/SDG 7	16,800 MW/year of renewable energy identified, planned, or generated
Ecosystems/SDG 14 and 15	178 million ha/year of land and water protected, managed, or restored
GHG Emission Reduction/SDG 13	20.6 million CO_2e MT/year avoided or captured
Social and Governance/SDG 3, 4, 5, 16	35 million lives improved/year from social and governance programs

"Tetra Tech received six Environmental Business International awards for excellent performance, innovation, and industry leadership in 2022. The annual awards from the Climate Change Business Journal and Environmental Business Journal were presented at the Environmental Industry Summit XXI on March 22, 2023, in San Diego, California."

D. Working Relationship with City Staff

Tetra Tech envisions a working relationship where we are an extension of the City of Ann Arbor's staff. This relationship will be especially crucial for the staff supplementation roles identified in the RFP. Our consistent team members will lead to a working understanding of the City's expectations and technical practices. The relationship we enjoy with communities like Brighton and Northfield Township allow us to coordinate project execution within multiple departments/units of each community, thereby reducing the burden of the staff of clients we serve.

Tetra Tech's Ann Arbor office is located two miles from the Wheeler Center next to the Ann Arbor Airport. Tetra Tech's Ann Arbor office and the proximity to all City buildings make us ideally suited to schedule a needed meeting with any City employee. We invite our clients to review our performance annually (or more frequently) so we can make necessary adjustments to improve and exceed our clients' expectations.

We can make numerous staff members available to work from City offices. We have identified Daniel Warren in the organization chart, but many others can be made available at least part-time.

Commitment to 24/7 Availability

Tetra Tech is committed to being available 24/7 to the City. We will serve the City from our office in Ann Arbor. Our Project Manager, Brian Rubel, PE, is an Ann Arbor resident. He can generally be mobilized to any Ann Arbor site within 10 minutes. He is a dedicated employee who monitors his cell phone and e-mail in the evenings and weekends.

Mr. Rubel is an Operations Manager for Tetra Tech's Michigan services and thus has the authority to assign Tetra Tech resources to best meet the needs of the City both during regular office hours and beyond. We invite you to contact him at any time to confirm his commitment at 734.649.4546 or brian.rubel@tetratech.com. Daniel Warren will be Mr. Rubel's deputy and has the same level of commitment monitoring his correspondence.

E. Consultant Capabilities

Tetra Tech's approach for this contract includes:

- Developing a thorough scope of work and schedule at the beginning of each assignment for mutual agreement to avoid conflicts regarding the project definition.
- A project start meeting at the beginning of each assignment to further refine the problem statement and to understand our clients' goal and objectives.
- A Tetra Tech internal kickoff meeting where the specific project technical standards are discussed (i.e., review of drawing standards and client specifications).
- In-person progress meetings (monthly or more) to discuss the project and adjust Tetra Tech's execution to arrive at our clients' goals. These periodic workshops allow clients to give their technical input to ensure satisfaction with the work.
- To the extent practical and acceptable to the City, Tetra Tech will assign the same staff to subsequent projects so that we consistently understand and meet the expectations and standards of the City.

Project Execution

Tetra Tech's approach to managing projects is depicted in the graphic on the following page that shows our QA/QC procedures used to produce a technically sound product. Since each project we complete is customized to our clients' needs, client input is clearly defined to ensure a successful project outcome.

Quality Assurance/Quality Control

Tetra Tech's QA/QC program is exercised on all projects to ensure our deliverables are technically sound, high-quality, cost-effective, and tailored to project objectives. The QA/QC program includes several milestones prior to submittal of deliverables. We will review each document in accordance with the program and document each review to verify implementation of the procedures. The QA/QC program consists of two distinct but interdependent components:

Quality Assurance (QA): The QA process is used to understand the project from the client's perspective, and that their goals and objectives have been met. QA representatives consist of individuals not directly involved in the project who provide an independent perspective. Each reviewer will document their results on a checklist or questionnaire, which is then shared with the project team for possible implementation. This provides a means to continually identify opportunities for improvement. The QA process consists of:

- **Client Satisfaction Process Interview:** A Tetra Tech representative, not associated with the project, meets with the client at the beginning of the project to establish measurables and periodic milestones to evaluate our performance. We also perform a follow-up evaluation with the client upon completion of the project to confirm that we met or exceeded their expectations. Our clients consistently tell us few consulting firms have such a process and these interviews do deliver projects with a higher level of satisfaction.

PROJECT MANAGEMENT APPROACH

1 Project Workshop Initiative
- Proposal/Scope of Services
- Project Budget
- Project Schedule

2 Client Satisfaction Interview

3 Work Plan
- Basis of Design (Prelim.)
- QA/QC Plan/Deliverables
- Project Tracking
- Budget/Hours/Schedule

4 Project Start Meeting
- Present Work Plan Items
- Budget/Hours/Schedule
- Confirm Commitments/ Schedule Meetings
- Client Priorities

5 Key Concept Review
- Project Team Review
- Concurrence from Clients on Basis of Design
- Cost Est. Review/Validation
- Ongoing Project Status Communication to Client

6 Project Initiation Audit
- Internal Auditor
- Make Work Plan Adjustments

7 Preliminary Drawings/ Reports
- Land Survey
- Develop Contractor Pre-qual
- Ongoing Team Workshops

8 QA/QC Reviews
- Technical Checks
- Constructability Review
- Report Enhancement
- Cost Est. Review/Validating

9 Preliminary Document Distribution to Client/ Outside Agencies
- Confirm Meeting Scope of Services
- Permit Application

10 Project Audit (50 to 60% Complete)
- Same as #6

11 Final Design/Report
- Ongoing Team Workshops

12 QA/QC Reviews
- Technical Checks
- Report Enhancement
- Cost Estimating Validation

13 Distribution of Deliverables

14 Construction Bidding
- Consider Contractor Pre-qual

15 Construction Services
- Resident Services
- Bidding
- Shop Drawing Reviews
- O&M Manuals/ Operator Training

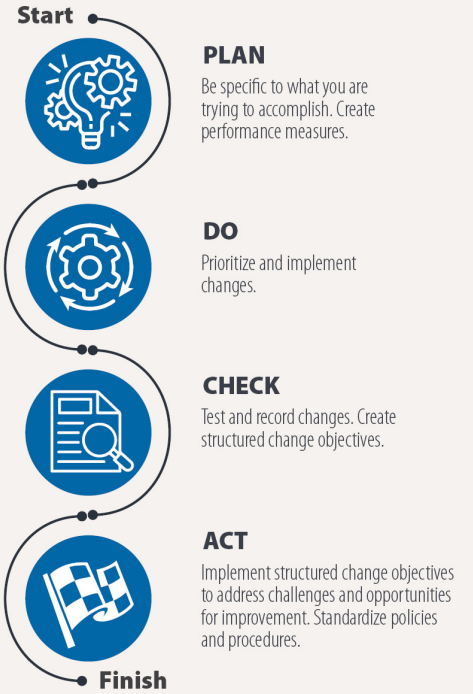
16 Project Closeout
- Prepare Final Project Summary
- File Design Notes and File Drawings/Reports
- Client Satisfaction Interview

- **Report Enhancement Process:** A representative reviews the report outline and draft report and compares the client's objectives with our approach to ensure clarity and thoroughness.
- **Key Concept Review:** A team of discipline experts review project concepts, looking for design ideas and alternatives that may not have been considered or potential innovative solutions to enhance the project.
- **Constructability Review:** Reviewers look specifically for cost-avoidance opportunities to make sure that the design promotes the most cost-effective construction operations.

Quality Control (QC): The QC process consists of detailed checking procedures and is performed by experienced professionals who are familiar with the client's standards and practices. It consists of:

- **Technical Reviews:** Each discipline is represented by a Lead Engineer who is responsible for developing, updating, and maintaining our document and design standards.
- **Calculations:** We review all calculations to ensure proper application of design criteria and technical standards and to verify the mathematical correctness of the results.
- **Checklists:** We use checklists during the review of calculations and report/construction documents to ensure proper application of city, state, and federal design criteria and standards.
- **Report Consistency:** All report documents developed by Tetra Tech are reviewed for consistency of format and standards.
- **Construction Documents:** We check construction plans and supplemental specifications for accuracy, consistency, constructability, and conformance with the standards of our clients.
- **Conforming to Construction Record Drawings:** Our construction inspectors, design engineers, and independent CAD staff review final record drawings to confirm accuracy, consistency, and conformance with client standards.

PLAN-DO-CHECK-ACT MODEL



Tetra Tech's Quality Assurance Plan Model

DETAILED WORK PLAN

Identified Capital Improvement Projects

The City identified five project areas from the Stormwater Model Calibration and Analysis Project (2015) to re-evaluate the conceptual design and feasibility. A sixth project was identified in the request proposals but was later dropped as part of Addendum 1; this was the South University/East University SWMM Area Stormwater Improvements (UT-ST-18-03). The five areas of interest are described further in this section.

1 East University Stormwater Improvements (UT-ST-22-06)

The area of interest is along East University Avenue between Hill Street and just north of Willard Street. According to the 2015 Report, the pipe along East University is undersized and causing a bottleneck during the 50% AEP storm. Flooding in the street may impact adjacent below-grade loading docks and building entrances.

Video footage of flooding (https://www.youtube.com/watch?v=TBciVA26aw4 from *Ann Arbor News*) in this area on June 27, 2013, clearly illustrates the severity of the situation. Although the storm had passed, the ponding water in the street is above the height of the curb flooding some of the sidewalks. According to the news articles, 2 inches of rain fell in less than 1 hour on June 27, 2013. Based on NOAA Atlas 14 data, this was approximately a 4% AEP storm event.

The CIP indicates that UM built storage in Monroe Mall, which may reduce the needs along East University. Also indicated is the potential for good soils in this area, which may allow for an infiltration practice. We're assuming that we'll be able to coordinate with UM to understand the hydraulics of the Monroe Mall project and hopefully there are some soil borings or other soil information available in the area. Subsurface storage in East University appears to be a good choice if space is available based on other underground utilities.

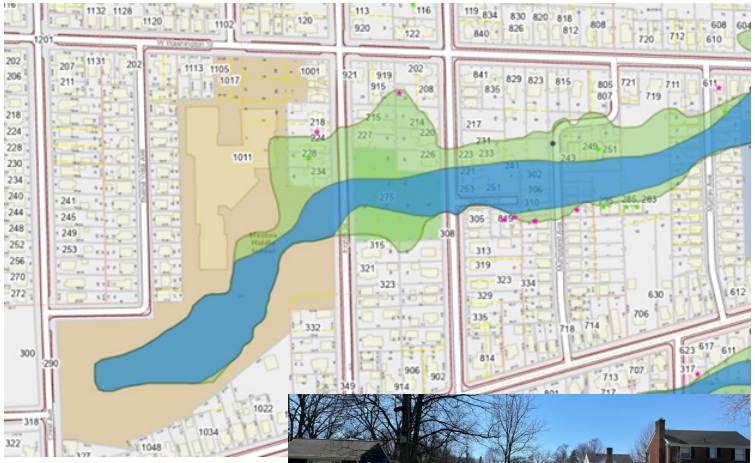
The 2015 report suggests that between 0.19 and 0.27 million gallons of storage are needed. One option to consider would be to use in-line pipe storage with or without infiltration. Something on the order of a 6- to 8-foot diameter pipe could handle this amount of storage, assuming a 700-foot construction length. Underground utilities are likely a challenge. Many other alternatives are available for storage.

2 Mulholland Avenue SWMM Area Stormwater Improvements (UT-ST-18-04)

The Mulholland Avenue project is part of the Murray-Washington branch of Allen Creek between South Seventh Street and West Washington Street. This project is in the 1% floodplain and the objective is to reduce the flooding of buildings and street structures. The City has acquired property at 302 Mulholland, which may be utilized as a part of the project design.

The 2015 Report considered upstream surface storage at Slauson Middle School, an above-ground storage tank, and conveyance improvements. There is a substantial grade change at South Seventh Street, which makes improved conveyance an attractive option. However, careful analysis would be required to ensure the frequency and severity of downstream flooding is not increased. Storage options are typically a better choice if adequate space is available. The challenge with the 302 Mulholland Avenue parcel is the relatively limited area of the parcel relative to the storage needs. A practice at the middle school is much more appealing if a partnership with the school district is realistic. Lots of different storage systems at the middle school are possible.

3 Glendale/Charlton SWMM Area Stormwater Storage (UT-ST-18-05)



Street flooding reportedly occurs along Charlton Avenue and some ponding water on the streets at low spots on Orchard Street and Glendale Drive. The 2015 Report considered storage for the multi-family residential units west of Glendale Drive and improved conveyance along Charlton Avenue from Pleasant Place to Virginia Avenue and south of Virginia Avenue. The CIP information indicates that the recommendations in the 2015 Report do not address street ponding on Glendale.

Based on a site visit, there is evidence to suggest that runoff from the parking lot for Hillside Terrace Senior Living is draining east onto the property of 402 Glendale Drive and the water likely ponds in the backyard of the parcel before flowing east out to Glendale Drive. To rectify this problem, drainage improvements would be needed in the parking lot, which may be coupled with some storage.

Charlton Avenue generally slopes downhill from Glendale Drive and we were surprised to see the 2015 Report indicated flooding along this section of the roadway. We suggest double checking the results of the model and pinpointing the locations of flooding along with the cause. We suspect a hybrid solution involving some storage, conveyance improvements, and green infrastructure along the streets may be a good solution.

4 Lawton Park Stormwater Basin (UT-ST-16-09)

The project idea here is underground storage at Lawton Park with conveyance improvements along Winsted Boulevard, Mershon Drive, and Scio Church Road. The CIP also calls for pipe improvements at the South Seventh Street and Mallets Creek crossing. The 2015 Report considered storage at Lawton Park in the range of 2.11 to 3.14 million gallons. It is our understanding that the intent of this project is to reduce flooding in nearby locations by rerouting some of the water. Further, the storage would benefit the Northwest Branch of Malletts Creek by slowing down the drainage, thereby reducing flooding along the creek.

There is plenty of room at the park to accommodate the proposed storage. One of the challenges will be the amount of excavation required as the park surface is approximately 6 feet higher than the Mershon Drive. The Winston Boulevard and Scio Church Road areas are approximately 11 feet higher in elevation than the park. One idea to consider would be placing an express sewer from the higher ground areas to the park. This may reduce the amount of cut required for the storage; surface storage with minimal excavation could be considered. This might also open the door to many different types of park improvement projects that could be done in concert with the drainage improvements.

5 Traver Road /Barton SWMM Area Stormwater Improvements (UT-ST-18-08)

The 2015 Report identified some overland flow and ponding occurring around the intersection of Traver Rd and Barton Dr. and recommended improved conveyance piping down Barton Dr. to the receiving stream.

Steep hills are present in the area and evidence of flooding along the streets was present during our site visit. Improved inlet capacities should be incorporated into the drainage improvements otherwise the momentum and velocity of the flow will allow water in the curb line to bypass the inlets. Significant tree and brush debris is also present from the vegetation along the streets. The debris likely contributes to the flooding problems.

Also of note is the properties west of Barton Dr and south of Traver Rd are lower than the street, particularly near the intersection. In these situations, properly intercepting the water in the ROW is important to prevent flow from going into nearby low property. This just reinforces the need for good inlet interception and piped conveyance capacity.

APPROACH

The City of Ann Arbor is seeking proposals for a feasibility analysis of a selection of stormwater projects that have been included in the City's Capital Improvements Plan (CIP), but further engineering evaluation and cost/benefit analysis is necessary to inform City staff for responsible and equitable decision making for the proposed projects.

Meetings

Kickoff Meeting. We'll initiate the project with a kickoff meeting. During the kickoff meeting we will review:

- *Project-specific information,* including what's known about each project site, site specific goals and objectives, questions and concerns, implementation challenges, ideas for improvements, and high-level concepts for potential solutions.
- The City's general *philosophy and approach to stormwater management,* including operation and maintenance. We would like to understand the types of stormwater control measures the City prefers to utilize (or not use) and review the level of service targets used for drainage improvements.
- *Data needs* for the project, including access to the hydraulic model, GIS files, and construction records. We would also like to talk through what any drainage improvement projects that have been completed since the master plan was prepared that might impact the hydraulics of the system. Likewise, we would like to review any land development changes that have occurred since the master plan which might impact the rainfall-runoff relationship.
- General *project management* issues, including lines of communication and a schedule for regular progress meetings.

Progress Meetings. During the kickoff meeting, we would like to schedule routine progress meetings. Progress meetings are intended to keep a finger on the pulse of the project and help stay on track. We will ensure the meetings are productive and beneficial by being prepared in advance with a meeting agenda, review progress since the previous meeting, next steps, questions we have, and potential hurdles. For budgeting purposes, we have assumed monthly progress meetings.

Deliverables: Meeting agenda and minutes.

Data Collection

The first step in the project is to gather the needed information and data. The City has already indicated the following data is available: the *Stormwater Model Calibration and Analysis Project Final Report* (2015), (which we've downloaded already and read), CIP project data sheets of selected projects (we've reviewed the City's online information), infrastructure record drawings, InfoSWMM hydraulic model, and GIS layers (contours, wetlands/woodlands, aerial photography, utilities, parcels, and soil survey).

In addition, we would appreciate obtaining GIS files of the building footprints, impervious coverage, tree inventory, and floodplain mapping (if different than FEMA's). We would also like to review any information regarding historical flooding complaints, (which we understand may reside with the County), along with any specific public complaint data or similar information that may be available from the previous public meetings held during the model calibration project.

It is our understanding that the hydraulic model may not be up to date based on infrastructure improvements since the model was developed. As previously mentioned in the project kickoff information, we would like to receive available information on changes both to the land surface and the drainage system that may not be reflected in the model. It is our understanding that the GIS infrastructure information is up to date and may be relied upon for our analysis.

Deliverables: Executed non-disclosure agreement for the stormwater hydraulic model.

Model Update and Analysis

It is our understanding that the hydraulic model was created in InfoSWMM. We are intimately familiar with SWMM modeling and all the relevant vendor versions of it, including InfoSWMM. We are assuming for this project that we will continue to use the model in InfoSWMM unless the City has a different preference.

It is our understanding that the model files that we will receive are only for the existing conditions and do not reflect the previously identified alternatives. Further we understand that infrastructure improvements made since the master plan are not reflected in the model files.

We are planning the following steps after receiving a copy of the modeling files:

- ***Reproduce Master Plan Results.*** Review the existing model models and solve the model for the design storm events used in the 2015 report. Compare the predicted model results with the master plan results. Identify discrepancies (if any) and review these with the City. The purpose of this step is to ensure we can reproduce the previous results. For budgeting purposes, we are assuming that we will be able to reproduce the previous model results and no discrepancies will need to be addressed.
- ***Model Updates.*** The next step is to update the model based on drainage improvement projects constructed since the model calibration. Addendum No. 1 indicates that for budgeting purposes we are to assume no updates to the model are necessary. We have included an hourly rate for potential model updates with our fee proposal as requested in the Addendum. If updates to the model are incorporated, then we will solve the model again for the design storms of interest and document the impact the changes have on the predicted model results.
- ***Previous Alternatives.*** Next, the model will be edited to reproduce the selected alternative from the model calibration and analysis project (2015) for each project area, unless the alternatives are determined to be undesirable. We assuming that the previously selected alternative for each project site is a good starting point for further alternative evaluations.

Workshop – Project Planning. We propose to hold workshops to promote and allow for focused discussion on each project site. This workshop will be held after data has been collected and we've reproduced the 2015 Report hydraulic model results and alternatives. At this first workshop we will walk through the 2015 Report analysis results and discuss challenges and ideas.

Deliverables: Model results will be reviewed at progress meetings and documented in the meeting minutes. Updated existing condition model files will be provided.

Level of Service Targets. The previous stormwater model calibration and analysis report considered a range of design storms from 100% to 0.2% AEP and used rainfall amounts from NOAA Atlas 14. The table below lists the range of design storms considered in the previous study.

AEP (%)	DURATION (HOURS)	RAINFALL (IN)	NOTES
100%	1	0.97	May serve as baseline for BMP evaluation
50%	24	2.35	May serve as baseline for BMP evaluation
20%	1	1.44	Older parts of the system were designed for 20% storm volume
10%	12	2.90	Represents current design standard
4%	24	3.93	
2%	24	4.50	
1%	24	5.11	Design standard for detention
0.2%	24	6.77	Flood analysis

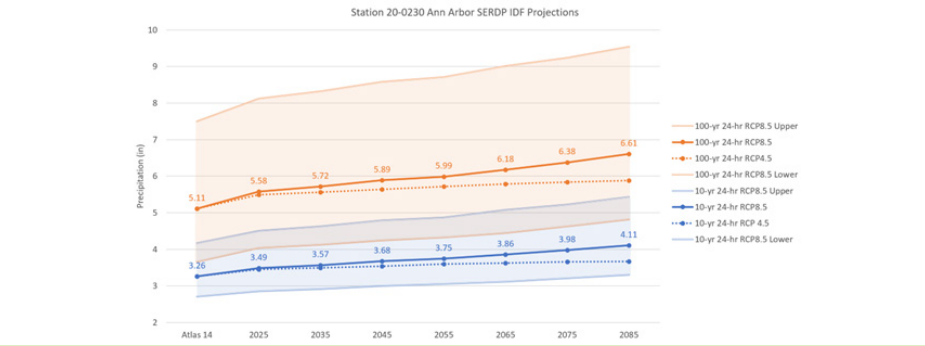
The City's Green Streets policy calls for on-site infiltration standards for public roads and right-of-way to be incorporated during construction and reconstruction projects. The policy calls for infiltration of 1 inch, 2.35 inches, or 3.26 inches of rainfall depending on site soil conditions, slope, and proximity to floodplains.

Areas identified for improvement were based conveyance capacity for the 20% and 10% AEP. Improvements were targeted to handle the 10% AEP with the hydraulic grade line at least 2 feet below the ground surface. Storage improvements targeted a release rate not to exceed 0.15 cfs per acre.

Suggestion. We would like to suggest the City consider some additional level of service requirements when sizing public infrastructure. For example, consider a target to maintain passable roadways for the 4% AEP and prevent building flooding for the 1% AEP. Also consider what happens during a cloudburst like the storm event that occurred on June 27, 2013, when 2 inches of rain fell in one hour (approximately a 4% AEP event) and flooded parts of the City.

Climate Change. We understand that climate change was discussed during the previous project (2015) and continues to be a point of discussion today. As precipitation events become more severe and occur more frequently the net effect is for the level of service provided by the drainage system to go down. Hence what may have been constructed to provide a 10% AEP may only be providing the equivalent service for the 20% AEP. We understand that as part of the previous work the rainfall amounts for each AEP were updated based on NOAA Atlas 14. NOAA Atlas 14 is considered to be the best available rainfall statistics however the documented rainfall amounts are low based on today's condition since the statistics assumed stationary climate.

Rain events are predicted to continue to increase throughout the century. The graph below projects rainfall changes based on the Strategic Environmental Research and Development Program (SERDP/Department of Defense) available at https://precipitationfrequency.ncics.org/. Our work for SEMCOG and MDOT predicted even larger potential rainfall changes (available at https://semcog.org/plans-for-the-region/environment/climate-resilience). NOAA Atlas 15 is expected to be available in a few years and is planned to include updates to historical rainfall statistics based on non-stationarity along with future rainfall estimates.



Suggestion. We recommend to design new drainage infrastructure to function as intended throughout the design life of the infrastructure. Fundamentally, this means considering climate change and designing based on a future rainfall projection. We suggest using a design life of approximately 50 years for conveyance pipes, which means designing based on projected rainfall in 2075. At the very least, a risk analysis should be done to allow the City to make an informed decision on the infrastructure improvements. From a practical standpoint, we've found pipes typically need to be increased in size by one pipe size. This is typically not burdensome on the CIP; however, the downstream impacts need to be considered.

Alternative Development

We will take a fresh look at the alternatives. Fundamentally the alternatives are considering a combination of storage and conveyance to meet the level of service targets. Storage and infiltration are provided to meet the City's Green Streets policy. For storage options we typically start by calculating how much storage is needed to meet the design criteria; then we look for potential locations and how much storage can be accommodated. Conveyance is typically more straight forward but does require an iterative approach with the model. Often with increased conveyance, the challenge is to not exacerbate downstream flooding. We like to start with high level concepts and review these with the City before developing the details.

As mentioned in the kickoff meeting narrative, we want to understand the City's general philosophy and approach to stormwater management. This includes the types of infrastructure desired (or not wanted) and the long-term maintenance plans as this can significantly influence the alternatives analysis.

Opportunity Assessment. For some projects we look at an opportunity assessment approach, where we identify locations where certain types of stormwater control measures may potentially fit.

These assessments typically focus on a GIS approach to identify potential land areas. For example, for the City of Grand Rapids we evaluated where bioretention type green infrastructure could be placed citywide on public land and in the ROW. Another example, for SEMCOG we will be identifying where large-scale stormwater practice may be placed to beneficially impact flooding (expected summer 2023). Identifying opportunity locations on a large scale has many benefits. Since this project is focused on five specific areas, we are not proposing to include an overall opportunity assessment.

Optimization. Tetra Tech has developed several different optimization applications. For example, we developed the USEPA's System for Urban Stormwater Treatment and Analysis IntegratioN (SUSTAIN), https://www.epa.gov/water-research/system-urban-stormwater-treatment-and-analysis-integration-sustain. SUSTAIN is a decision support system intended to assist professionals optimize BMP placement and size within a watershed based on cost and effectiveness. We use this on projects in southern California, as an example, to optimize BMP placement and size to meet water quality requirements. An opportunity assessment first identifies the potential sites and then SUSTAIN optimizes the design. We also developed an application referred to as iPOP, which works with USEPA SWMM to optimize most any variables. We used this for example in Grand Rapids to assist with calibrating a very large and complex stormwater drainage model. Optimization approaches can be very beneficial for certain applications. An example would be to site BMPs to meet TMDL load reductions within a watershed. For this project, we are not planning to use optimization software based on the limited number of sites to be evaluated.

We will develop up to three alternatives for each project site area. Each alternative will be documented with a figure illustrating the layout, proposing the major drainage improvements, and identifying impacts to property not owned by the City to identify easement needs, potential project partners, and potential implementation challenges. We will edit the hydraulic model to reflect each alternative and assist with sizing the infrastructure.

Part of the alternative analysis will consider the need for easements outside of the ROW. Where possible, the planned stormwater control measures will be located on public land to minimize the need for an easement. The need for temporary construction easements will be identified along with permanent easements. Easement locations will be determined based on ROW and parcel map information. Locations potentially requiring easements will be delineated in GIS for each parcel. Easement requirements will be tabulated by parcel for each alternative and project site.

We will review alternatives with the City for each project site. Some alternatives may be discarded because they are determined to be impractical or not realistic for one reason or another. Only viable alternatives will be advanced forward to the cost-benefit analysis.

Workshop – Alternative Review. We propose to hold a workshop to promote and allow for focused discussion on each project site. This workshop will be held after the initial development of alternatives to review and discuss the analysis. The anticipated outcome will be refinements to the alternatives.

Workshop – Site Walkthrough. We propose to hold a workshop to promote and allow for focused discussion on each project site. This workshop will be a walk-through of the sites with visualization of the alternatives on the ground. We will look for potential challenges previously missed on paper. Emphasis will be on the preferred alternative for each site. We anticipate the outcome of this workshop are minor changes to the alternatives and a list of items flagged for consideration during design of the project.

Deliverables: The alternative analysis results will be reviewed at progress meetings and workshops and documented in the meeting minutes.

Cost Benefit Analysis

We understand the City would like a cost-benefit analysis for each project to prioritize capital improvement projects. We further understand that the City does not have a set methodology for evaluating and quantifying the benefits of proposed stormwater improvements. We would be happy to work with the City to review options on quantifying benefits.

We would really enjoy discussing options for a robust analysis system but have not included in our budget the time needed to work through all the criteria, metrics, and criteria weighting factors. For budgeting purposes, we are assuming a straightforward cost-benefit approach.

For budgeting purposes, we are planning on quantifying the design, construction, and maintenance costs, along with easily quantified benefits such as the number of buildings removed from flooding, number of manholes removed from surcharging on the surface, area and volume of flooding removed, area of natural resources protected or restored, and protection of critical infrastructure. For critical infrastructure we suggest using FEMA's Resilience Analysis and Planning Tool (RAPT) if the City doesn't already have critical infrastructure defined. We also suggest incorporating an equity component into the benefit analysis and recommend using either SEMCOGs Equity Emphasis Area information or CDCs Social Vulnerability Index (SVI) if the City doesn't already have an equivalent tool. The cost-benefit analysis will be documented in a spreadsheet.

We would be excited to work with the City about a more robust cost-benefit analysis. This would involve a series of workshops to discuss a

CASE STUDY

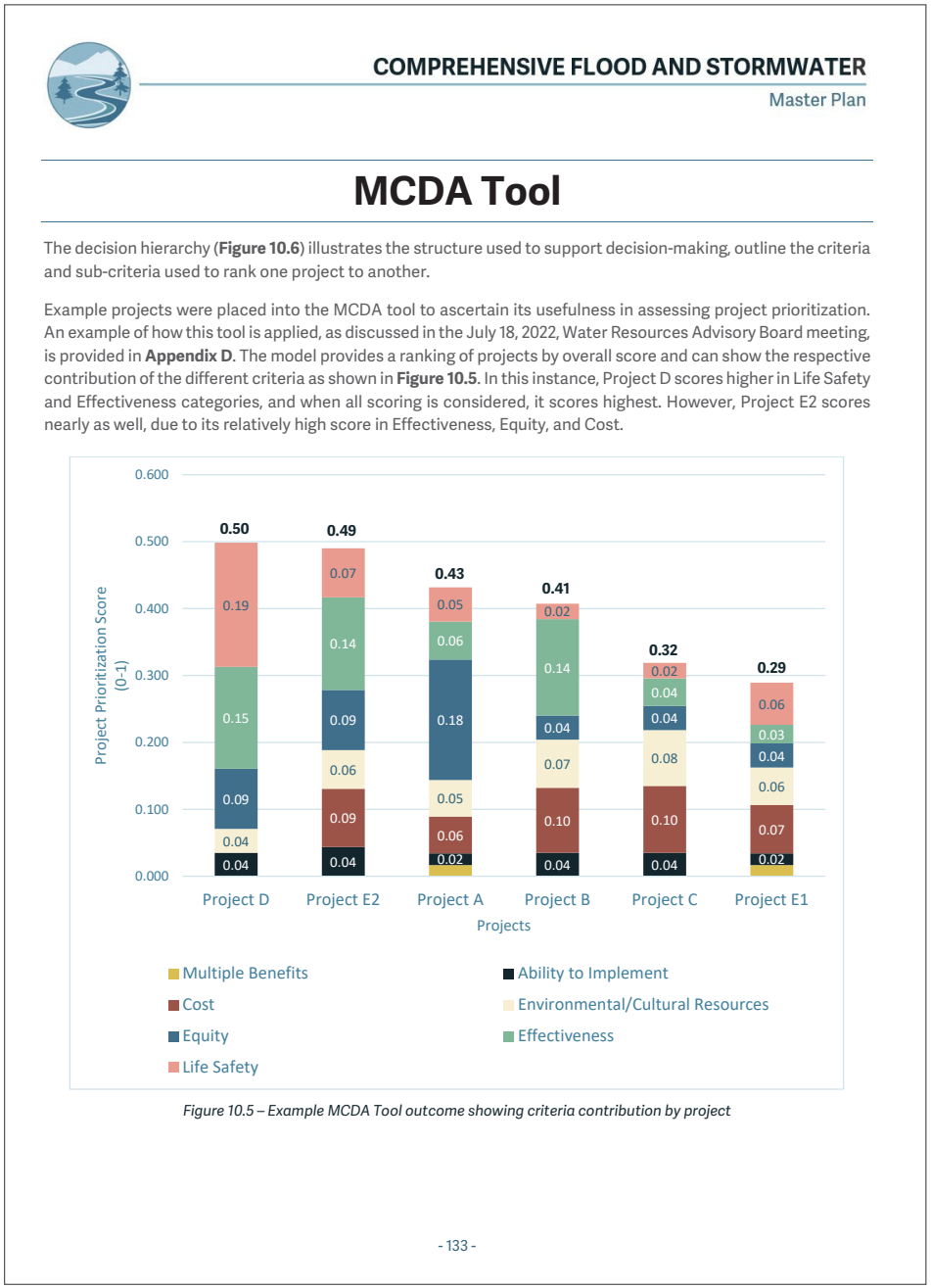
Our team recently completed a **Comprehensive Flood and Stormwater Master Plan** project for Boulder, Colorado (2022), which, among other things, developed a project prioritization framework. Prior to our work with Boulder, the prioritization methodologies used a "losses avoided" approach to calculate project benefits resulting in benefit/cost ratios that typically favor projects in areas with the highest property values as opposed to where the life safety risk and community needs are highest. Characteristics of an effective framework include:

- A clear and defensible framework
- Incorporation of community values identified through stakeholder engagement and constructive dialog
- Ability to rank major capital projects that have been developed from different studies

For the Boulder plan, we identified prioritization criteria along with assessment units. The prioritization criteria were then ranked by community members to develop the relative weights placed on each of the criteria. The City reviewed the weighting criteria to ensure strategic alignment with their overall mission. The criteria attributes include:

- **Cost:** capital cost and operation and maintenance cost (quantitative metrics).
- **Effectiveness:** property protection (reduction in the number of structures and the dollar amount of the damage to the structures) and level of service increase (quantitative metrics).
- **Environmental and Cultural Resources:** protection and restoration of natural features, and protection of cultural resources (quantitative and semi-quantitative metrics).
- **Social Impact, Equity and Fairness:** social vulnerability index (quantitative metrics).
- **Ability to Implement:** constraints and community acceptance and support (qualitative metrics with defined scales).
- **Life Safety**: protection of critical infrastructure and road level of service (quantitative metrics).
- **Multiple Benefits:** benefits over and above recognized attributes (qualitative metric with defined scale).

More details can be found in the Comprehensive Flood and Stormwater Master Plan Volume II Chapter 10 available at: https://bouldercolorado.gov/projects/comprehensive-flood-and-stormwater-master-plan.



COMPREHENSIVE FLOOD AND STORMWATER
Master Plan

MCDA Tool

The decision hierarchy (**Figure 10.6**) illustrates the structure used to support decision-making, outline the criteria and sub-criteria used to rank one project to another.

Example projects were placed into the MCDA tool to ascertain its usefulness in assessing project prioritization. An example of how this tool is applied, as discussed in the July 18, 2022, Water Resources Advisory Board meeting, is provided in **Appendix D**. The model provides a ranking of projects by overall score and can show the respective contribution of the different criteria as shown in **Figure 10.5**. In this instance, Project D scores higher in Life Safety and Effectiveness categories, and when all scoring is considered, it scores highest. However, Project E2 scores nearly as well, due to its relatively high score in Effectiveness, Equity, and Cost.

Figure 10.5 – Example MCDA Tool outcome showing criteria contribution by project

- 133 -

Sample from Boulder Comprehensive Flood and Stormwater Master Plan Report (2022)

clear and defensible framework, how best to bring in community values, and developing weighting criteria to align project implementation with your overall mission. One of the challenging issues is to develop a fair and equitable set of metrics and weighting criteria. Based on our experience, we suggest seeking input on the weighting criteria from stakeholders and testing out the approach on identified stormwater capital improvement projects. Getting input from stakeholders helps improve community acceptance and defensibility. To make this process successful, we suggest populating the cost-benefit variables for all identified stormwater capital improvement projects, not just the five identified in this scope of work. Populating data for all the projects helps work through the metrics and weighting criteria.

Deliverables: Cost-benefit spreadsheet.

Report

We will summarize the project activities and results in a report format, for which we can prepare a standard template. We suggest preparing a separate document for each project area. Separating the documentation by project area also aligns with a staggered project schedule, discussed in the schedule section. The feasibility assessment will document the design criteria, modeling analysis, alternatives developed, cost-benefit analysis, and recommendations. The reports will be submitted to the City for review and comments, then finalized after the comments have been addressed.

We will provide recommended improvements in a GIS geodatabase. Storing proposed improvements in GIS is an excellent way of keeping a record of improvements needs. For example, when street improvements are planned in an area, having the stormwater improvements in GIS already, immediately provides the necessary information for comprehensive improvements. The geodatabase should include not only conveyance improvements, such as pipes, and storage locations but also other hydraulic notes such as locations of new or improved inlets and areas with grading problems. We also suggest including model results so that the hydraulic model does not need to be rerun during design. Model results attributes such as proposed pipe size, nominal pipe capacity, peak flow from design storms, outlet control details for storage systems, and inlet capacity needs, to name a few examples.

Deliverables: Project area draft and final reports, and a GIS geodatabase of the selected alternatives.