

WATER & SEWER BOARD AGENDA

Wednesday August 18, 2021

2:00 p.m.

1. Roll Call: _____ Chairman Harold Evans _____ Vice Chairman Mick Todd
 _____ Mr. Fred Otis _____ Mr. Joe Murphy
 _____ Mr. Tony Miller _____ Mr. Manuel Sisneros
 _____ Mrs. Cheri Witt-Brown _____ Mayor John Gates
 _____ Mr. John Karner _____ Mr. Raymond Lee (interim CM)
2. Approval of Minutes
3. Approval of and/or Additions to Agenda

Consent Agenda

The Consent Agenda is a meeting management tool to allow the Board to handle several routine items with one action.

The Board or staff may request an item to be “pulled” off the Consent Agenda and considered separately under the next agenda item in the order they were listed.

4. Authorize Closing on the property identified in the Purchase and Sale Agreement, dated June 1, 2021, between Longs Peak Dairy and Greeley

End of Consent Agenda

5. Welcome New Employees and Promotions
6. Approve Cameron Peak Wildfire Project Management Services Agreement with CPRW
7. Approve Reimbursement Agreement for Wildfire Mitigation and Rehabilitation Services with CPRW
8. Overview of Proposed Interconnect and transfer of transmission line customers with West Fort Collins Water District
9. Approve and Recommend to City Council the 2021 Non Potable Master Plan
10. Approve and Recommend to City Council the Second Amendment to Intergovernmental Agreement for Treated Water Service with the Town of Windsor
11. Legal Report



If, to effectively and fully participate in this meeting, you require an auxiliary aid or other assistance related to a disability, please contact Shannon Metcalf at 970-350-9818.

12. Executive Session

13. Resolution Recognizing Roy Otto as ExOfficio Board Member

14. Director's Report

- Cameron Peak Fire recovery and mitigation funding update
- City Clerk's analysis of Petitions to Amend Greeley Charter

15. Such Other Business That May Be Brought Before the Board and Added to This Agenda by Motion of the Board



If, to effectively and fully participate in this meeting, you require an auxiliary aid or other assistance related to a disability, please contact Shannon Metcalf at 970-350-9818.

**City of Greeley
Water and Sewer Board
Minutes of July 21, 2021
Regular Board Meeting**

Chairman Harold Evans called the Water and Sewer Board meeting to order at 2:00 p.m. on Wednesday, July 21, 2021.

1. Roll Call

The Clerk called the roll and those present included:

Board Members:

Chairman Harold Evans, Vice Chairman Mick Todd, Fred Otis, Tony Miller, Joe Murphy, Manuel Sisneros, Cheri Witt-Brown, Roy Otto and Mayor Gates

Water and Sewer Department Staff:

Director Sean Chambers, Deputy Director Water Resources Adam Jokerst, Deputy Director of Operations Nina Cudahy, Chief Engineer Adam Prior, Utility Finance Manager Erik Dial, Water Resources Manager Jen Petrzelka, Water Conservation Manager Dena Egenhoff and Office Manager Shannon Metcalf

Legal Counsel:

City Attorney Doug Marek, Counsel to Water & Sewer Board Attorney Jim Noble, Environmental and Water Resources Attorney Jerrae Swanson, Environmental and Water Resources Attorney Dan Biwer, Environmental and Water Resources Attorney Aaron Goldman

2. Approval of Minutes

Vice-chairman Todd made motion, seconded by Mr. Miller, to approve the June 16, 2021 Water and Sewer Board meeting minutes. The motion carried 7-0.

3. Approval of and/or Additions to Agenda

There were no changes to the agenda.

4. Welcome New Water & Sewer Board member Cheri Witt-Brown

Mr. Chambers welcomed newly appointed member Cheri Witt-Brown.

5. Welcome New Employees and Promotions

Mr. Chambers provided an introduction of new Water and Sewer Department employees starting this month.

6. Water Supply Update

Ms. Petrzelka noted that staff reports to the Water and Sewer Board in April, July, and November of each year on Greeley's water supply status. In April, the Board makes a declaration concerning the adequacy of the Water Year. Projected storage is presently at 21,436 acre feet.

7. 2nd Quarter Water Court Update

Ms. Petrzelka updated the Board on the current status of Greeley's Water Court cases, including statements of opposition and cases where Greeley is the applicant or will soon be filing an application for change of water rights, and provided a summary of the Water Resources Division's legal costs.

8. Review and Recommend to Planning Commission and City Council the 2021 Wastewater Collections Infrastructure Master Plan

Mr. Prior explained that Water and Sewer Department has embarked on the process of completing a Wastewater Collections Master Plan. The project started in 2018 with the selection of CDM Smith to complete the engineering services based on past experience with Greeley and extensive master planning qualifications. The following year started with monitoring flows in the entire collection system, which involved 12 temporary flow meters, nine permanent flow meters, two rain gauges, and 60 days of data collection. This critical step was followed by developing the existing system model and updating the Utility Plan report with North Front Range Water Quality Planning Association. The project then progressed to utilizing the system model to look at existing conditions of the system and planning the expansion of the system in the 5-year, 20-year, and full system build-out time frames. The final steps included developing CIP projects throughout the system and making sure it was coordinated with the other two Water & Sewer master plan projects and other City Department CIP projects. The final aspects of the project also included coordinating outreach efforts to discuss the planned master plans with different community members and groups interested in participating in reviewing the City's draft master plan and providing critical input or comments.

Mr. Miller made motion, seconded by Mr. Sisneros that the Board recommend to City Council adoption of the enclosed 2021 Wastewater Collections Infrastructure Master Plan and incorporation of the same by reference as an amendment to the 2018

Comprehensive Plan and to the Planning Commission recommendation of the same to City Council. The motion carried 7-0.

9. Review and Recommend to Planning Commission and City Council the 2021 Water Distribution Infrastructure Master Plan

Mr. Prior explained that the Water and Sewer Department has embarked on the process of completing the Water Transmission and Distributions Master Plan. The project started in 2017 with the selection of Bohannon Huston to update the existing 2008 transmission and distribution model. Then in 2018, the City selected CDM Smith to complete the engineering services for the Master Plan and planning for the expansion of the system. One of the first steps was developing the long term water demands within the Long Term Growth Boundary was utilizing the 2018 Imagine Greeley Land Use Guidance Map, existing zoning, future development projections, and working with the Planning Department. This information was combined to estimate the peak month water demands for full buildout of the system. The next steps were developing the water distribution system that could meet the water demands and pressures required throughout the system. The project then progressed to utilizing the system model for maintaining fire flows, water quality, the expansion of the system in the 5-year, 20-year, and full system build-out time frames. The final steps included developing CIP projects throughout the system and making sure it was coordinated with the other two Water & Sewer master plan projects and other City Department CIP projects. The final aspects of the project also included coordinating outreach efforts to discuss the planned master plans with different community members and groups interested in participating in reviewing the City's draft master plan and providing critical input or comments.

Vice-Chairman Todd made motion, seconded by Mr. Murphy that the Board recommend to City Council adoption of the enclosed 2021 Water Distribution Infrastructure Master Plan and incorporation of the same by reference as an amendment to the 2018 Comprehensive Plan and to the Planning Commission recommendation of the same to City Council. The motion carried 7-0.

10. Approve and Recommend to the City Manager the Water and Sewer 2020 Operating Budget and 5 Year CIP

Mr. Dial explained that Staff prepared the 2022 operating budget and the five-year capital program for review by the Water and Sewer Board. The 2022 operating budget would normally be a two-year operating budget but because 2021 was a one-year budget due to COVID, Greeley is preparing 2022 as a one-year budget as well.

Staff prepared the operating and capital budgets by reviewing service levels, incorporating capital improvements from recent master plans and evaluating how the department can most efficiently provide its critical, regulatory driven services. The enclosed capital budgets meet the regulatory, rehabilitation, and long range planning

needs of the City's water and sewer services while being mindful of the rates that Greeley's citizens pay.

On average, residential water bills will increase approximately \$4.16/month and residential sewer bills will increase approximately \$4.22/month for a total water and sewer bill increase of \$8.38/month. The water and sewer PIFs for a 3/4" tap remain unchanged at \$11,200 and \$6,800 respectively.

11. Approve Resolution in Recognition of Robert Ruyle's service to the Greeley community through decades of continuous service and appointment as an emeritus board member to the Greeley Water & Sewer Board

Mr. Chambers stated that Mr. Ruyle's generous contributions of time, judgement, wisdom, and insight, over the last 46 years, have been of incalculable value to the City, to the Board and the Water and Sewer Department. His service and generosity has also extended into many other areas in community and have been equally valuable. Mr. Ruyle is one of those rare individuals who truly have made difference in the life of their community.

12. Chairman Evans made motion, seconded by Vice-chairman Todd to Approve the Resolution in Recognition of Robert Ruyle's service to the Greeley community through decades of continuous service and appointment as an emeritus board member to the Greeley Water & Sewer Board. The motion carried 7-0.

13. Legal Report

Jim Noble of Welborn, Sullivan, Meck & Tooley stated Greeley's counsel and Water and Sewer Department staff had reviewed the resume of water court applications filed in May of 2021, and that he does not recommend that Greeley file any statements of opposition in water court cases that would be due this month.

Mr. Noble also provided an update on Water Court Case No. 21CW3046. In this case, the Parker Water and Sanitation District filed a lawsuit against the Colorado Division of Water Resources, seeking an injunction prohibiting the State Engineer from imposing a "total allowed withdrawal limit" on its nontributary groundwater permits. The court's determination of the legal issue raised in this case could have a statewide effect. Therefore, several parties that have an interest in the legal issue raised by this case intervened as parties, including Greeley. Greeley has concerns with the plaintiff's position, because it could have negative effects on holders of nontributary groundwater rights who seek to conserve their groundwater supplies for times of need. This case is at the very early stages. No trial has been set at this time. Mr. Noble will provide further updates as the case progresses.

14. Director's Report

- Bizwest Confluence Water Summit – July 22
- Colorado Water Center – Climate & Adaptation
- Wildfire Recovery Status
- Board/Council Systems Tour

11. Such Other Business That May be Brought before the Board and Added to This Agenda by Motion of the Board

There were no additional items brought before the Board and added to the agenda.

Chairman Evans adjourned the meeting at 4:54 p.m.

Harold Evans, Chairman

Shannon Metcalf, Office Manager

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 4

TITLE: AUTHORIZE CLOSING ON THE PROPERTY IDENTIFIED IN THE PURCHASE AND SALE AGREEMENT, DATED JUNE 1, 2021, BETWEEN LONGS PEAK DAIRY AND GREELEY

RECOMMENDATION &
PROPOSED MOTION: AUTHORIZE CLOSING ON THE PROPERTY IDENTIFIED IN THE PURCHASE AND SALE AGREEMENT, DATED JUNE 1, 2021 BETWEEN LONGS PEAK DAIRY AND GREELEY AND DELEGATE AUTHORITY TO THE DIRECTOR TO MAKE MINOR AMENDMENTS TO THE PURCHASE AND SALE AGREEMENT AND EXECUTE ALL OTHER DOCUMENTS NECESSARY TO CLOSE ON THE PROPERTY.

ADDITIONAL INFORMATION:

On May 19, 2021, the Water and Sewer Board approved the Purchase and Sale Agreement with Longs Peak Dairy for the acquisition of 5.16667 shares of Water Supply and Storage Company (the property). Under Article 6 of the Agreement, Greeley's obligation to close on the property is contingent upon the Board's authorization within 28 days after the expiration of the Inspection Period.

Staff has completed due diligence on the property. Based on its findings, staff is recommending that the Water and Sewer Board authorize the closing and delegate authority to the Director to make minor amendments to the Purchase and Sale Agreement and execute all other documents necessary to close on the property.

Water Rights Acquisition:
Longs Peak Dairy
Water Supply and Storage

August 18th, 2021



Purchase & Sale Overview

- Water Only Purchase
 - 5 1/6 shares of Water Supply and Storage Company (WSSC)
 - 5 1/6 share of The Collins Ditch Company
 - 5 1/6 share of The Lone Tree Lateral Company
 - Potable supply
- Right of First Refusal (ROFR) for sellers 7 remaining shares of WSSC along with running rights
- Dry up and revegetation covenants included
- Purchase price of \$10,900,000 plus exchange of two Greeley-owned farms (Hasbrouck and Varra Farms)



Due Diligence

- Diligence completed: No major concerns were identified
 - Share analysis indicates good historical use of water
 - No issues identified during title review
 - Dry-up is sufficient to cover all shares
- Longs Peak Dairy did not raise any issue with the two farms



Recommendation

W&S staff recommends that Board authorize the closing and delegate authority to the Director to make minor amendments to the purchase and sale agreement and execute all other documents necessary to close on the property.





Questions?



WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE _____ NO ENCLOSURE X

ITEM NUMBER: 5

TITLE: WELCOME NEW EMPLOYEES AND
PROMOTIONS

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 6

TITLE: APPROVE CAMERON PEAK WILDFIRE
PROJECT MANAGEMENT PROFESSIONAL
SERVICES AGREEMENT WITH CPRW

RECOMMENDATION &
PROPOSED MOTION: APPROVE CAMERON PEAK WILDFIRE
PROJECT MANAGEMENT PROFESSIONAL
SERVICES AGREEMENT WITH CPRW AND
DELEGATE AUTHORITY TO THE DIRECTOR
TO MAKE MINOR AMENDMENTS TO THE
AGREEMENT BEFORE EXECUTION

ADDITIONAL INFORMATION:

Greeley and the Coalition for the Poudre River Watershed (CPRW) are actively working with other stakeholder partners throughout the affected region to coordinate efforts in response to the Cameron Peak Fire, in part to ensure that available grant funding obtained is used efficiently and effectively to mitigate and rehabilitate the impacts of the Fire. In order to achieve this, Greeley has agreed to partially fund and co-coordinate a post-fire recovery project manager position. This agreement details the management and funding of those services.

Cameron Peak Wildfire Project Management Services Agreement with Coalition for the Poudre River Watershed



Coalition for the Poudre River Watershed (CPRW)

- Non-profit that formed after the 2012 High Park Fire
- Mission “To improve & maintain the ecological health of the Poudre River Watershed through community collaboration.”
- Leading the coordination of the Cameron Peak Fire Recovery Effort



Terms of Agreement

- Stakeholders desired a project manager to help coordinate all the recovery efforts
- Funded by Greeley, Fort Collins, and grant funds
- 5 year term
- \$23,000/year + overhead expenses



Terms of Agreement

- Work is co-directed by Greeley and Fort Collins
- PM will lead the oversight, coordination and management of post-fire recovery projects
 - Manage EWP work
 - Coordinate non-EWP work
 - Coordinate with partners and stakeholders
 - Fundraising and fund management
 - Community/landowner outreach



Questions?



**INTERGOVERNMENTAL AGREEMENT
REGARDING REHABILITATION WORK FOR THE CAMERON PEAK FIRE**

THIS AGREEMENT dated April 29, 2021, is entered into by and between the following Parties: the City of Fort Collins, Colorado, a Colorado municipal corporation ("Fort Collins"); the City of Greeley, a Colorado municipal corporation ("Greeley"); and Larimer County, Colorado (together, "Managing Entities").

RECITALS

A. The 2020 Cameron Peak Fire ("Fire") has burned over 200,000 acres in the watersheds of the Cache la Poudre ("Poudre") River and Big Thompson River.

B. The Fire has also burned large areas in and impacting private properties, and public infrastructure serving such properties, including roadways, bridges, culverts, and other public service facilities outside of the public right of ways.

C. Greeley and the Water Supply and Storage Company immediately undertook measures to mitigate hazards and damages to drinking water supplies at the Chambers Reservoir.

D. The Managing Entities each divert and treat, and/or take deliveries of water from the Poudre River watershed and the Colorado Big Thompson ("CBT") Project, and/or maintain public infrastructure supporting private properties located in the basins affected by the Fire.

E. Through the Emergency Watershed Protection Program, administered by the Natural Resources Conservation Service ("NRCS"), United States Department of Agriculture, Greeley and Larimer County separately received funding for post-fire mitigation and infrastructure protection efforts related to the Fire ("EWP funds").

F. In addition to EWP funds, various funds, grants, programs, and other monetary and other resources may be or become available to assist the Managing Entities to address and mitigate damages from the Fire in the Poudre River and CBT Project watersheds ("non-EWP funds").

G. Use of EWP funds may be restricted to pre-approved scopes of services and a local government "cost-share", with EWP funds applied to a percentage of the project's costs, and the entity(s) awarded the funds being responsible for the remaining percentage. Terms and scopes of services applicable to use of non-EWP funds will be set forth in a separate agreement(s).

H. The Managing Entities desire to coordinate efforts to acquire the most funding possible and to efficiently and effectivity utilize EWP funds to address and mitigate damages from the Fire in the Poudre River and CBT Project watersheds.

I. Greeley and Larimer County agree to be the main contacts and contracting parties for EWP funds.

J. All Parties agree to independently engage other federal and state agencies as practical, for the purposes of seeking and acquiring non-EWP funds, as defined below. As set forth herein, Greeley and Larimer County will coordinate with Fort Collins and other contributing parties to this Agreement to acquire and seek reimbursements under grant and program funding requirements.

K. Fort Collins and other water users that become contributing parties to this Agreement will also contribute matching funds to the cost-share portion of certain projects, as may be required by the terms associated with EWP funds applied under this Agreement.

L. The Managing Entities desire to work with the Coalition for the Poudre River Watershed (“CPRW”), a Colorado nonprofit corporation, to manage certain projects undertaken under this Agreement, as set forth in Paragraph 7.

M. The Managing Entities also desire to include other impacted water users in these efforts, including water providers and local governmental entities that may desire to become Parties in the future. The pressing need for this Agreement, and the shifting nature of Fire impacts have made it difficult for these other water users and entities to complete their internal evaluations and processes regarding whether to become a Party. Consequently, this Agreement includes a process to add “Contributing Parties” to this Agreement.

N. The Managing Entities desire to enter into an intergovernmental agreement to coordinate emergency stabilization and restoration services, e.g., hillslope mulching, debris catchment systems, vegetation matting, seeding, rock netting, on the targeted public and private lands burned by the Fire.

O. The Managing Entities wish to record their mutual understanding in intergovernmental agreements.

P. The Managing Entities enter this into agreement pursuant as permitted §29-1-203, C.R.S.

Q. Pursuant to Art. II, § 16 of the Fort Collins City Charter, the Fort Collins City Council, may, by ordinance or resolution, enter into contracts with other governmental bodies to furnish governmental services and make charges for such services or enter into cooperative or joint activities with other governmental bodies.

R. Pursuant to Section 02.07.040, Greeley Municipal Code, Greeley may enter into contracts with other governmental bodies to furnish governmental services and make charges for such services or enter into cooperative or joint activities with other governmental bodies, the entry into such contracts being subject to the approval of the Greeley City Council under certain circumstances.

S. The authority for this Agreement is, without limitation, Section 18 of Article XIV of the Colorado Constitution; Section 6 of Article XX of the Colorado Constitution; Section 29-1-203,

C.R.S., and provisions of the Colorado Disaster Emergency Act, Section 24-33.5-701, et seq., C.R.S., as amended.

T. It is in the best interest of the citizens of Fort Collins, Greeley, and Larimer County for the parties to enter into this intergovernmental agreement.

NOW, THEREFORE, in consideration of the premises and the covenants and agreements hereinafter set forth, it is agreed by and between Fort Collins, Greeley, and Larimer County as follows:

AGREEMENT

1. **AUTHORITY.** This Agreement has been duly adopted by the Parties' governing bodies and the undersigned representatives are authorized to execute this Agreement on behalf of each respective Party.

2. **INCORPORATION OF RECITALS.** The foregoing recitals are hereby incorporated as if fully restated in their entirety.

3. **PARTIES TO THIS AGREEMENT.**

3.1. **Principals.** For purposes of completing the work described in this Agreement, portions will be delivered within the scopes of the respective funding award contracts secured by Greeley and Larimer County, and each funding recipient will take the lead in preparing and submitting reimbursements for costs associated with such work, as follows:

1. Category 1 – watershed work. Greeley will take the lead for purposes of initiating access to EWP funds and establishing the initial scope of qualifying watershed work, including hillslope and stream channel stabilization, erosion control, water supply infrastructure protection, and water quality work.
2. Category 2 – property and infrastructure work. Larimer County will take the lead for purposes of initiating access to EWP funds and establishing the initial scope of qualifying services for addressing impacts to private residences, roads, bridges, culverts and other public facilities outside of the public right of ways.
3. The Managing Entities will share responsibilities for mutually beneficial portions of qualifying Category 1 and 2 services and coordinating with third party project management services for Category 1 work.

3.2. **Addition of Parties.** Any other water user or local agency in the Poudre River watershed or that takes delivery of CBT Project water may become a “Contributing Party” to this Agreement by completing the Schedule of Participants addendum to this Agreement in the form of Exhibit B to be signed by all Parties.

3.3. **Withdrawal of Parties.** Any Party may withdraw itself from this Agreement by providing written notice pursuant to Paragraph 12. The withdrawing Party shall continue to be responsible for any commitments or contributions made prior to withdrawal.

4. **FUNDING.**

4.1. **EWP Technical Assistance Funds.** The EWP Sponsors, Greeley and Larimer County, will initially pay costs associated with NCRS-approved Technical Assistance Work under this Agreement, initial estimates for which and the associated work scoped are set forth in Exhibit A, attached hereto ("TA Funds"). EWP Sponsors may also pursue additional TA Funds for work later approved by NRCS, the work scopes for which will be incorporated in Exhibit A as amendments. Costs associated with approved TA Funds Work are ultimately 100% reimbursable.

4.2. **EWP Construction Funds.** In 2020, NRCS also awarded Financial Assistance funds ("FA Funds") to Greeley and Larimer County, respectively, for aerial mulching and enhanced mitigation efforts. Initial FA Funds awards and the associated work scopes approved by NRCS are set forth in Exhibit A.

4.3. **Local Matching Funds.** Under the respective FA Funds notices of award (a/k/a EWP funds) the Parties are required to expend certain local matching funds, anticipated to be 20 percent of the EWP funds. The Parties anticipate total funding for the Work during the Term will increase from the initial amount described in Exhibit A, as additional EWP funds become available, Contributing Parties join this Agreement, and project work orders are developed.

4.4. **Other funding.** The Parties may also pursue non-EWP funds and resources to complete projects associated with the Work, the costs for which the Parties will work in good faith to equitably share, based on a "percent of Poudre River water use" cost-share model, or as may be identified in separate agreements for such projects and as referenced in amendments to Exhibit A.

5. **APPORTIONMENT OF COSTS AND DUTIES.**

5.1. **Project Cost Allocation.**

1. Project costs will be allocated as follows for individual projects the Parties agree to pursue under this Agreement:
 - EWP funds will be used first to the maximum extent possible towards project costs, including submittal of reimbursement applications against the initial NRCS award amounts described in Paragraph 4;
 - Any remaining costs will be allocated among the Managing Entities that would benefit directly and indirectly from the project, according to criteria mutually agreed to by the participating parties at the time of project commencement ("Benefit Cost Allocation Methodology").
2. For projects Greeley agrees to pursue directly with Contributing Parties who are also water service users, project costs will be allocated based on the

participating parties' respective average annual percent municipal diversions from the Cache La Poudre river for the years 2015 to 2019 ("Water User Cost Allocation Methodology").

5.2. Category 1 Project Management.

1. Greeley may advertise and request bid proposals ("Proposal") for post-fire aerial mulching services and other post-fire mitigation services for Category 1 Work, and Greeley and Fort Collins will select a general contractor based on the criteria set forth in the Proposal.
2. Upon selection of a general contractor to perform the designated Category 1 Work, Greeley shall execute a contract with the selected general contractor ("Cat 1 Contract") and will be identified as the owner therein for such projects, which may include work designed by or with a shared benefit for Fort Collins and/or Larimer County.
3. As specified in the terms of the Cat 1 Contract, the selected general contractor will first invoice Greeley directly, up to and not to exceed any amount to which Greeley has agreed pursuant to an executed NRCS notice of award, for the designated Category 1 Work. After receiving EWP reimbursements, Greeley will divide non-reimbursable Category 1 Work project costs among the project partners, including Fort Collins and benefited Contributing Parties, pursuant to either the Benefit or Water User Cost Allocation Methodology as appropriate.

5.3. Category 2 Project Management.

1. Larimer County may advertise and request bid proposals ("Proposal") for post-fire aerial mulching services and other post-fire mitigation services for Category 2 Work and will select a general contractor based on the criteria set forth in the Proposal.
2. Upon the selection of a general contractor to perform the designated Category 2 Work, Larimer County shall execute a contract with the selected general contractor ("Cat 2 Contract") and will be identified as owner therein for such projects, which may include work designed by or with a shared benefit for county partners.

6. **PROJECTS.** The projects ("Work") performed under this Agreement and subject to the EWP fund reimbursement conditions shall fall within the objectives outlined in the scope of services and contract between the local government entity and NRCS, as described in Exhibit A, attached hereto, and incorporated by this reference. Reimbursement obligations for such Work shall be subject to cost distributions and conditions set forth in the respective funding contract. Any (additional) Work requested by a Party that NRCS may subsequently approve for reimbursement with EWP funds will be set forth in an amendment to Exhibit A.

7. **PROJECT PLANNING.**

7.1. **Decision Making.** In making decisions on which projects fall under Category 1 or Category 2 to pursue and the allocation of project costs, the Parties shall operate by consensus. To this end, the Parties shall make a good faith effort to reach consensus, propose alternative solutions, and otherwise work to resolve any issues that prevent consensus. Any decisions involving the use of a particular Parties' lands or structures may only be made with the consent of that Party in its sole discretion.

7.2. **Project Identification and Prioritization.** The Parties will identify potential projects on which to use the EWP funds. The Parties' identification of potential projects and the order in which they are taken on and completed will be guided by the following considerations:

- The need and expected benefit of the project;
- The entities that would benefit directly and indirectly from the project;
- The cost of the project, including whether EWP funds can be applied towards the project's costs;
- Accessibility of the project location; and
- Administrative, legal, and/or regulatory steps associated with the project, including receiving approval for the project to be eligible for funds, such as necessary permits; and

7.3. **Project Selection.** For projects the Parties agree to pursue under this Agreement, Greeley and Larimer County will provide a written summary, including: a description of the project work; a timeline; and the project cost allocation ("Project Summary"), which may be initially prepared by a third-party contractor. A scope of work provided by the contractor hired to undertake such project may be used as the Project Summary, if it contains the information described in this paragraph.

- **Category 1 Projects:** Greeley will circulate a draft Project Summary to the Contributing Parties for review and comment. Greeley and the Contributing Parties must mutually approve the Project Summary in writing prior to project commencement. After the Project Summary is approved, Work may commence, and as projects under this Agreement are completed, Greeley will invoice the Contributing Parties for project costs not reimbursed by EWP funds, according to the Project Summary. Greeley will prepare an annual work summary for projects completed under this Agreement and submit the summary to the Parties by December 31. The annual summary will exclude any projects that Greeley or Larimer County take on independently or without involvement of other Parties.
- **Category 2 Projects:** Larimer County will circulate a draft Project Summary to the Contributing Parties for review and comment. Larimer County and the Contributing Parties must mutually approve the Project Summary in writing prior to project commencement. After the Project Summary is approved, Work may commence, and as projects under this Agreement are completed, Larimer County

will invoice the Contributing Parties for project costs not reimbursed by EWP funds, according to the Project Summary. Larimer County will prepare an annual work summary for projects completed under this Agreement and submit the summary to the Parties by December 31. The annual summary will exclude any projects that Greeley or Larimer County take on independently or without involvement of other Parties.

8. **CPRW PROJECT MANAGEMENT.** Greeley and Fort Collins may secure project management (PM) services through the Coalition for the Poudre River Watershed (“CPRW”) to coordinate post-fire project implementation and ensure the Work is completed. The terms of CPRW’s engagement will be documented in a separate agreement, under which Fort Collins will reimburse Greeley for a portion of the PM costs. Greeley and Fort Collins may choose to maintain and oversee CPRW’s delivery of PM services through resources employed directly by CPRW. The initial focus of the PM service will be EWP fund Category 1 projects, with accommodation for other priorities identified in this Agreement as resources and funding conditions may permit.

9. **OTHER FIRE-RELATED EFFORTS.** Nothing in this Agreement shall impact the ability of any Party to perform other activities to address and mitigate damages from the Fire in the Poudre River and CBT Project watersheds, including efforts with affiliated local agencies affected by the Fire that may seek to coordinate with Work performed under this Agreement, e.g., City of Fort Collins Natural Areas.

10. **FISCAL CONTINGENCY.** Notwithstanding any other provisions of this Agreement to the contrary, the obligations of the governmental Parties in fiscal years after the fiscal year of this Agreement shall be subject to appropriation of funds sufficient and intended therefor, with each governmental Party having the sole discretion to determine whether the subject funds are sufficient and intended for use under this Agreement, and the failure of any governmental Party to appropriate such funds shall be grounds for the Party to withdraw from this Agreement with written notice pursuant to Paragraph 12.

11. **NO THIRD-PARTY BENEFICIARIES.** This Agreement is entered into among the Parties for the purposes set forth herein. It is the intent of the Parties that they are the only beneficiaries of this Agreement and the Parties are only benefitted to the extent provided under the express terms and conditions of this Agreement.

12. **NOTICES.** All notices or other communications hereunder shall be sufficiently given and shall be deemed given when personally delivered, or after the lapse of five business days following mailing by certified mail-return receipt requested, postage prepaid, addressed as follows:

To Fort Collins:	City Manager City Hall West 300 LaPorte Avenue; P.O. Box 580 Fort Collins, Colorado 80522-0580
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With copy to:	Fort Collins City Attorney 300 LaPorte Avenue; P.O. Box 580 Fort Collins, Colorado 80522-0580
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epotyondy@fcgov.com

and:

Fort Collins Utilities
Attn: Water Resources Manager
700 Wood Street
Fort Collins, Colorado 80521
ddustin@fcgov.com

To Greeley:

Greeley Water and Sewer Department
Attn: Director of Water and Sewer
1001 11th Avenue, Second Floor
Greeley, Colorado 80631
sean.chambers@greeleygov.com;
jennifer.petrzelka@greeleygov.com

With a copy to:

Greeley City Attorney's Office
Attn: Environmental and Water Resources
1100 10th Street, Suite 401
Greeley, Colorado 80631
daniel.biwer@greeleygov.com

To Larimer County:

County Manager
200 W. Oak Street
Fort Collins, CO 80522

With copy to:

Office of Emergency Management
Attn: Director OEM
200 W. Oak Street
Fort Collins, Colorado 80522

13. **NO WAIVER OF IMMUNITY. NO WAIVER OF IMMUNITY.** Nothing herein shall constitute a waiver, express or implied, of any of the immunities, rights, benefits, protection, or other provisions of the Colorado Governmental Immunity Act ("CGIA"), C.R.S. §24-10-101, et seq., or the Federal Tort Claims Act ("FTCA") 28 U.S.C. 2671 et seq., as applicable, as now or hereafter amended nor shall any portion of this Agreement be deemed to have created a duty of care which did not previously exist with respect to any person not a party to this Agreement. Liability for claims for injuries to persons or property arising from the negligence of the Parties, its departments, institutions, agencies, boards, officials, and employees is controlled and limited by the provisions of the CGIA or the FTCA as applicable, as now or hereafter amended.

14. **NON-LIABILITY AND INSURANCE-GENERAL.** This Agreement shall not be construed to create a duty as a matter of law, contract, or otherwise for any Party to assume any liability for injury, property damage, or any other loss or damage that may occur by any action, or non-action taken, or service provided, to the public or any person, as a result of this Agreement. Each Party shall take all necessary precautions in performing the work hereunder to prevent injury to persons and property as a result of any act or omission of a Party, or its employees, agents, or assignees pursuant to the terms of this Agreement, Each Party retains all obligations and

protections afforded by the provisions of the Colorado Governmental Immunity Act, C.R.S. 24-10-101 et. seq., as the same may be amended from time to time.

15. **GOVERNING LAW.** This Agreement shall be governed by and construed in accordance with the laws of the State of Colorado, except for conflicts of laws provisions. The forum for any dispute regarding this Agreement shall be in the Weld County District Court, State of Colorado.

16. **CONSTRUCTION.** This Agreement shall be construed according to its fair meaning as it was prepared by the Parties. Headings in this Agreement are for convenience and reference only and shall in no way define, limit, or prescribe the scope or intent of any provision of this Agreement.

17. **ENTIRE AGREEMENT.** This Agreement constitutes the entire agreement of the Parties regarding the matters addressed herein. This Agreement binds and benefits the Parties and their respective successors. Covenants or representations not contained in this Agreement regarding the matters addressed herein shall not bind the Parties.

18. **AMENDMENTS.** Any amendments or modifications to this Agreement must be in writing and executed by all parties to be valid and binding.

19. **REPRESENTATIONS.** Each Party represents to the other Parties that it has the power and authority to enter into this Agreement and the individuals signing below on behalf of that Party have the authority to execute this Agreement on its behalf and legally bind that Party.

20. **ASSIGNMENT.** No Party may assign any rights or delegate any duties under this Agreement without the written consent of all other Parties.

21. **SEVERABILITY.** If any provision of this Agreement shall be found illegal, invalid, unenforceable, or impossible to perform by a court of competent jurisdiction, the remainder of this Agreement shall remain in full force and effect.

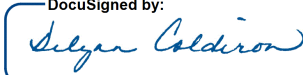
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CITY OF FORT COLLINS, COLORADO, a Colorado municipal corporation

By: 
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Darin Atteberry, City Manager

Date: 4/29/2021

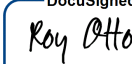
ATTEST:


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City Clerk's Office Delynn Coldiron
Printed Name: _____
Title: City Clerk

APPROVED AS TO FORM:

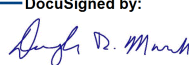

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Printed Name: _____
Assistant City Attorney

CITY OF GREELEY, COLORADO, a home rule municipal corporation

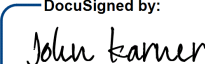
By: 
D93D100AE64B4E6...
Roy Otto, City Manager

Date: 4/28/2021

AS TO LEGAL FORM:

By: 
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City Attorney Douglas Marek

AS TO AVAILABILITY OF FUNDS:

By: 
F8DCA83C0CBA494...
Director of Finance John Karner

LARIMER COUNTY, COLORADO, a county subdivision of the State of Colorado

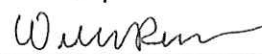
By: 
Chairman of Board of County Commissioners

Date: 4/20/21

ATTEST:

By: 
Deputy Clerk

AS TO LEGAL FORM:

By: 
County Attorney



AS TO AVAILABILITY OF FUNDS:

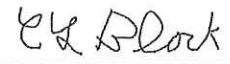
By: 
Director of Finance

Exhibit A
Scope of Coordinated Services

Greeley and Larimer County intend to use EWP funds for the implementation of recovery measures, which left undone, pose a threat to life and or property. Example recovery projects may include, but are not limited to, erosion and sedimentation prevention, debris removal, and structure protection from the threat of future flooding due to the Cameron Peak Fire.

Examples of Project Types:

I. Direct Remediation

a. Category 1 services.

- Mulching of hillslopes
- Hillslope stabilizations such as waddles, tree welling, etc.
- Sedimentation basins
- Erosion Control Measures
- Stream Channel Stabilization
- Seeding/ Revegetation / Reforestation

b. Category 2 services.

- Repair or upgrades to culverts, bridges, and roads
- Debris removal
- Flooding prevention structures
- Hazard Tree Removal
- Hillslope protection / stabilization
- Warning Signage
- Stream channel stabilization
- Seeding/ Revegetation / Reforestation

II. Project Management

As needed, Greeley and Fort Collins will jointly select and coordinate through Greeley a third-party project manager (“PM Work”) to oversee organization of Projects under this Agreement and related work, including Category 2 services for which Larimer County may be involved. The Managing Entities will equitably apportion the cost of PM Work, based on the respective benefits realized by the Parties, to be paid from individual resources without seeking NRCS reimbursement.



U.S. Department of Agriculture
Natural Resources Conservation Service

NRCS-ADS-093

NOTICE OF GRANT AND AGREEMENT AWARD

1. Award Identifying Number NR218B05XXXXC001	2. Amendment Number	3. Award /Project Period NRCS Signature - 05/13/2021	4. Type of award instrument: Cooperative Agreement
5. Agency (Name and Address) Natural Resources Conservation Service Denver Federal Center, Building 56, Room 2604 PO Box 25426 Denver, CO 80225-0426		6. Recipient Organization (Name and Address) GREELEY, CITY OF CITY ATTORNEY'S OFFICE 1000 10TH STREET GREELEY CO 80631-3808 DUNS: 112066225 EIN:	
7. NRCS Program Contact Name: Todd Boldt Phone: (970) 215-9897 Email: todd.boldt@usda.gov	8. NRCS Administrative Contact Name: MOIRA SANFORD Phone: (614) 255-2495 Email: MOIRA.SANFORD@USDA.GOV	9. Recipient Program Contact Name: Jennifer Petrzelka Phone: 970-350-9859 Email: jennifer.petrzelka@greeleygov.com	10. Recipient Administrative Contact Name: Jennifer Petrzelka Phone: 970-350-9859 Email: jennifer.petrzelka@greeleygov.com
11. CFDA 10.923	12. Authority 33 U.S.C. 701b-1	13. Type of Action New Agreement	14. Program Director Name: Jennifer Petrzelka Phone: 970-350-9859 Email: jennifer.petrzelka@greeleygov.com
15. Project Title/ Description: EWP CO 5084 City of Greeley, Mesa County, DSR 08-03-20-5084-001 Colorado 2020 Fires - Cameron Peak, debris removal and streambank stabilization (6000016217)			
16. Entity Type: C = City or township Government			
17. Select Funding Type			
Select funding type:	☒ Federal	☒ Non-Federal	
Original funds total	\$475,000.00	\$100,000.00	
Additional funds total	\$0.00	\$0.00	
Grand total	\$475,000.00	\$100,000.00	
18. Approved Budget			

Personnel	\$0.00	Fringe Benefits	\$0.00
Travel	\$0.00	Equipment	\$0.00
Supplies	\$0.00	Contractual	\$0.00
Construction	\$400,000.00	Other	\$75,000.00
Total Direct Cost	\$475,000.00	Total Indirect Cost	\$0.00
		Total Non-Federal Funds	\$100,000.00
		Total Federal Funds Awarded	\$475,000.00
		Total Approved Budget	\$575,000.00

This agreement is subject to applicable USDA NRCS statutory provisions and Financial Assistance Regulations. In accepting this award or amendment and any payments made pursuant thereto, the undersigned represents that he or she is duly authorized to act on behalf of the awardee organization, agrees that the award is subject to the applicable provisions of this agreement (and all attachments), and agrees that acceptance of any payments constitutes an agreement by the payee that the amounts, if any, found by NRCS to have been overpaid, will be refunded or credited in full to NRCS.

Name and Title of Authorized Government Representative Randolph Randall Acting State Conservationist	Signature	Date
Name and Title of Authorized Recipient Representative Sean Chambers Water & Sewer Director	Signature 	Date Oct. 21, 2020

NONDISCRIMINATION STATEMENT

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW., Washington, DC 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

PRIVACY ACT STATEMENT

The above statements are made in accordance with the Privacy Act of 1974 (5 U.S.C. Section 522a).

Statement of Work

Purpose

The purpose of this agreement is for the United States Department of Agriculture, Natural Resources Conservation Service, hereinafter referred to as the "NRCS", to provide technical and financial assistance to the City of Greeley, hereinafter referred to as the "Sponsor", for EWP Project # 5084 in Larimer County, Colorado for implementation of recovery measures, that, if left undone, pose a risk to life and/or property.

Objectives

The design and installation of EWP measures as detailed in the individual Damage Survey Reports (DSR) and described here:

- DSR 5084-001 - Erosion & sedimentation prevention, debris removal, structure protection from the threat of future flooding due to the Cameron Peak Fire.

Budget Narrative

A. The estimated costs for the Project:

1. Total Estimated Project Budget: \$575,000

The budget includes:

Financial Assistance (FA) Costs:

Construction Costs (80% NRCS \$400,000 + 20% Sponsor \$100,000): \$500,000

Technical Assistance (TA) Costs:

100% NRCS (not to exceed): \$75,000

2. NRCS reimburses up to 80 percent of eligible construction costs and Sponsor pays 20 percent of construction costs. NRCS will contribute up to \$75,000 for contract administration and construction management costs. It is possible that technical and administrative costs will exceed this amount, requiring the Sponsor to contribute resources to complete technical and administrative work

3. NRCS funding for this project is provided to the Sponsor in two separate NRCS funding accounts, one for financial assistance (FA) and one for technical assistance (TA). FA costs are associated with construction activities; TA costs are associated with services. These expenditures shall be accounted for separately in order for expenses to be eligible for reimbursement.

4. NRCS will provide FA for actual costs as reimbursement to the Sponsor for approved on-the-ground construction costs, subject to above limits. If costs are reduced, reimbursement will be reduced accordingly. Construction costs are associated with the installation of the project measures including labor, equipment and materials.

5. NRCS will provide TA reimbursement to the Sponsor for technical and administrative costs directly charged to the project, subject to the above limits. If costs are reduced, reimbursement will be reduced accordingly. These costs include

a. engineering costs include, but not limited to, developing a project design that includes construction drawings and specifications, an operation and maintenance plan, a quality assurance/inspection plan and an engineer's estimate of the project installation costs in addition to providing necessary quality assurance during construction.

b. contract administration costs include, but not limited to, soliciting, evaluating, awarding and administering contracts for construction and engineering services, including project management, verifying invoices and record keeping.

6. The Sponsor will contribute funds toward the total construction costs in either direct cash expenditures, the value of non-cash materials or services, or in-kind contributions. The value of any in-kind contribution shall be agreed to in writing prior to implementation.

Responsibilities of the Parties:

A. Sponsor will—

1. Accomplish construction of the EWP project measures by contracting, in-kind construction services, or a combination of both.
2. Ensure and certify by signing this agreement that its cost share obligation is from a non-Federal source.
3. Comply with the terms and conditions of this agreement and the attached general terms and conditions except those that are not applicable to State and local governments.
4. Acquire adequate real property rights (land and water), permits and licenses in accordance with local, state, and Federal laws necessary for the installation of EWP project measures at no cost to NRCS prior to construction. This includes any rights associated with required environmental mitigation. Costs related to land rights and permits are the Sponsor's responsibility and ineligible for reimbursement.
5. Accept all financial and other responsibility for excess costs resulting from their failure to obtain, or their delay in obtaining, adequate land and water rights, permits and licenses needed for the Project.
6. Provide the agreed-to portion of the actual, eligible and approved construction cost. These costs may be in the form of cash, in-kind construction services, or a combination of both. Final construction items that are eligible construction costs will be agreed upon during the pre-design conference. These costs consist of costs from contracts awarded to contractors and eligible Sponsor in-kind construction costs for materials, labor, and equipment. The Sponsor shall provide NRCS documentation to support all eligible construction costs. Construction costs incurred prior to the Sponsor and NRCS signing this agreement are ineligible and will not be reimbursed.
7. Be responsible for 100 percent of all ineligible construction costs and 100 percent of any unapproved upgrade to increase the level of protection over and above that described in the engineering plans.
8. Account for and report FA and TA expenditures separately in order for expenses to be eligible for reimbursement. NRCS funding for this project is provided to the Sponsor in two separate NRCS funding accounts, one for TA and one for FA, requiring this separation.
9. The contracts for design services and construction described in this Agreement shall not be awarded to the Sponsor or to any firm in which any Sponsor's official or any member of such official's immediate family has direct or indirect interest in the pecuniary profits or contracts of such firms. Reference 2 CFR § 200.318 regarding standards of conduct covering conflicts of interest and governing the performance of its employees engaged in the selection, award, and administration of contracts.
10. For in-kind construction services (materials, labor, and/or equipment supplied by the Sponsor), develop a Plan of Operations describing the construction services to be performed including estimated quantities and values. The Plan of Operations shall be concurred in by NRCS at the pre-design conference. In-kind construction services for equipment shall not exceed published FEMA equipment rates unless otherwise documented and concurred in advance by NRCS.
11. The following documentation is required to support the Sponsor's request for reimbursement of in-kind construction services:
 - a. Invoices covering actual costs of materials used in constructing the eligible EWP project measures.
 - b. Records documenting the type, quality, and quantities of materials actually used in constructing the eligible EWP project measures.
 - c. Daily time records for each employee showing name, classification, wage rate, hours, and dates actually employed for constructing the eligible EWP project measures.
 - d. Equipment operating records showing the type and size of equipment, hourly rate, actual hours of operation and dates used to install the eligible EWP project measures. Equipment idle time is not eligible in-kind construction services, even if on the job site, and should not be included in the equipment operating records.
12. Ensure that any special requirements for compliance with environmental and/or cultural resource laws are incorporated into the project.
13. The Sponsor must secure at its own expense all Federal, State, and local permits and licenses necessary for completion of the work described in this agreement as well as any necessary natural resource rights and provide copies of all permits and licenses obtained to NRCS.

14. Will arrange and pay for any necessary location, removal, or relocation of utilities. EWP program regulations prohibit NRCS from reimbursing the Sponsor or otherwise paying for any such costs; nor do the costs qualify as a Sponsor cost-share contribution.

15. Ensure that technical and engineering standards and specifications of NRCS are adhered to during construction of the Project, as interpreted by NRCS State Conservation Engineer. Provide NRCS State Conservation Engineer and Program/Technical Contact progress reports as necessary and agreed to. Progress reports should include technical on-site inspections of work accomplished for the period, work planned, results of material tests, deficient work products and/or tests with corrective actions taken, modifications anticipated, technical problems encountered, contractual issues and other relevant information.

16. Ensure that all contractors on NRCS assisted projects are performing their work in accordance with OSHA regulations and the Contract Work Hours and Safety Standards Act (40 USC 3701-3708) as supplemented by Department of Labor regulations (29 CFR Part 5). The Sponsor is responsible for periodically checking the contractor's compliance with safety requirements.

17. Provide a Colorado registered PE-certified as-built drawings and quantities for the project. A copy of the as-built drawings will be submitted to the NRCS State Conservation Engineer and Program/Technical Contact.

18. Pay the contractor(s) for work performed in accordance with the agreement and submit a SF-270, "Request for Advance or Reimbursement" to the Program/Technical Contact with all documentation to support the request. Final payment request shall be submitted within 90 calendar days of completion of the EWP project measures. Payments will be withheld until all required documentation is submitted and complete.

a. The required supporting documentation for reimbursement of construction costs include invoices and proof of payment to the contractor showing the items and quantities installed and certified by the engineer of record along with any supporting documentation such as quantity calculations, rock weight tickets, etc.

b. The required supporting documentation for reimbursement of in-kind construction expenses will include employee time sheets, employee hourly rate, equipment operating logs, equipment hourly rate, and material quantities and invoices.

c. The required documentation for reimbursement of technical and administrative services will be invoices and proof of payment to consultants and/or employee time sheets along with the employee's hourly rate, hours worked, and date work was performed.

19. Ensure that information in the System for Award Management (SAM) is current and accurate until the final financial report (SF-425) under this award or final payment is received, whichever is later.

20. Take reasonable and necessary actions to dispose of all contractual and administrative issues arising out of the contract(s) awarded under this Agreement. This includes, but is not limited to disputes, claims, protests of award, source evaluation, and litigation that may result from the Project. Such actions will be at the expense of the Sponsor, including any legal expenses. The Sponsor will advise, consult with, and obtain prior written concurrence of NRCS on any litigation matters in which NRCS could have a financial interest.

21. Sponsor must indemnify and hold NRCS harmless to the extent permitted by State law for any costs, damages, claims, liabilities, and judgments arising from past, present, and future acts or omissions of the Sponsor in connection with its acquisition and management of the Emergency Watershed Protection Program pursuant to this agreement. Further, the Sponsor agrees that NRCS will have no responsibility for acts and omissions of the Sponsor, its agents, successors, assigns, employees, contractors, or lessees in connection with the acquisition and management of the Emergency Watershed Protection Program pursuant to this agreement that result in violation of any laws and regulations that are now or that may in the future become applicable.

22. Retain all records dealing with the award and administration of the contract(s) for 3 years from the date of the Sponsor's submission of the final request for reimbursement or until final audit findings have been resolved, whichever is longer. If any litigation is started before the expiration of the 3-year period, records are to be retained until the litigation is resolved or the end of the 3-year period, whichever is longer. Make such records available to the Comptroller General of the United States or his or her duly authorized representative and accredited representatives of the Department of Agriculture or cognizant audit agency for the purpose of making audit, examination, excerpts, and transcriptions.

23. Be liable to the NRCS for damages sustained by the NRCS as a result of the contractor failing to complete the work within the specified time. The damages will be based upon the additional costs incurred by the NRCS resulting from the contractor not completing the work within the allowable performance period. These costs include but are not limited to personnel costs, travel, etc. The NRCS will have the right to withhold such amount out of any monies that may be then due or that may become due and payable to the Sponsor. This liability is not applicable to the extent that the contract

performance time is extended by court judgment unless such judgment results from actions of the Sponsor not concurred in by NRCS.

24. Take necessary legal action, including bringing suit, to collect from the contractor any monies due in connection with the contract, or upon request of NRCS, assign and transfer to NRCS any or all claims, demands, and causes of action of every kind whatsoever that the Sponsor has against the contractor or his or her sureties.

25. Submit performance reports on an annual basis to ezFedGrants or to the Farm Production and Conservation (FPAC) Grants and Agreements Division staff via email to: FPAC.BC.GAD@usda.gov. Reports are due 30 calendar days after the reporting period and are based on the agreement period of performance start date.

26. Submit SF-425 Financial Reports on a semi-annual basis to ezFedGrants or to the Farm Production and Conservation (FPAC) Grants and Agreements Division via email to: FPAC.BC.GAD@usda.gov. Reports are due 30 calendar days after the reporting period on July 31 and January 31. Please note that financial reporting is based on the calendar year.

27. Submit payment requests to ezFedgrants or to the Farm Production and Conservation (FPAC) Grants and Agreements Division via email to: FPAC.BC.GAD@usda.gov on a monthly or quarterly basis. Refer to the General Terms and Conditions for more information regarding payment requests.

28. The recipient (including subrecipients) is responsible for compliance with the prohibition on certain telecommunications and video surveillance services or equipment identified in 2 CFR 200.216. See Public Law 115-232, Section 889 for additional information. In accordance with 2 CFR 200.216, the recipient (including subrecipients) is prohibited from obligating or expending loan or grant funds for covered telecommunications equipment or services to:

- (1) procure or obtain, extend or renew a contract to procure or obtain;
- (2) enter into a contract (or extend or renew a contract) to procure; or
- (3) obtain the equipment, services or systems.

29. In accordance with 2 CFR 200.340, the recipient understands this agreement may be terminated in whole or in part as follows:

- (1) By the Federal awarding agency or pass-through entity, if a recipient fails to comply with the terms and conditions of a Federal award;
- (2) By the Federal awarding agency or pass-through entity, to the greatest extent authorized by law, if an award no longer effectuates the program goals or agency priorities;
- (3) By the Federal awarding agency or pass-through entity with the consent of the recipient, in which case the two parties must agree upon the termination conditions, including the effective date and, in the case of partial termination, the portion to be terminated; or
- (4) By the recipient upon sending to the Federal awarding agency or pass-through entity written notification setting forth the reasons for such termination, the effective date, and, in the case of partial termination, the portion to be terminated. However, if the Federal awarding agency or pass-through entity determines in the case of partial termination that the reduced or modified portion of the Federal award or subaward will not accomplish the purposes for which the Federal award was made, the Federal awarding agency or pass-through entity may terminate the Federal award in its entirety.

B. NRCS will—

1. Assist Sponsor in establishing design parameters; determine eligible construction costs during the pre-design conference.

2. Designate a Government representative (GR) to serve as liaison with the Sponsor and identify that person's contact information with this executed agreement.

3. Review, comment and concur in preliminary and final plans, specifications, O&M Plan, Plan of Operations (if required) and QAP.

4. Make periodic site visits during the installation of the EWP project measures to review construction progress, document conformance to engineering plans and specifications, and provide any necessary clarification on the Sponsor's responsibilities.

5. Upon notification of the completion of the EWP project measures, NRCS shall promptly review the performance of the Sponsor to determine if the requirements of this agreement and fund expenditures as agreed have been met.

6. Make payment to the Sponsor covering NRCS' share of the cost upon receipt and approval of Form SF-270 and supporting documentation, withholding the amount of damages sustained by NRCS as provided for in this agreement. In the event there are questions regarding the SF 270 and supporting documentation, NRCS will contact the Sponsor in a

timely manner to resolve concerns.

C. MUTUALLY AGREED

1. The furnishing of financial, administrative, and/or technical assistance above the original funding amount by NRCS is contingent on there being sufficient unobligated and uncommitted funding in the Emergency Watershed Protection Program that is available for obligation in the year in which the assistance will be provided. NRCS may not make commitments in excess of funds authorized by law or made administratively available. Congress may impose obligational limits on program funding that constrains NRCS's ability to provide such assistance.
2. In the event of default of a construction contract awarded pursuant to this agreement, any additional funds properly allocable as construction costs required to ensure completion of the job are to be provided in the same ratio as construction funds are contributed by the parties under the terms of this agreement. Any excess costs including interest resulting from a judgment collected from the defaulting contractor, or his or her surety, will be prorated between the Sponsor and NRCS in the same ratio as construction funds are contributed under the terms of the agreement.
3. Additional funds, including interest properly allocable as construction costs as determined by NRCS, required as a result of decision of the CO or a court judgment in favor of a claimant will be provided in the same ratio as construction funds are contributed under the terms of this agreement. NRCS will not be obligated to contribute funds under any agreement or commitment made by the Sponsor without prior concurrence of NRCS.
4. The State Conservationist may make adjustments in the estimated cost to NRCS set forth in this agreement for constructing the EWP measures. Such adjustments may increase or decrease the amount of estimated funds that are related to differences between such estimated cost and the amount of the awarded contract or to changes, differing site conditions, quantity variations, or other actions taken under the provisions of the contract. No adjustment will be made to change the cost sharing assistance provided by NRCS as set forth in this agreement, nor reduce funds below the amount required to carry out NRCS' share of the contract.
5. Except for item 4. above (last sentence), this document may be revised as mutually agreed through a written amendment duly executed by authorized officials of all signatory parties to this agreement.
6. NRCS, at its sole discretion, may refuse to cost share should the Sponsor, in administering the contract, elect to proceed without obtaining concurrence as set out in this agreement.
7. Once the project is completed and all requests for reimbursement submitted, any excess funding remaining in the agreement will be de-obligated from the agreement.
8. If inconsistencies arise between the language in the Statement of Work (SOW) in the agreement and the general terms and conditions, the language in the SOW takes precedence.

Expected Accomplishments and Deliverables

1. Prepare design, construction specifications, and drawings in accordance with standard engineering principles that comply with NRCS programmatic requirements; and/or contract/install the designed construction. Any design services will be by a professional State of Colorado registered engineer. Sponsor will obtain NRCS review and concurrence on the design, construction plans, and specifications. The Sponsor must ensure description of work is reviewed, concurred, and approved by NRCS. A copy of the final signed and sealed plans and specifications shall be provided to the NRCS State Conservation Engineer.
2. Contract for services and construction in accordance with the Code of Federal Regulations (CFR), 2 CFR § 200.317 through 200.326, applicable State regulations, and the Sponsor's procurement regulations, as appropriate. (See general terms and conditions attached to this agreement for a link to the CFR.) In accordance with 2 CFR § 200.326, contracts must contain the applicable provisions described in Appendix II to Part 200. Davis-Bacon Act would not apply under this Federal program legislation.
3. Provide copies of site maps to appropriate Federal and State agencies for environmental review. Sponsor will notify NRCS of environmental clearance, modification of construction plans, or any unresolved concerns as well as copies of all permits, licenses, and other documents required by Federal, state, and local statutes and ordinances prior to solicitation for installation of the EWP project measures. All modifications to the plans and specifications shall be reviewed and concurred on by NRCS.
4. Prepare and submit to the NRCS State Conservation Engineer for NRCS concurrence an Operation and Maintenance (O&M) Plan, if applicable, prior to commence of work. The O&M Plan shall describe the activities the Sponsor will do to ensure the project performs as designed. Upon completion of the project measures, the Sponsor shall assume responsibility for O&M.

5. Prior to commencement of work and/or solicitation of bids, submit to the NRCS State Conservation Engineer for NRCS review and concurrence a Quality Assurance Plan (QAP). The QAP shall outline technical and administrative expertise required to ensure the EWP project measures are installed in accordance with the plans and specifications, identify individuals with the expertise, describe items to be inspected, list equipment required for inspection, outline the frequency and timing of inspection (continuous or periodic), outline inspection procedures, and record keeping requirements. A copy of the final QAP shall be provided to NRCS prior to commencement of construction.

6. Provide construction inspection in accordance with the QAP.

7. Arrange for and conduct final inspection of completed project with NRCS to determine whether all work has been performed in accordance with contractual requirements. Provide a State of Colorado registered PE certification that the Project was installed in accordance with approved plans and specifications.

Resources Required

As stated in this agreement.

Milestones

Milestones shall include, but not limited to, the following items:

1. Pre-construction design conference within 30 days of signing agreement.
2. Submit to NRCS a schedule with time lines of major items to be completed within 30 days of the pre-design conference.
3. Acquire needed landowner permissions prior to start of construction and provide proof to NRCS.
4. Obtaining permits and provide to NRCS prior to the start of construction.
5. Completing any necessary surveys.
6. Completing draft engineering plans and specifications for NRCS review and concurrence.
7. Completing final engineering plans and specifications for NRCS review and approval.
8. Completing quality assurance plan for NRCS review and approval.
9. Solicit bids and provide to NRCS.
10. Award contract and provide to NRCS.
11. Submit Request for Reimbursement (SF-270) with supporting documentation every 30 days.
12. Date of estimated completion of construction
13. Complete agreement close-out activities

GENERAL TERMS AND CONDITIONS

Please reference the below link(s) for the General Terms and Conditions pertaining to this award:

U.S. DEPARTMENT OF AGRICULTURE FARM PRODUCTION AND CONSERVATION

GENERAL TERMS AND CONDITIONS GRANTS AND COOPERATIVE AGREEMENTS

The Farm Production and Conservation (FPAC) mission area encompasses the following USDA agencies: Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), Risk Management Agency (RMA), the Commodity Credit Corporation (CCC), and the FPAC Business Center.

I. APPLICABLE REGULATIONS

a. As a condition of this award, the recipient assures and certifies that it has and/or will comply and require subrecipients to comply with the requirements contained in the following statutes and regulations, as applicable. The full text of Code of Federal Regulations references may be found at <https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR> and <http://www.ecfr.gov/>.

(1) 2 CFR Part 25, "Universal Identifier and System of Award Management" (2) 2 CFR Part 170, "Reporting Subaward and Executive Compensation Information" (3) 2 CFR Part 175, "Award Term for Trafficking in Persons" (4) 2 CFR Part 180, "OMB Guidelines to Agencies On Governmentwide Debarment And Suspension (Nonprocurement)" (5) 2 CFR Part 182, "Governmentwide Requirements for Drug-Free Workplace (Financial Assistance)" (6) 2 CFR Part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards" (7) 2 CFR Part 400, "Uniform Administrative Requirements, Cost Principles, And Audit Requirements for Federal Awards" (8) 2 CFR Part 417, "Nonprocurement Debarment and Suspension" (9) 2 CFR Part 418, "New Restrictions on Lobbying" (10) 2 CFR Part 421, "Requirements for Drug-Free Workplace (Financial Assistance)" (11) 2 CFR Part 422, "Research Institutions Conducting USDA-Funded Extramural Research; Research Misconduct"

b. Allowable project costs will be determined in accordance with the authorizing statute, the purpose of the award, and, to the extent applicable, to the type of organizations receiving the award, regardless of tier. The following portions of the Code of Federal Regulations are hereby incorporated by reference. The full text of Code of Federal Regulations references may be found at <https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR> and <http://www.ecfr.gov/>.

(1) 2 CFR Part 200, "Uniform Administrative Requirements, Cost Principles And Audit Requirements For Federal Awards" (2) 48 CFR Part 31, "Contract Cost Principles and Procedures" c. For corporate recipients, by accepting this award the recipient acknowledges: (1) that it does not have a Federal tax delinquency, meaning that it is not subject to any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability, and (2) that it has not been convicted of a felony criminal violation under any Federal law within 24 months preceding the award, unless a suspending and debarment official of the USDA has considered suspension or debarment of the recipient corporation based on these convictions and/or tax delinquencies and determined that suspension or debarment is not necessary to protect the interests of the Government. If the recipient fails to comply with these provisions, the agency will annul this agreement and may recover any funds the recipient has expended in violation of the above cited statutory provisions.

II. UNALLOWABLE COSTS

The following costs are not allowed:

a. Costs above the amount authorized for the project. b. Costs incurred after the award period of performance end date. c. Costs not identified in the approved budget or approved budget revisions. d. Profit resulting from Federal financial assistance. Recipients may not earn and keep income resulting from an award. e. Costs of promotional items and memorabilia, including models, gifts, and souvenirs. f. Compensation for injuries to persons or damage to property arising from project activities.

This list is not exhaustive. For general information about the allowability of particular items of costs, please see 2 CFR Part 200, "Subpart E - Cost Principles", or direct specific inquiries to the administrative contact identified in the award.

The allowability of some items of costs may be difficult to determine. To avoid disallowance or dispute of such costs, the recipient may seek prior approval before incurring them. See 2 CFR 200.407. III. PRIOR APPROVAL REQUIREMENTS

Certain items of cost and award revisions require the prior written approval of the awarding agency. The following are the most common situations requiring prior approval. However, this list is not exhaustive, and the recipient is also bound by any other prior approval requirements identified in the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards.

a. Pre-award costs.—To receive reimbursement for costs incurred prior to the award date, recipients must request written approval before incurring the costs. This restriction also applies to costs intended to meet cost-share requirements. FPAC agencies will not approve expenses incurred more than 90 calendar days before the period of performance start date. All costs incurred before the period of performance start date, even if approved, are at the recipient's risk (i.e., the Federal awarding agency is under no obligation to reimburse such costs if for any reason the recipient does not receive a Federal award or if the Federal award is less than anticipated and inadequate to cover such costs). b. Revisions to scope, objective, or deliverables.—When it is necessary to modify the scope, objective, or deliverables of an award, the recipient authorized signatory must submit a written request and justification for the change along with the revised scope, objective, or deliverables of the award to the administrative contact. The request should contain the following information: 1. Grant or agreement number 2. Narrative explaining the requested modification to the project scope, objectives, or deliverables 3. A description of the revised scope, objectives, or deliverables

c. Additions or changes to subawards and contracts.—The subawarding, transferring, or contracting out of any work under a Federal award not identified in the original award budget or any changes to subaward or contracts requires prior written approval. The recipient must submit a justification for the proposed subaward/contract, a statement of work to be performed, and a detailed budget for the subaward/contract to the administrative contact. This provision does not apply to the acquisition of supplies, material, equipment, or general support services. d. Change in a key person specified in the application or award.—When there is a change in key personnel, the recipient must request prior written approval for the substitution or change. The request must identify the replacement personnel and provide his or her qualifications.

e. Absence or change in project leadership.—If the approved project director or principal investigator disengages from the project for more than three months or reduces time devoted to the project by 25 percent or more, the recipient must notify the administrative contact in writing, identifying who will be in charge during the project director's absence. The notification must include the qualifications of the replacement.

f. Budget revisions.—Recipients must request prior written approval for deviations from the approved budget in the instances described below. For all budget revisions, the recipient must submit a new SF 424A or 424C and budget narrative to support the request. 1. The inclusion of costs that require prior approval in accordance with Subpart E—Cost Principles of this part or 45 CFR part 75 Appendix IX, "Principles for Determining Costs Applicable to Research and Development under Awards and Contracts with Hospitals," or 48 CFR part 31, "Contract Cost Principles and Procedures," as applicable. 2. Where the cumulative amount of transfers of funds among direct cost categories or programs, functions, and activities exceeds or is expected to exceed 10 percent of the total budget as last approved by the Federal awarding agency, and where the Federal share of the project exceeds the simplified acquisition threshold. 3. The transfer of funds budgeted for participant support costs to other categories of expense requires prior written approval. Participant support costs means direct costs for items such as stipends or subsistence allowances, travel allowances, and registration fees paid to or on behalf of participants or trainees (but not employees) in connection with conferences or training projects. 4. Changes in the approved cost-sharing or matching provided by the recipient. 5. Additional Federal funds needed to complete the project. 6. Changes to negotiated indirect cost rates during the award period of performance. 7. Equipment purchases not specifically identified in the approved budget.

g. No-Cost Extensions of Time.—When a no-cost extension of time is required, the recipient authorized signatory must submit a written request to the FPAC administrative contact. Except in very limited circumstances, a no-cost extension of time cannot exceed 12 months. FPAC cannot approve requests for no-cost extensions received after the expiration of the award. In addition, time may not allow extension requests submitted less than 30 calendar days before the period of performance end date to be processed, so recipients are encouraged to submit requests as soon as possible. FPAC agencies cannot approve no-cost extensions requested merely to expend remaining funds. The request must contain the following: 1. Amount of additional time requested 2. Explanation for the need for the extension 3. A summary of progress to date and revised milestones

IV. PAYMENTS

a. Recipients must request reimbursement or advances using a properly completed and executed SF-270, submitted with supporting documentation to either the ezFedGrants system or to the e-mail address specified in the statement of work. FPAC agencies will make payment to the recipient on a reimbursable or advance basis in accordance with the frequency specified in the statement of work.

b. Recipients requesting advances should request payments in amounts necessary to meet their current needs pursuant

to procedures contained in the Federal administrative provisions and 31 CFR Part 205. At the end of each advance period, the recipient must provide a justification (i.e., documentation) showing the amount of advanced funds spent.

c. The method of payment between the recipient and its contractors will be in accordance with the policies and procedures established by the recipient except that the contractors may not use the USDA Office of Financial Management/National Finance Center method to request payments. If the recipient makes advance payments to contractors, the recipient must ensure that the timing of such payments is designed to minimize elapsed time between the advance payment and the disbursement of funds. Recipients must not submit requests from their contractors for review or approval.

d. Accounting records for all costs incurred under this award must be supported by source documentation. Such documentation includes, but is not limited to, canceled checks, paid bills, payroll records, and subaward documents. Labor cost charges to this award must be based upon salaries actually earned and the time actually worked on this award. All project costs must be incurred within the approved project period of this award, including any approved no-cost extension of time. Costs that cannot be supported by source documentation or that are incurred outside of the approved project period and budget may be disallowed and may result in award funds being returned to the Federal Government by the recipient. The level of detail and documentation required to be provided to support any individual payment request is at the discretion of the Government.

e. Recipients must pay all costs incurred (i.e., liquidate obligations) under the award not later than 90 calendar days after the period of performance end date.

V. FINANCIAL REPORTING

a. Recipients must submit a Federal Financial Report (FFR), SF 425 in accordance with the schedule included in the award statement of work. Recipients must submit reports to either the ezFedGrants system or to the email address specified in the statement of work. Failure to submit reports as required may result in suspension or termination of award.

b. The recipient must submit a final financial report no later than 90 days after the period of performance end date. c. The FPAC awarding agency will withhold payments under this award if the recipient is delinquent in submitting required reports.

VI. PERFORMANCE MONITORING AND REPORTING

a. The recipient is responsible for monitoring day-to-day performance and for reporting to FPAC. If the project involves subaward/contractual arrangements, the recipient is also responsible for monitoring the performance of project activities under those arrangements to ensure that approved goals and schedules are met.

b. The recipient must submit a written progress report at the frequency specified in the statement of work to either the ezFedGrants system or to the email address specified in the statement of work. Each report must cover— 1. A comparison of actual accomplishments with the goals and objectives established for the reporting period and, where project output can be quantified, a computation of the costs per unit of output.

2. The reasons why goals and objectives were not met, if appropriate.

3. Additional pertinent information including, where appropriate, analysis and explanation of cost overruns or high unit costs.

c. The recipient must submit a final performance report within 90 calendar days of the period of performance end date. d. The FPAC awarding agency will withhold payments under this award if the recipient is delinquent in submitting required reports.

VII. AUDIT REQUIREMENTS

The recipient is responsible for complying with audit requirements in accordance with 2 CFR 200, Subpart F. A recipient entity that expends \$750,000 or more during the recipient's fiscal year in Federal awards must have a single or program-

specific audit conducted for that year.

VIII. SPECIAL PROVISIONS

a. The recipient assures and certifies that it will comply with the minimum-wage and maximum- hour provisions of the Federal Fair Labor Standards Act.

b. Employees of FPAC agencies will participate in efforts under this agreement solely as representatives of the United States. They may not participate as directors, officers, employees, or otherwise serve or hold themselves out as representatives of the recipient. They also may not assist the recipient with efforts to lobby Congress or to raise money through fundraising efforts. Further, FPAC employees must report to their immediate supervisor any negotiations with the recipient concerning future employment and must refrain from participation in projects or agreements with such recipients.

c. Employees of the recipient will not be considered Federal employees or agents of the United States for any purposes under this agreement. d. Except in very limited circumstances (e.g., construction agreements), no agreement period of performance can exceed a total of five years, including extensions. e. Recipients who engage or assist in scientific related activities on behalf of USDA must uphold the principles of scientific integrity established by Departmental Regulations 1074-001, Scientific Integrity. Covered activities include engaging in, supervising, managing, and reporting scientific work; analyzing and publicly communicating information resulting from scientific work; and utilizing information derived from scientific work in policy and decision making. f. Recipients of awards under covered programs (as defined in Executive Order 13858, January 31, 2019) are hereby notified that they are encouraged to use, to the greatest extent practicable, iron and aluminum as well as steel, cement, and other manufactured products produced in the United States in every contract, subcontract, purchase order, or subaward that is chargeable under the award. "Covered program" means a program that provides financial assistance for the alteration, construction, conversion, demolition, extension, improvement, maintenance, construction, rehabilitation, or repair of an infrastructure project in the United States. However, it does not include programs for which a domestic preference is inconsistent with law or programs providing financial assistance that are subject to comparable domestic preferences. g. The recipient and its employees are prohibited from promoting, recommending, or discussing the availability of specific commercial products or services with FPAC agency clients in the course of carrying out activities under this agreement, including any products or services offered by the recipient, except as may be specifically allowed in the agreement.

IX. PATENTS, INVENTIONS, COPYRIGHTS, AND ACKNOWLEDGMENT OF SUPPORT AND DISCLAIMER

a. Allocation of rights of patents, inventions, and copyrights must be in accordance with 2 CFR Part 200.315. This regulation provides that small businesses normally may retain the principal worldwide patent rights to any invention developed with USDA support.

b. In accordance with 37 CFR Section 401.14, each subject invention must be disclosed to the Federal agency within 2 months after the inventor discloses it in writing to contractor personnel responsible for patent matters. Invention disclosure statements pursuant to 37 CFR Section 401.14(c) must be made in writing to:

Farm Production and Conservation Business Center Grants and Acquisitions Division 1400 Independence Avenue, SW.
Room 6819 South Building Washington, DC 20250

c. USDA receives a royalty-free license for Federal Government use, reserves the right to require the patentee to license others in certain circumstances, and requires that anyone exclusively licensed to sell the invention in the United States must manufacture it domestically.

d. The following acknowledgment of USDA support must appear in the publication of any material, whether copyrighted or not, and any products in electronic formats (World Wide Web pages, computer programs, etc.) that is substantially based upon or developed under this award:

"This material is based upon work supported by the U.S. Department of Agriculture, under agreement number [recipient should enter the applicable award number here]."

In addition, all publications and other materials, except scientific articles or papers published in scientific journals, must include the following statement:

"Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture. In addition, any reference to specific brands or types of products or services does not constitute or imply an endorsement by the U.S. Department of Agriculture for those products or services."

e. All publications printed with Federal Government funds will include the most current USDA nondiscrimination statement, available from the Public Affairs Division, Civil Rights Division, or on the USDA home page. If the material is too small to permit the full nondiscrimination statement to be included, the material must, at a minimum, include the statement:

“USDA is an equal opportunity provider and employer.”

The recipient is responsible for ensuring that an acknowledgment of USDA is made during news media interviews, including popular media such as radio, television, and news magazines, that discuss work funded by this award in a substantial way.

X. COST-SHARING REQUIREMENTS

a. If the award has specific cost-sharing requirements, the cost-sharing participation in other projects may not be counted toward meeting the specific cost-share requirement of this award and must come from non-Federal sources unless otherwise stated in the applicable program authorizing statute. b. Cost share must be documented on each SF 425 and SF 270 and in source documentation as it is provided by the recipient or third party. The required cost-share or matching ratio must be met by the end of the agreement period of performance; however, it does not have to be maintained for every payment request.

c. Should the recipient become aware that it may be unable to provide the cost-sharing amount identified in this award, it must— 1. Immediately notify the FPAC administrative contact of the situation. 2. Specify the steps it plans to take to secure replacement cost sharing. 3. Indicate the plans to either continue or phase out the project in the absence of cost sharing. If the recipient's plans are not acceptable to FPAC, the award may be subject to termination. FPAC modifications to proposed cost sharing revisions are made on a case-by-case basis. Failure by the recipient to notify FPAC in accordance with this section may result in the disallowance of some or all the costs charged to the award, the subsequent recovery by FPAC of some of the FPAC funds provided under the award, and possible termination of the award. It may constitute a violation of the terms and conditions of the award so serious as to provide grounds for subsequent suspension or debarment.

d. The recipient must maintain records of all project costs that are claimed by the recipient as cost sharing as well as records of costs to be paid by FPAC. If the recipient's cost participation includes in-kind contributions, the basis for determining the valuation for volunteer services and donated property must be documented.

e. Recipients must provide notification to the agency administrative contact when adding or replacing sources of cost-share contributions.

XI. PROGRAM INCOME

Program income is the gross revenue generated by a Federally funded activity earned during the performance period of the award. Program income may be earned by recipients from fees charged for conference or workshop attendance, from rental fees earned from real property or equipment acquired with Federal funds, or from the sale of commodities or items developed under the grant or cooperative agreement. It must fall within the guidelines at 2 CFR 200.307. Unless identified and addressed in the award, the recipient must provide notification to the administrative contact and request the manner it would like to treat the income (i.e., deductive or additive). Program income may be used to meet recipient cost-share requirements with the approval of the Government. All program income must be reported on the applicable SF 270 and SF 425.

XII. NONEXPENDABLE EQUIPMENT

Recipients purchasing equipment or products with funds provided under this award are encouraged to purchase only American-made equipment and products. Title to nonexpendable equipment purchased with award funds will vest in the recipient upon completion of the award project and acceptance by FPAC of required final reports. When equipment is no longer needed by the recipient and the per-unit fair market value is less than \$5,000, the recipient may retain, sell, or dispose of the equipment with no further obligation to FPAC. However, if the per-unit fair market value is \$5,000 or more, the recipient must submit a written request to the FPAC administrative contact for disposition instructions.

XIII. LIMIT OF FEDERAL LIABILITY

The maximum financial obligation of FPAC to the recipient is the amount of funds indicated in the award as obligated by FPAC. However, if an erroneous amount is stated on the approved budget, or any supporting document relating to the award, FPAC will have the unilateral right to make the correction and to make an appropriate adjustment in the FPAC share of the award to align with the Federal amount authorized.

XIV. MODIFICATIONS AND TERMINATIONS

The parties may amend this award through an exchange of correspondence between the authorized signatory of each or via formal amendment document. The award is subject to termination if FPAC determines that the recipient has failed to comply with the terms and conditions of the award. If the award is terminated, the guidelines at 2 CFR 200.339-42 will govern the obligations of the parties.

XV. PRIVACY ACT AND PROHIBITION AGAINST CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS

a. Activities performed under this award may involve access to confidential and potentially sensitive information about governmental and landowner issues. The term "confidential information" means proprietary information or data of a personal nature about an individual, or information or data submitted by or pertaining to an organization. This information must not be disclosed without the prior written consent of FPAC.

b. The recipient's personnel will follow the rules and procedures of disclosure set forth in the Privacy Act of 1974, 5 U.S.C. Section 552a, and implementing regulations and policies with respect to systems of records determined to be subject to the Privacy Act. The recipient's personnel must also comply with privacy of personal information relating to natural resources conservation programs in accordance with section 1244 of Title II of the Farm Security and Rural Investment Act of 2002 (Public Law 107-171).

c. The recipient agrees to comply with the "Prohibition Against Certain Internal Confidentiality Agreements:"

1. You may not require your employees, contractors, or subrecipients seeking to report fraud, waste, or abuse to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting them from lawfully reporting that waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information. 2. You must notify your employees, contractors, or subrecipients that the prohibitions and restrictions of any internal confidentiality agreements inconsistent with paragraph (1) of this award provision are no longer in effect. 3. The prohibition in paragraph (1) of this award provision does not contravene requirements applicable to any other form issued by a Federal department or agency governing the nondisclosure of classified information. 4. If FPAC determines that you are not in compliance with this award provision, FPAC: i. Will prohibit your use of funds under this award, in accordance with sections 743 and 744 of Division E of the Consolidated Appropriations Act, 2016, (Pub. L. 114-113) or any successor provision of law; ii. May pursue other remedies available for your material failure to comply with award terms and conditions. XVI. ACKNOWLEDGMENT OF SECTION 1619 COMPLIANCE

The recipient agrees to comply with FPAC guidelines and requirements regarding the disclosure of information protected under Section 1619 of the Food, Conservation, and Energy Act of 2008 (PL 110-246), 7 U.S.C. 8791 as described below.

a. Responsibilities. 1. Acceptance of this award indicates acknowledgment and understanding that the recipient is legally bound by Federal statute to comply with the provisions of Section 1619 and that the recipient will not subsequently disclose information protected by section 1619 to any individual or organization that is not directly covered by this award. Any such subsequent disclosure of the protected information (except as permitted under Section 1619) will be considered a violation of Section 1619. The recipient will be held responsible should disclosure of the protected information occur.

2. Acceptance of this award legally binds every owner, manager, supervisor, employee, contractor, agent, and representative of the recipient to comply with the provisions in Section 1619. The recipient must consult with FPAC prior to providing protected information to an entity or individual outside of the recipient and as necessary to implement the program to ensure that such release is permissible.

3. The recipient will use the protected information only to perform work that is directly connected to this award. Use of the protected information to perform work that is not directly connected to this award is expressly prohibited.

4. The recipient must internally restrict access to the protected information to only those individuals who have a demonstrated need to know the protected information to perform work under this award.

5. The provisions in Section 1619 are continuing obligations. Even when the recipient is no longer a recipient, or when individuals currently affiliated with the recipient become no longer so affiliated, every person having been provided access to the protected information will continue to be legally bound to comply with these provisions.

6. The recipient must notify all managers, supervisors, employees, contractors, agents, and representatives about this provision and the requirements of Section 1619. Notifications about the existence of this provision must be made to those individuals who are new to the organization and periodic notifications must be sent throughout the organization (as well as to all contractors and agents) to remind all about the ongoing and continuing requirements.

7. When the recipient is unsure whether particular information is covered or protected by Section 1619, the recipient must consult with FPAC to determine whether the information must be withheld.

8. Use of the protected information for any purpose is expressly prohibited after the period of performance end date of this award. Upon the award end date, any protected information provided under this award must be immediately destroyed or returned to FPAC. The recipient must provide to FPAC written certification that the protected information (paper copy, electronic copy, or both) has been properly destroyed, removed from any electronic storage media, or both.

9. Any State's "sunshine law," "open records act" or other version of the Freedom of Information Act is superseded by section 1619 under the Supremacy Clause of the U.S. Constitution. Accordingly, information protected from disclosure by section 1619 must not be released under such State laws.

b. Protected Information.

1. Examples of the types of information prohibited by disclosure under Section 1619 include, but are not limited to, the following:

i. State identification and county number (where reported and where located). ii. Producer or landowner name, business full address, phone number, Social Security Number, and similar personal identifying information. iii. Farm, tract, field, and contract numbers. iv. Production shares and share of acres for each Farm Serial Number (FSN) field. v. Acreage information, including crop codes. vi. All attributes for Common Land Units (CLUs) in USDA's Geospatial Information System. vii. Any photographic, map, or geospatial data that, when combined with other maps, can be used to identify a landowner. viii. Location of conservation practices.

2. Section 1619 allows disclosure of "payment information (including payment information and the names and addresses of recipients of payments) under any Department program that is otherwise authorized by law" (emphasis added). The names and payment information of producers generally may be provided to the public; however, the recipient shall consult with FPAC if there is any uncertainty as to the provision of such information.

3. Section 1619 also allows disclosure of otherwise protected information if "the information has been transformed into a statistical or aggregate form without naming any—(i) individual owner, operator, or producer; or (ii) specific data gathering site." The recipient must consult with FPAC as to whether specific information falls within this exception prior to relying on this exception.

c. Violations. The recipient will be held responsible for violations of this provision and Section 1619. A violation of this provision by the recipient may result in action by FPAC, including termination of the underlying Federal award.

d. Effective Period. The requirements of this provision is effective on the date of the final signature and will continue until FPAC notifies the recipient that it is no longer required based on changes in applicable Federal law.

XVII. AWARD CLOSEOUT

a. Award closeout is the process by which FPAC determines that all required project activities have been performed satisfactorily and all necessary administrative actions have been completed. b. The recipient must submit, no later than 90 calendar days after the end date of the period of performance, all financial, performance, and other reports as required by the terms and conditions of the agreement, including documentation showing that match or cost-share requirements have been met. The awarding agency may approve extensions when requested by the recipient. c. Unless the awarding agency authorizes an extension, the recipient must liquidate all obligations incurred under the agreement not later than 90 calendar days after the end date of the period of performance. d. Recipients must submit all requests for reimbursements no later than 90 calendar days after the end date of the period of performance. e. The recipient must promptly refund any balances of unobligated cash that the awarding agency paid in advance or paid and that are not authorized to be retained by the recipient for use in other projects. See OMB Circular A-129 and see §200.345 Collection of amounts due, for requirements regarding unreturned amounts that become delinquent debts. f. Recipients must retain all records pertaining to the agreement in accordance with 2 CFR 200.333-337 and any additional requirements included in the agreement statement of work. g. Recipients must follow disposition requirements for property acquired with award funds in accordance with 2 CFR 200.310-316.

**THE CITY OF GREELEY,
a Colorado home rule municipal corporation**

DocuSigned by:
By: Roy Otto
D93D100AE64B4E6...
City Manager

Date: 10/22/2020

Approved as to Legal Form:

DocuSigned by:
By: Doug Marek
FE617506B21B4AA...
City Attorney

As to Availability of Funds:

DocuSigned by:
By: Robert Miller
3CE4090199AB441...
Director of Finance

AGREEMENT ID: TBD 600000XXXX
SPONSOR: Larimer County
PROJECT: Larimer County 2020 EWP

EMERGENCY WATERSHED PROTECTION PROGRAM STATEMENT OF WORK

PURPOSE

The purpose of this agreement is for the United States Department of Agriculture, Natural Resources Conservation Service, hereinafter referred to as the "NRCS", to provide technical and financial assistance to the Larimer County, hereinafter referred to as the "Sponsor", for EWP Project # 5084 in Larimer County, Colorado for implementation of recovery measures, that, if left undone, pose a risk to life and/or property.

OBJECTIVES

The design and installation of EWP measures as detailed in the individual Damage Survey Reports (DSR) and described here:

- DSR 5084-001 - Erosion & sedimentation prevention, debris removal, structure protection from the threat of future flooding due to the Cameron Peak Fire.

BUDGET NARRATIVE

A. The estimated costs for the Project:

1. Total Estimated Project Budget: \$2,550,000

The budget includes:

Financial Assistance (FA) Costs:

Construction Costs (80% NRCS \$1,920,000 + 20% Sponsor \$480,000): \$2,400,000

Technical Assistance (TA) Costs:

100% NRCS (not to exceed): \$150,000

2. NRCS reimburses up to 80 percent of eligible construction costs and Sponsor pays 20 percent of construction costs. NRCS will contribute up to \$150,000 for contract administration and construction management costs. It is possible that technical and administrative costs will exceed this amount, requiring the Sponsor to contribute resources to complete technical and administrative work
3. NRCS funding for this project is provided to the Sponsor in two separate NRCS funding accounts, one for financial assistance (FA) and one for technical assistance (TA). FA costs are associated with construction activities; TA costs are associated with services. These expenditures shall be accounted for separately in order for expenses to be eligible for reimbursement.
4. NRCS will provide FA for actual costs as reimbursement to the Sponsor for approved on-the-ground construction costs, subject to above limits. If costs are reduced, reimbursement will be reduced accordingly. Construction costs are associated with the installation of the project measures including labor, equipment and materials.

AGREEMENT ID: TBD 600000XXXX

SPONSOR: Larimer County

PROJECT: Larimer County 2020 EWP

5. NRCS will provide TA reimbursement to the Sponsor for technical and administrative costs directly charged to the project, subject to the above limits. If costs are reduced, reimbursement will be reduced accordingly. These costs include
 - a. engineering costs include, but not limited to, developing a project design that includes construction drawings and specifications, an operation and maintenance plan, a quality assurance/inspection plan and an engineer's estimate of the project installation costs in addition to providing necessary quality assurance during construction.
 - b. contract administration costs include, but not limited to, soliciting, evaluating, awarding and administering contracts for construction and engineering services, including project management, verifying invoices and record keeping.
6. The Sponsor will contribute funds toward the total construction costs in either direct cash expenditures, the value of non-cash materials or services, or in-kind contributions. The value of any in-kind contribution shall be agreed to in writing prior to implementation.

RESPONSIBILITIES OF THE PARTIES

A. Sponsor will—

1. Accomplish construction of the EWP project measures by contracting, in-kind construction services, or a combination of both.
2. Ensure and certify by signing this agreement that its cost share obligation is from a non-Federal source.
3. Comply with the terms and conditions of this agreement and the attached general terms and conditions except those that are not applicable to State and local governments.
4. Acquire adequate real property rights (land and water), permits and licenses in accordance with local, state, and Federal laws necessary for the installation of EWP project measures at no cost to NRCS prior to construction. This includes any rights associated with required environmental mitigation. Costs related to land rights and permits are the Sponsor's responsibility and ineligible for reimbursement.
5. Accept all financial and other responsibility for excess costs resulting from their failure to obtain, or their delay in obtaining, adequate land and water rights, permits and licenses needed for the Project.
6. Provide the agreed-to portion of the actual, eligible and approved construction cost. These costs may be in the form of cash, in-kind construction services, or a combination of both. Final construction items that are eligible construction costs will be agreed upon during the pre-design conference. These costs consist of costs from contracts awarded to contractors and eligible Sponsor in-kind construction costs for materials, labor, and equipment. The Sponsor shall provide NRCS documentation to support all eligible construction costs.

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Construction costs incurred prior to the Sponsor and NRCS signing this agreement are ineligible and will not be reimbursed.

7. Be responsible for 100 percent of all ineligible construction costs and 100 percent of any unapproved upgrade to increase the level of protection over and above that described in the engineering plans.
8. Account for and report FA and TA expenditures separately in order for expenses to be eligible for reimbursement. NRCS funding for this project is provided to the Sponsor in two separate NRCS funding accounts, one for TA and one for FA, requiring this separation.
9. The contracts for design services and construction described in this Agreement shall not be awarded to the Sponsor or to any firm in which any Sponsor's official or any member of such official's immediate family has direct or indirect interest in the pecuniary profits or contracts of such firms. Reference 2 CFR § 200.318 regarding standards of conduct covering conflicts of interest and governing the performance of its employees engaged in the selection, award, and administration of contracts.
10. For in-kind construction services (materials, labor, and/or equipment supplied by the Sponsor), develop a Plan of Operations describing the construction services to be performed including estimated quantities and values. The Plan of Operations shall be concurred in by NRCS at the pre-design conference. In-kind construction services for equipment shall not exceed published FEMA equipment rates unless otherwise documented and concurred in advance by NRCS.
11. The following documentation is required to support the Sponsor's request for reimbursement of in-kind construction services:
 - a. Invoices covering actual costs of materials used in constructing the eligible EWP project measures.
 - b. Records documenting the type, quality, and quantities of materials actually used in constructing the eligible EWP project measures.
 - c. Daily time records for each employee showing name, classification, wage rate, hours, and dates actually employed for constructing the eligible EWP project measures.
 - d. Equipment operating records showing the type and size of equipment, hourly rate, actual hours of operation and dates used to install the eligible EWP project measures. Equipment idle time is not eligible in-kind construction services, even if on the job site, and should not be included in the equipment operating records.
12. Ensure that any special requirements for compliance with environmental and/or cultural resource laws are incorporated into the project.
13. The Sponsor must secure at its own expense all Federal, State, and local permits and licenses necessary for completion of the work described in this agreement as well as any necessary natural resource rights and provide copies of all permits and licenses obtained to NRCS.

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14. Will arrange and pay for any necessary location, removal, or relocation of utilities. EWP program regulations prohibit NRCS from reimbursing the Sponsor or otherwise paying for any such costs; nor do the costs qualify as a Sponsor cost-share contribution.
15. Ensure that technical and engineering standards and specifications of NRCS are adhered to during construction of the Project, as interpreted by NRCS State Conservation Engineer. Provide NRCS State Conservationn Engineer and Program/Technical Contact progress reports as necessary and agreed to. Progress reports should include technical on-site inspections of work accomplished for the period, work planned, results of material tests, deficient work products and/or tests with corrective actions taken, modifications anticipated, technical problems encountered, contractual issues and other relevant information.
16. Ensure that all contractors on NRCS assisted projects are performing their work in accordance with OSHA regulations and the Contract Work Hours and Safety Standards Act (40 USC 3701-3708) as supplemented by Department of Labor regulations (29 CFR Part 5). The Sponsor is responsible for periodically checking the contractor's compliance with safety requirements.
17. Provide a Colorado registered PE-certified as-built drawings and quantities for the project. A copy of the as-built drawings will be submitted to the NRCS State Conservation Engineer and Program/Technical Contact.
18. Pay the contractor(s) for work performed in accordance with the agreement and submit a SF-270, "Request for Advance or Reimbursement" to the Program/Technical Contact with all documentation to support the request. Final payment request shall be submitted within 90 calendar days of completion of the EWP project measures. Payments will be withheld until all required documentation is submitted and complete.
 - a. The **required supporting documentation for reimbursement of construction costs** include invoices and proof of payment to the contractor showing the items and quantities installed and certified by the engineer of record along with any supporting documentation such as quantity calculations, rock weight tickets, etc.
 - b. The **required supporting documentation for reimbursement of in-kind construction expenses** will include employee time sheets, employee hourly rate, equipment operating logs, equipment hourly rate, and material quantities and invoices.
 - c. The **required documentation for reimbursement of technical and administrative services** will be invoices and proof or payment to consultants and/or employee time sheets along with the employee's hourly rate, hours worked, and date work was performed.
19. Ensure that information in the System for Award Management (SAM) is current and accurate until the final financial report (SF-425) under this award or final payment is received, whichever is later.

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20. Take reasonable and necessary actions to dispose of all contractual and administrative issues arising out of the contract(s) awarded under this Agreement. This includes, but is not limited to disputes, claims, protests of award, source evaluation, and litigation that may result from the Project. Such actions will be at the expense of the Sponsor, including any legal expenses. The Sponsor will advise, consult with, and obtain prior written concurrence of NRCS on any litigation matters in which NRCS could have a financial interest.
21. Sponsor must indemnify and hold NRCS harmless to the extent permitted by State law for any costs, damages, claims, liabilities, and judgments arising from past, present, and future acts or omissions of the Sponsor in connection with its acquisition and management of the Emergency Watershed Protection Program pursuant to this agreement. Further, the Sponsor agrees that NRCS will have no responsibility for acts and omissions of the Sponsor, its agents, successors, assigns, employees, contractors, or lessees in connection with the acquisition and management of the Emergency Watershed Protection Program pursuant to this agreement that result in violation of any laws and regulations that are now or that may in the future become applicable.
22. Retain all records dealing with the award and administration of the contract(s) for 3 years from the date of the Sponsor's submission of the final request for reimbursement or until final audit findings have been resolved, whichever is longer. If any litigation is started before the expiration of the 3-year period, records are to be retained until the litigation is resolved or the end of the 3-year period, whichever is longer. Make such records available to the Comptroller General of the United States or his or her duly authorized representative and accredited representatives of the Department of Agriculture or cognizant audit agency for the purpose of making audit, examination, excerpts, and transcriptions.
23. Be liable to the NRCS for damages sustained by the NRCS as a result of the contractor failing to complete the work within the specified time. The damages will be based upon the additional costs incurred by the NRCS resulting from the contractor not completing the work within the allowable performance period. These costs include but are not limited to personnel costs, travel, etc. The NRCS will have the right to withhold such amount out of any monies that may be then due or that may become due and payable to the Sponsor. This liability is not applicable to the extent that the contract performance time is extended by court judgment unless such judgment results from actions of the Sponsor not concurred in by NRCS.
24. Take necessary legal action, including bringing suit, to collect from the contractor any monies due in connection with the contract, or upon request of NRCS, assign and transfer to NRCS any or all claims, demands, and causes of action of every kind whatsoever that the Sponsor has against the contractor or his or her sureties.
25. Submit performance reports on a quarterly basis to the Program/Technical Contact and/or to the Farm Production and Conservation (FPAC) Grants and Agreements Division staff via email to: FPAC.BC.GAD@usda.gov. Reports are due 30 calendar days after the reporting period and are based on the agreement period of performance start date.
26. Submit SF-425 Financial Reports on a semi-annual basis to the NRCS Program/Technical Contact and/or to the Farm Production and Conservation (FPAC) Grants and Agreements

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Division staff via email to: FPAC.BC.GAD@usda.gov. Reports are due 30 calendar days after the reporting period on July 31 and January 31. Please note that financial reporting is based on the calendar year.

27. Submit payment requests to the Program/Technical Contact and/or to the Farm Production and Conservation (FPAC) Grants and Agreements Division staff via email to: FPAC.BC.GAD@usda.gov. on a monthly basis. Refer to the General Terms and Conditions for more information regarding payment requests.

B. NRCS will—

1. Assist Sponsor in establishing design parameters; determine eligible construction costs during the pre-design conference.
2. Designate a Government Representative (GR) to serve as liaison with the Sponsor and identify that person's contact information with this executed agreement.
3. Review, comment and concur in preliminary and final plans, specifications, O&M Plan, Plan of Operations (if required) and QAP.
4. Make periodic site visits during the installation of the EWP project measures to review construction progress, document conformance to engineering plans and specifications, and provide any necessary clarification on the Sponsor's responsibilities.
5. Upon notification of the completion of the EWP project measures, NRCS shall promptly review the performance of the Sponsor to determine if the requirements of this agreement and fund expenditures as agreed have been met.
6. Make payment to the Sponsor covering NRCS' share of the cost upon receipt and approval of Form SF-270 and supporting documentation, withholding the amount of damages sustained by NRCS as provided for in this agreement. In the event there are questions regarding the SF 270 and supporting documentation, NRCS will contact the Sponsor in a timely manner to resolve concerns.

C. MUTUALLY AGREED

1. The furnishing of financial, administrative, and/or technical assistance above the original funding amount by NRCS is contingent on there being sufficient unobligated and uncommitted funding in the Emergency Watershed Protection Program that is available for obligation in the year in which the assistance will be provided. NRCS may not make commitments in excess of funds authorized by law or made administratively available. Congress may impose obligational limits on program funding that constrains NRCS's ability to provide such assistance.
2. In the event of default of a construction contract awarded pursuant to this agreement, any additional funds properly allocable as construction costs required to ensure completion of the job are to be provided in the same ratio as construction funds are contributed by the parties under the terms of this agreement. Any excess costs including interest resulting from a judgment collected from the

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defaulting contractor, or his or her surety, will be prorated between the Sponsor and NRCS in the same ratio as construction funds are contributed under the terms of the agreement.

3. Additional funds, including interest properly allocable as construction costs as determined by NRCS, required as a result of decision of the CO or a court judgment in favor of a claimant will be provided in the same ratio as construction funds are contributed under the terms of this agreement. NRCS will not be obligated to contribute funds under any agreement or commitment made by the Sponsor without prior concurrence of NRCS.
4. The State Conservationist may make adjustments in the estimated cost to NRCS set forth in this agreement for constructing the EWP measures. Such adjustments may increase or decrease the amount of estimated funds that are related to differences between such estimated cost and the amount of the awarded contract or to changes, differing site conditions, quantity variations, or other actions taken under the provisions of the contract. No adjustment will be made to change the cost sharing assistance provided by NRCS as set forth in this agreement, nor reduce funds below the amount required to carry out NRCS' share of the contract.
5. Except for item 4. above (last sentence), this document may be revised as mutually agreed through a written amendment duly executed by authorized officials of all signatory parties to this agreement.
6. NRCS, at its sole discretion, may refuse to cost share should the Sponsor, in administering the contract, elect to proceed without obtaining concurrence as set out in this agreement.
7. Once the project is completed and all requests for reimbursement submitted, any excess funding remaining in the agreement will be de-obligated from the agreement.
8. If inconsistencies arise between the language in the Statement of Work (SOW) in the agreement and the general terms and conditions, the language in the SOW takes precedence.

EXPECTED ACCOMPLISHMENTS AND DELIVERABLES

1. Prepare design, construction specifications, and drawings in accordance with standard engineering principles that comply with NRCS programmatic requirements; and/or contract/install the designed construction. Any design services will be by a professional State of Colorado registered engineer. Sponsor will obtain NRCS review and concurrence on the design, construction plans, and specifications. The Sponsor must ensure description of work is reviewed, concurred, and approved by NRCS. A copy of the final signed and sealed plans and specifications shall be provided to the NRCS State Conservation Engineer.
2. Contract for services and construction in accordance with the Code of Federal Regulations (CFR), 2 CFR § 200.317 through 200.326, applicable State regulations, and the Sponsor's procurement regulations, as appropriate. (See general terms and conditions attached to this agreement for a link to the CFR.) In accordance with 2 CFR § 200.326, contracts must contain the applicable provisions described in Appendix II to Part 200. Davis-Bacon Act would not apply under this Federal program legislation.

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3. Provide copies of site maps to appropriate Federal and State agencies for environmental review. Sponsor will notify NRCS of environmental clearance, modification of construction plans, or any unresolved concerns as well as copies of all permits, licenses, and other documents required by Federal, state, and local statutes and ordinances prior to solicitation for installation of the EWP project measures. All modifications to the plans and specifications shall be reviewed and concurred on by NRCS.
4. Prepare and submit to the NRCS State Conservation Engineer for NRCS concurrence an Operation and Maintenance (O&M) Plan, if applicable, prior to commence of work. The O&M Plan shall describe the activities the Sponsor will do to ensure the project performs as designed. Upon completion of the project measures, the Sponsor shall assume responsibility for O&M.
5. Prior to commencement of work and/or solicitation of bids, submit to the NRCS State Conservation Engineer for NRCS review and concurrence a Quality Assurance Plan (QAP). The QAP shall outline technical and administrative expertise required to ensure the EWP project measures are installed in accordance with the plans and specifications, identify individuals with the expertise, describe items to be inspected, list equipment required for inspection, outline the frequency and timing of inspection (continuous or periodic), outline inspection procedures, and record keeping requirements. A copy of the final QAP shall be provided to NRCS prior to commencement of construction.
6. Provide construction inspection in accordance with the QAP.
7. Arrange for and conduct final inspection of completed project with NRCS to determine whether all work has been performed in accordance with contractual requirements. Provide a State of Colorado registered PE certification that the Project was installed in accordance with approved plans and specifications.

RESOURCES REQUIRED:

As stated in this agreement.

MILESTONES

Milestones shall include, but not limited to, the following items:

1. Pre-construction design conference within 45 days of signing agreement.
2. Submit to NRCS a schedule with time lines of major items to be completed within 30 days of the pre-design conference.
3. Acquire needed landowner permissions prior to start of construction and provide proof to NRCS.
4. Obtaining permits and provide to NRCS prior to the start of construction.
5. Completing any necessary surveys.
6. Completing draft engineering plans and specifications for NRCS review and concurrence.
7. Completing final engineering plans and specifications for NRCS review and approval.
8. Completing quality assurance plan for NRCS review and approval.
9. Solicit bids and provide to NRCS.
10. Award contract and provide to NRCS.

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11. Submit Request for Reimbursement (SF-270) with supporting documentation every 30 days.
12. Date of estimated completion of construction: May 13, 2013
13. Complete agreement close-out activities

Exhibit B
Participating Parties

The following local governmental entities are the principal parties to this Agreement, “Managing Entities”:

- CITY OF FORT COLLINS, COLORADO a home-rule municipality (“Fort Collins”) with principal offices at 300 LaPorte Avenue, Fort Collins, Colorado 80521
- CITY OF GREELEY, COLORADO, a home-rule municipality (“Greeley”) with principal offices of its Water and Sewer Department at 1001 11th Avenue, Second Floor, Greeley, Colorado 80631
- LARIMER COUNTY, COLORADO, a county subdivision of the State of Colorado (“Larimer County”) with principal offices at [...], Fort Collins, Colorado [...]

The following entities are Contributing Parties to this Agreement, whose obligations and contributions to the Work described in this Agreement may be different than those of the Managing Entities, as set forth in addenda to this Exhibit B:

- _____, with principal offices at [...]
(Organization Name)
- _____, with principal offices at [...]
(Organization Name)

(Form of Addendum to Add a Party)

***CONTRIBUTING PARTY ADDENDUM TO
AGREEMENT REGARDING REHABILITATION WORK
FOR THE CAMERON PEAK FIRE***

This Addendum, dated _____, 2020, is entered into by and between the Parties to the Agreement Regarding Rehabilitation Work for the Cameron Peak Fire (“Agreement”) and _____, a _____ (“New Party”).

1. The New Party has reviewed the Agreement as desires to become a “Contributing Party” thereto. The Parties to the Agreement agree to permit the New Party to become a Contributing Party to the Agreement for purposes of the following ☐ Category 1; ☐ Category 2 services:

[...]

2. The New/Contributing Party represents to the other Parties that it has the power and authority to enter into this Agreement and the individuals signing below on behalf of the New/Contributing Party have the authority to execute this Agreement on its behalf and legally bind the New/Contributing Party.

3. For purposes of Paragraph 11 of the Agreement, the contact information of the New/Contributing Party is:

To _____:

_____, a _____

By: _____

Date: _____

[Insert signature pages of other Parties]

Certificate Of Completion

Envelope Id: 2FDC2BC539E74EF1967B85C3E2588230

Status: Completed

Subject: Please DocuSign: Cameron Peak Fire IGA FC Greeley Larimer CO 04272021.pdf

Source Envelope:

Document Pages: 40

Signatures: 6

Envelope Originator:

Certificate Pages: 7

Initials: 0

Katherine Martinez

AutoNav: Enabled

215 N Mason Street

Envelopeld Stamping: Enabled

Fort Collins , CO 80522

Time Zone: (UTC-07:00) Mountain Time (US & Canada)

kamartinez@fcgov.com

IP Address: 198.59.47.100

Record Tracking

Status: Original

Holder: Katherine Martinez

Location: DocuSign

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kamartinez@fcgov.com

Signer Events

Roy Otto

Roy.Otto@Greeleygov.com

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(None)

Signature

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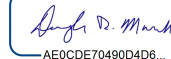
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Douglas Marek

Douglas.Marek@Greeleygov.com

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John Karner

john.karner@greeleygov.com

Security Level: Email, Account Authentication
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Darin Atteberry

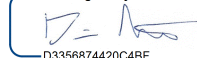
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City Manager

City of Fort Collins

Security Level: Email, Account Authentication
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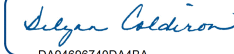
Delynn Coldiron
decoldiron@fcgov.com
City Clerk

City of Fort Collins – PDT Administration
Security Level: Email, Account Authentication (None)

Electronic Record and Signature Disclosure:

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Intermediary Delivery Events	Status	Timestamp
Certified Delivery Events	Status	Timestamp
Carbon Copy Events	Status	Timestamp

Jill Oropeza
joropeza@fcgov.com
Utilities Water QQuality Services
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Electronic Record and Signature Disclosure:
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Dawn Kennedy
dkennedy@fcgov.com
City of Fort Collins – PDT Administration
Security Level: Email, Account Authentication (None)
Electronic Record and Signature Disclosure:
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Melanie Clark
mclark@fcgov.com
City of Fort Collins - Neighborhood Services
Security Level: Email, Account Authentication (None)
Electronic Record and Signature Disclosure:
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Payment Events	Status	Timestamps
Electronic Record and Signature Disclosure		

ELECTRONIC RECORD AND SIGNATURE DISCLOSURE

From time to time, City of Fort Collins " Water Resources & Treatment Operations (we, us or Company) may be required by law to provide to you certain written notices or disclosures.

Described below are the terms and conditions for providing to you such notices and disclosures electronically through your DocuSign, Inc. (DocuSign) Express user account. Please read the information below carefully and thoroughly, and if you can access this information electronically to your satisfaction and agree to these terms and conditions, please confirm your agreement by clicking the 'I agree' button at the bottom of this document.

Getting paper copies

At any time, you may request from us a paper copy of any record provided or made available electronically to you by us. For such copies, as long as you are an authorized user of the DocuSign system you will have the ability to download and print any documents we send to you through your DocuSign user account for a limited period of time (usually 30 days) after such documents are first sent to you. After such time, if you wish for us to send you paper copies of any such documents from our office to you, you will be charged a \$0.00 per-page fee. You may request delivery of such paper copies from us by following the procedure described below.

Withdrawing your consent

If you decide to receive notices and disclosures from us electronically, you may at any time change your mind and tell us that thereafter you want to receive required notices and disclosures only in paper format. How you must inform us of your decision to receive future notices and disclosure in paper format and withdraw your consent to receive notices and disclosures electronically is described below.

Consequences of changing your mind

If you elect to receive required notices and disclosures only in paper format, it will slow the speed at which we can complete certain steps in transactions with you and delivering services to you because we will need first to send the required notices or disclosures to you in paper format, and then wait until we receive back from you your acknowledgment of your receipt of such paper notices or disclosures. To indicate to us that you are changing your mind, you must withdraw your consent using the DocuSign 'Withdraw Consent' form on the signing page of your DocuSign account. This will indicate to us that you have withdrawn your consent to receive required notices and disclosures electronically from us and you will no longer be able to use your DocuSign Express user account to receive required notices and consents electronically from us or to sign electronically documents from us.

All notices and disclosures will be sent to you electronically

Unless you tell us otherwise in accordance with the procedures described herein, we will provide electronically to you through your DocuSign user account all required notices, disclosures, authorizations, acknowledgements, and other documents that are required to be provided or made available to you during the course of our relationship with you. To reduce the chance of you inadvertently not receiving any notice or disclosure, we prefer to provide all of the required notices and disclosures to you by the same method and to the same address that you have given us. Thus, you can receive all the disclosures and notices electronically or in paper format through the paper mail delivery system. If you do not agree with this process, please let us know as described below. Please also see the paragraph immediately above that describes the consequences of your electing not to receive delivery of the notices and disclosures electronically from us.

How to contact City of Fort Collins – Water Resources & Treatment Operations:

You may contact us to let us know of your changes as to how we may contact you electronically, to request paper copies of certain information from us, and to withdraw your prior consent to receive notices and disclosures electronically as follows:

To contact us by email send messages to: kamartinez@fcgov.com

To advise City of Fort Collins – Water Resources & Treatment Operations of your new e-mail address

To let us know of a change in your e-mail address where we should send notices and disclosures electronically to you, you must send an email message to us at kamartinez@fcgov.com and in the body of such request you must state: your previous e-mail address, your new e-mail address. We do not require any other information from you to change your email address..

In addition, you must notify DocuSign, Inc to arrange for your new email address to be reflected in your DocuSign account by following the process for changing e-mail in DocuSign.

To request paper copies from City of Fort Collins – Water Resources & Treatment Operations

To request delivery from us of paper copies of the notices and disclosures previously provided by us to you electronically, you must send us an e-mail to kamartinez@fcgov.com and in the body of such request you must state your e-mail address, full name, US Postal address, and telephone number. We will bill you for any fees at that time, if any.

To withdraw your consent with City of Fort Collins – Water Resources & Treatment Operations

To inform us that you no longer want to receive future notices and disclosures in electronic format you may:

- i. decline to sign a document from within your DocuSign account, and on the subsequent page, select the check-box indicating you wish to withdraw your consent, or you may;
- ii. send us an e-mail to kamartinez@fcgov.com and in the body of such request you must state your e-mail, full name, US Postal Address, telephone number, and account number. We do not need any other information from you to withdraw consent.. The consequences of your withdrawing consent for online documents will be that transactions may take a longer time to process..

Required hardware and software

Operating Systems:	Windows2000? or WindowsXP?
Browsers (for SENDERS):	Internet Explorer 6.0? or above
Browsers (for SIGNERS):	Internet Explorer 6.0?, Mozilla FireFox 1.0, NetScape 7.2 (or above)
Email:	Access to a valid email account
Screen Resolution:	800 x 600 minimum
Enabled Security Settings:	•Allow per session cookies •Users accessing the internet behind a Proxy Server must enable HTTP 1.1 settings via proxy connection

** These minimum requirements are subject to change. If these requirements change, we will

provide you with an email message at the email address we have on file for you at that time providing you with the revised hardware and software requirements, at which time you will have the right to withdraw your consent.

Acknowledging your access and consent to receive materials electronically

To confirm to us that you can access this information electronically, which will be similar to other electronic notices and disclosures that we will provide to you, please verify that you were able to read this electronic disclosure and that you also were able to print on paper or electronically save this page for your future reference and access or that you were able to e-mail this disclosure and consent to an address where you will be able to print on paper or save it for your future reference and access. Further, if you consent to receiving notices and disclosures exclusively in electronic format on the terms and conditions described above, please let us know by clicking the 'I agree' button below.

By checking the 'I Agree' box, I confirm that:

- I can access and read this Electronic CONSENT TO ELECTRONIC RECEIPT OF ELECTRONIC RECORD AND SIGNATURE DISCLOSURES document; and
- I can print on paper the disclosure or save or send the disclosure to a place where I can print it, for future reference and access; and
- Until or unless I notify City of Fort Collins “Water Resources & Treatment Operations as described above, I consent to receive from exclusively through electronic means all notices, disclosures, authorizations, acknowledgements, and other documents that are required to be provided or made available to me by City of Fort Collins “Water Resources & Treatment Operations during the course of my relationship with you.

Scope of Work
Cameron Peak Wildfire Project Management Professional Services Agreement

The Program Manager will help lead CPRW, City of Greeley, and City of Fort Collins efforts to improve watershed health and resilience by coordinating stakeholders and managing projects related to fire mitigation and recovery on the Cameron Peak Fire. The Program Manager will lead the oversight, coordination, and management of post-wildfire related EWP projects and other wildfire mitigation and restoration projects and tasks on public and private lands. These projects will include a variety of hillslope stabilization projects to decrease erosion and sedimentation, including aerial and mechanical mulching, installation of wattles, seeding, tree felling, etc. While this position will be employed by CPRW, it will be funded and co-directed by the Cities of Greeley and Fort Collins (“Cities”).

The Program Manager will procure, oversee, and coordinate contractors, ensure completion of EWP and other contract requirements by the Cities, and coordinate and help implement field verification (mulching locations, coverage monitoring, and other specifications). This position will also be responsible for working with the United States Forest Service to acquire project permissions and will work with private landowners to implement projects on private land. This position will ensure that EWP and other post-fire milestones are met and will manage/adhere to project budgets. The Program Manager will work closely with CPRW staff, the Cities, other agencies, project design teams, researchers, landowners, and other identified stakeholders to manage implementation of priority projects. The Program Manager will also help coordinate staff to ensure individual project implementation occurs on schedule.

Component 1- Managing Emergency Watershed Protection program work

- Coordinating EWP project implementation and monitoring among partners and contractors.
- Establishing mapping polygons for setting treatment locations, verifying model outputs, and verifying treatment applications.
- Participating in and coordinating partners to conduct field verification program.
- Developing field safety and communications plans.
- Meeting EWP reporting requirements.
- Working with USFS to obtain permission approval for projects on federal lands.
- Coordinating project implementation with USFS on forest service lands.

Component 2- Coordinating Other Post Fire Restoration work

- Helping coordinate nonprofit partners working on post fire restoration on private lands.
- Helping coordinate post-fire volunteer projects on private lands with staff or nonprofit partners.
- Working with contractors and design teams to develop additional post-fire restoration project to complement ongoing EWP and other post-fire restoration work.

Component 3- Stakeholder and partner coordination

- Leading coordination of regular Cameron Peak Fire recovery subcommittee meetings (setting agendas, recording meeting notes, setting action items, etc.).
- Attending Larimer County Recovery Collaborative meetings to update partners on watershed.
- Helping manage shared data across recovery partners.

Component 4- Fundraising and Fund Management

- Developing and managing EWP and other relevant post fire project budgets.
- Managing and overseeing all relevant post-fire grant invoicing and reporting.
- Seeking additional grant or other funding as needed to ensure holistic and successful projects are completed.

Component 5- Community Outreach

- Helping organize and attend community meetings to keep the public and private landowners informed on post-fire work.
- Helping provide content for CPRW e-newsletter, social media, website regarding post-fire mitigation work.

CAMERON PEAK WILDFIRE
PROJECT MANAGEMENT PROFESSIONAL SERVICES AGREEMENT

This CAMERON PEAK WILDFIRE PROJECT MANAGEMENT PROFESSIONAL SERVICES AGREEMENT ("Agreement") is entered into this ____ day of _____ 2021 ("Effective Date"), by and between COALITION FOR THE Poudre RIVER WATERSHED, a Colorado nonprofit corporation ("CPRW") and THE CITY OF GREELEY, COLORADO, a Colorado home rule municipal corporation acting by and through its Water Enterprise ("City" or "Greeley").

Recitals

WHEREAS, the 2020 Cameron Peak Fire burned over 200,000 acres in the watersheds of the Cache la Poudre and Big Thompson Rivers, including acreage upon both public and private properties, and caused severe impacts to public infrastructure serving properties throughout Larimer and Weld Counties, including, without limitation, water supply infrastructure; and

WHEREAS, Greeley and CPRW are actively working with other stakeholder partners throughout the affected region to coordinate efforts in response to the Cameron Peak Fire, in part to ensure that available grant funding obtained is used efficiently and effectively to mitigate and rehabilitate the impacts of the Fire; and

WHEREAS, to that end, Greeley entered into that certain Intergovernmental Agreement regarding Rehabilitation Work for the Cameron Peak Fire with the City of Fort Collins and Larimer County, dated April 29, 2021 and attached hereto as Exhibit A ("Cameron Peak Rehabilitation IGA"); and

WHEREAS, Greeley desires to retain CPRW to perform project management services associated with the coordinated mitigation and rehabilitation activities in response to the Cameron Peak Fire, as is contemplated by and more particularly described in paragraph 8 of the Cameron Peak Rehabilitation IGA;

WHEREAS, Greeley and CPRW have reached an understanding regarding the terms and conditions by which CPRW will provide such project management services, and desire to reduce that understanding to writing; and

NOW THEREFORE, for good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, Greeley and CPRW agree as follows.

Agreement

1. **Term of Agreement.** The term of this Agreement commences upon its mutual execution by Greeley and CPRW, and expires after a period of five (5) years.

2. **CPRW Project Management Services.** CPRW hereby agrees to provide project management services for wildfire mitigation and rehabilitation activities to Greeley, as contemplated by paragraph 8 of the Cameron Peak Rehabilitation IGA, and in accordance with the scope of services attached hereto as Exhibit B ("Scope of Work"). The project management services provided by CPRW shall be under the direction of the individual (or individuals) designated by the Director of Water and Sewer to act as the City's representative during the performance of this Agreement ("Greeley Representative"). The Greeley Representative will be the primary point of contact for CPRW for purposes of this Agreement, and will provide CPRW all necessary technical information related to the project management services required by this Agreement. The Greeley Representative will remain available to CPRW as necessary and appropriate, and to refine strategy as circumstances require.

2.1 Payment for Project Management Services. The City shall pay CPRW for services satisfactorily performed, based on sum not to exceed one hundred and fifteen thousand dollars (\$115,000.00). CPRW will bill the City on an annual basis for services to be rendered in the following year and allowable costs and expenses incurred in the prior year toward the completion of the Scope of Work described on Exhibit B. The amounts billed shall include an annual amount of twenty-three thousand dollars (\$23,000.00) for services to be rendered in the following calendar year. CPRW shall submit a Request for Payment for allowable costs and expenses for services rendered in the prior calendar year. CPRW shall track expenditures and inform the City of any reasonably anticipated cost overrun prior to completing work that would exceed the maximum Agreement sum. The City may choose to increase the budget for the work using a mutually acceptable amendment to this Agreement or it may choose not to increase the budget and terminate the work accordingly. Invoices received from CPRW pursuant to this Agreement will be reviewed by the Greeley Representative for conformity with the Agreement and, if approved, sent to the Finance Department for payment. Payment by the City for services performed by CPRW under this Agreement from resources attributable to grant funding, including, without limitation, from the NRCS Emergency Watershed Protection Program, is subject to the terms and conditions of the grant award.

3. Truth in Negotiation Certificate. Signature of this Agreement by CPRW shall act as the execution of a truth-in-negotiation certificate certifying that the wage rates and costs used to determine the compensation provided for in this Agreement are accurate, complete, and current as of the date of this Agreement. The said rates and costs shall be adjusted to exclude any significant sums should the City determine that the rates and costs were increased due to inaccurate, incomplete, or non-current wage rates or due to inaccurate representations of fees paid to outside consultants. The City shall exercise its rights under this "Certificate" within one (1) year following final payment.

4. Termination. This Agreement may be terminated by CPRW upon 10 days' prior written notice to the City in the event of substantial failure by the City to perform in accordance with the terms of this Agreement through no fault of CPRW. It may also be terminated by the City, with or without cause, immediately upon written notice to CPRW. Unless CPRW is in substantial breach of this Agreement, CPRW shall be paid for services rendered to the satisfaction of the City through the date of termination. After receipt of a Termination Notice and except as otherwise directed by the City, CPRW shall (a) stop work on the date and to the extent specified, (b) terminate and settle all orders and subcontracts relating to the performance of the terminated work, (c) transfer all work in process, completed work, and other material related to the terminated work to the City, and (d) continue and complete all parts of the work that have not been terminated. CPRW shall be paid for services actually rendered to the date of termination.

5. Personnel. CPRW represents that it has, or will, secure at its own expense all necessary personnel required to perform the services under this Agreement. Such personnel shall not be employees of or have any contractual relationship with the City. All of the services required herein under shall be performed by CPRW or under its supervision, and all personnel engaged in performing the services shall be fully qualified and if required, authorized or permitted under state and local law to perform such services. Any changes or substitutions in CPRW's key personnel, as described on Exhibit B, must be made known to the Greeley Representative and written approval granted by the City before said changes or substitutions can become effective. Such approval by the City shall not be unreasonably withheld. CPRW declares that all services shall be performed by skilled and competent personnel to the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions.

6. Sub-Consultant. The City reserves the right to accept the use of a sub-consultant or to reject the selection of a particular sub-consultant and to inspect all facilities of any sub-consultants in order

to make a determination as to the capability of the sub-consultant to perform properly under this Agreement. CPRW is encouraged to seek minority and women business enterprises for participation in sub-contracting opportunities. If a sub-consultant fails to perform or make progress, as required by this Agreement, and it is necessary to replace the sub-consultant to complete the work in a timely fashion, CPRW shall promptly do so, subject to acceptance of the new sub-consultant by the City.

7. Federal and State Tax. The City is exempt from payment of Colorado State Sales and Use Taxes. The City will sign an exemption certificate submitted by CPRW. CPRW shall not be exempted from paying sales tax to their suppliers for materials used to fulfill contractual obligations with the City, nor is CPRW authorized to use the City's tax exemption number in securing such materials. CPRW shall be responsible for payment of its own FICA and Social Security benefits with respect to this Agreement.

8. Availability of Funds. When funds are not appropriated or otherwise made available to support continuation of performance in a subsequent fiscal period, the Agreement may be cancelled and the City shall reimburse CPRW for work performed and expenses incurred during the Agreement period.

9. Insurance.

9.1 CPRW shall not commence work under this Agreement until they have obtained all insurance required under this paragraph and such insurance has been approved by the City.

9.2 All insurance policies shall be issued by companies authorized to do business under the laws of the State of Colorado. CPRW shall furnish Certificates of Insurance to the City prior to the commencement of operations. The Certificates shall clearly indicate that CPRW has obtained insurance of the type, amount, and classification as required for strict compliance with this paragraph and that no material change or cancellation of the insurance shall be effective without ten (10) days prior written notice to the City. Compliance with the foregoing requirements shall not relieve CPRW of its liability and obligations under this Agreement.

9.3 CPRW shall maintain, during the life of this Agreement, professional liability insurance (errors and omissions) in the amount of \$1,000,000 per occurrence to protect CPRW of claims for damages for negligent acts, errors or omissions in the performance of professional services under this Agreement, whether such acts, errors or omissions be by CPRW or by anyone directly employed by or contracting with CPRW.

9.4 CPRW shall maintain, during the life of this Agreement, comprehensive automobile liability insurance in the amounts of \$1,000,000 combined single limit bodily injury and \$50,000 property damage to protect CPRW from claims for damages for bodily injury, including wrongful death, as well as from claims for property damage, which may arise from the ownership, use, or maintenance of owned and non-owned automobiles, including rented automobiles whether such operations by CPRW or by any directly or indirectly employed by CPRW.

9.5 CPRW shall maintain, during the life of this Agreement, adequate Workmen's Compensation Insurance and Employer's Liability Insurance in at least such amounts as are required by law for all of its employees performing work for the City pursuant to this Agreement.

9.6 All insurance, other than Workmen's Compensation and Professional Liability, is to be maintained by CPRW shall specifically include the City as an "Additional Insured".

10. Indemnification. CPRW shall indemnify and save harmless the City, its agents, servants, and employees from and against any and all claims, liability, demands, losses, and/or expenses resulting from any negligent act or omission of CPRW, its agents, servants, subcontractors, suppliers or employees in the performance of services under this Agreement. Such duty to indemnify and save harmless the City shall be for an amount represented by the degree or percentage of negligence or fault attributable to CPRW, its agents, servants, subcontractors, suppliers or employees. If CPRW is providing architectural, engineering, design, or surveying services, the obligation to indemnify and pay costs, expenses, and attorneys' fees, is limited to the amount represented by the degree or percentage of negligence or fault attributable to CPRW, or CPRW's agents, representatives, employees, servants, subcontractors, or suppliers as determined by adjudication, alternative dispute resolution, or otherwise resolved by mutual agreement between the contractor and the City. CPRW's indemnification obligation shall not be construed to extend to any injury, loss, or damage caused by the City's own negligence.

11. Successors and Assigns. The City and CPRW each binds itself and its partners, successors, executors, administrators, and assigns to the other party of this Agreement and to the partners, successors, executors, administrators, and assigns of such other party, in respect to all covenants of this Agreement. Except as above, neither the City nor CPRW shall assign, sublet, convey, or transfer its interest on this Agreement without the written consent of the other. Nothing herein shall be construed as creating any personal liability on the part of any officer or agent of the City or CPRW which may be party hereto, nor shall it be construed as giving any rights or benefits hereunder to anyone other than the City and CPRW.

12. Waiver and Remedies. The City's approval of studies, drawings, designs, plans, specifications, reports, computer programs and other work or materials produced pursuant to this Agreement shall not in any way relieve CPRW of its responsibility for the technical accuracy of the services. The City's approval or acceptance of, or the City's payment for, any service pursuant to this Agreement shall not be construed to operate as a waiver of any rights under this Agreement or of any cause of action arising out of the performance of this Agreement. No remedy herein conferred upon any party is intended to be exclusive of any other remedy, and each and every other remedy given hereunder or now or hereafter existing at law or in equity or by statute or otherwise. No single or partial exercise by any party of any right, power, or remedy hereunder shall preclude any other or further exercise thereof.

13. Governing Law and Venue. This Agreement shall be governed by the laws of the State of Colorado. Venue for any and all legal action necessary to enforce the Agreement shall be proper in Larimer County.

14. Conflict of Interest.

14.1 CPRW represents and agrees that it will not engage in any transaction, activity or conduct which would, directly or indirectly, result in a conflict of interest under this Agreement. CPRW represents that it has disclosed any and all current or potential conflicts of interest. A conflict of interest shall include, but is not limited to, transactions, activities or conduct that would affect the judgment, actions or work of CPRW by placing CPRW's own interests, or the interest of any other party with whom CPRW has a contractual arrangement, in actual current or potential future conflict with the City's interests.

14.2 During the effective period of this Agreement, CPRW shall promptly notify the City in writing of all potential conflicts of interest for any proposed prospective work, business association, interest or any other circumstance which may influence or appear to influence CPRW's judgment or quality of services being provided hereunder. Such written notification shall: (a) identify the entity and the nature of the prospective work, business association, interest or circumstance that CPRW may undertake, (b) request an opinion of the City as to whether the work,

association, interest or circumstance would, in the opinion of the City, constitute a conflict of interest if entered into by CPRW, and (c) if the City determines that a conflict or potential conflict exists, request whether the City waives such conflict and consents to such work, association, interest or circumstance. The City, in its sole discretion, shall determine the existence or nonexistence of a conflict of interest and, if a conflict is determined to exist, shall elect whether to waive the conflict, and shall notify CPRW of its decision in writing within thirty (30) days of the City's receipt of notification from CPRW. CPRW shall not conduct any work or proceed with any association, interest or circumstance covered by this provision or enter into any Agreement to conduct such work or proceed with such association, interest or circumstance unless and until it has received the City's decision authorizing such work under this Article 14.

14.3 In the event the City has given CPRW its written decision that a conflict of interest exists and the City does not waive the conflict, but CPRW proceeds to undertake or indicates it will undertake the work creating the disputed conflict, the City may notify CPRW of breach of this Article 14 and after thirty (30) days may terminate this Agreement pursuant to Article 4 above, except that breaches under this Article 14 CPRW shall have thirty (30) days after the notice of such breach is received to eliminate or cure the conflict of interest in a manner acceptable to the City.

15. Excusable Delays. CPRW shall not be considered in default by reason of any failure in performance if such failure arises out of causes reasonably beyond CPRW's control and without its fault or negligence. Such causes may include, but are not limited to: acts of God; the City's omissive and commissive failures; natural or public health emergencies; labor disputes; freight embargoes; and severe weather conditions. If failure to perform is caused by the failure of CPRW's sub-consultant(s) to perform or make progress, and if such failure arises out of causes reasonably beyond the control of CPRW and its sub-consultant(s) and is without the fault or negligence of either of them, CPRW shall not be deemed to be in default. Upon CPRW's request, the City shall consider the facts and extent of any failure to perform the work and, if CPRW's failure to perform was without its fault or negligence, the Agreement Schedule and/or any other affected provision of this Agreement shall be revised accordingly; subject to the City's rights to change, terminate, or stop any or all of the work at any time.

16. Arrears. CPRW shall not pledge the City's credit or make it a guarantor of payment or surety for any contract, debt, obligation, judgment, lien, or any form of indebtedness. CPRW further warrants and represents that it has no obligation or indebtedness that would impair its ability to fulfill the terms of this Agreement.

17. Disclosure and Ownership of Documents. CPRW shall deliver to the City for approval and acceptance, and before being eligible for final payment of any amounts due, all documents and materials prepared by and for the City under this Agreement. From time to time, the City will provide CPRW printed and electronic data, analyses, comments, reports, studies and/or similar materials (together with supporting work and other substantiating documents) for use in the preparation of the work ("City's Work Product"). Some of the City's Work Product may include materials that consist of privileged or proprietary confidential business information. Except as provided in this paragraph, CPRW shall keep the City's Work Product confidential, shall not use the City's Work Product for any other purpose other than the preparation of the work contemplated herein, and shall not disseminate or disclose the City's Work Product, or the information contained therein, directly or indirectly, to any other party without the prior written consent of the City. The City's Work Product shall be the sole property of the City and shall be returned to the City upon completion of the work. CPRW's obligation to keep the City's Work Product confidential under this paragraph shall not apply to information that CPRW can document: (a) is or has become (through no action or inaction by CPRW or any affiliate, agent, consultant or employee) generally available to the public; (b) was in CPRW's possession prior to receipt from City, except to the extent that such information was unlawfully appropriated; (c) was independently developed by CPRW without use of any of City's Work Product; or

(d) was disclosed pursuant to the requirements of law. Nothing herein shall affect the obligations of CPRW to either make disclosures or preserve the confidentiality of City's Work Product to the extent required by law or court order, including, but not limited to, requirements under applicable Colorado and federal statutes, court rules, and administrative rules and regulations. The obligations of CPRW pursuant to this paragraph shall survive expiration or termination of this Agreement.

18. Independent Consultant Relationship. CPRW is, and shall be, in the performance of all work services and activities under this Agreement, an independent consultant, and not an employee, agent, or servant of the City. All persons engaged in any of the work or services performed pursuant to this Agreement shall at all times, and in all places, be subject to CPRW's sole direction, supervision, and control. CPRW shall exercise control over the means and manner in which it and its employees perform the work, and in all respects CPRW's relationship and the relationship of its employees to the City shall be that of an independent consultant and not as employees or agents of the City. CPRW does not have the power or authority to bind the City in any promise, contract, or representation other than specifically provided for in this Agreement.

19. Contingent Fees. CPRW warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for CPRW to solicit or secure this Agreement and that it has not paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working solely for CPRW, any fee, commission, percentage, gift, or any other consideration contingent upon or resulting from the award or making of this Agreement.

20. Access and Audits. CPRW shall maintain adequate records to justify all charges, expenses, and costs incurred in performing the work for at least three (3) years after completion of this Agreement. The City shall have access to such books, records, and documents as required in this section for the purpose of inspection or audit during normal business hours, at the City's cost, upon five (5) days' written notice.

21. Nondiscrimination. CPRW declares and represents that all of its employees are treated equally during employment without regard to race, color, religion, physical handicap, sex, age, or national origin.

22. Entirety of Contractual Agreement. The City and CPRW agree that this Agreement sets forth the entire agreement between the parties, and that there are no promises or understandings other than those stated herein. None of the provisions, terms, and conditions contained in this Agreement may be added to, modified, superseded or otherwise altered, except by written instrument executed by the parties hereto.

23. Enforcement Costs. If any legal action or other proceeding is brought for the enforcement of this Agreement, or because of an alleged dispute, breach, default, or misrepresentation in connection with any provisions of this Agreement, the successful or prevailing party or parties shall be entitled to recover reasonable attorney's fees, court costs, and all expenses (including taxes) incurred in that action or proceeding, in addition to any other relief to which such party or parties may be entitled.

24. Authority to Practice. CPRW hereby represents and declares that it has and will continue to maintain all licenses and approvals required to perform the work under this Agreement, and that it will at all times conduct its business activities in a reputable manner.

25. Severability. If any term or provision of this Agreement, or the application thereof to any person or circumstances shall, to any extent, be held invalid or unenforceable, the remainder of this Agreement, or the application of such term or provision, to person or circumstances other than those as to

which it is held invalid or unenforceable, shall not be affected, and every other term and provision of this Agreement shall be deemed valid and enforceable to the extent permitted by law.

26. Amendments and Modification. No amendment and/or modification of this Agreement shall be valid unless in writing and signed by each of the parties. The City reserves the right to make changes in the work, including alterations, reductions therein or additions thereto. Upon receipt by CPRW of the City's notification of a contemplated change, CPRW shall (a) if requested by the City, provide an estimate for the increase or decrease in cost due to the contemplated change, (b) notify the City of any estimated change in the completion date, and (c) advise the City in writing if the contemplated change will affect the CPRW's ability to meet the completion dates or schedules of this Agreement. If the City so instructs in writing, CPRW shall suspend work on that portion of the Work affected by a contemplated change, pending the City's decision to proceed with the change. If the City elects to make the change, the City shall issue an amendment to this Agreement or Change Order and CPRW shall not commence work on any such change until such written amendment or change order has been issued and signed by each of the parties.

27. Compliance with C.R.S. § 8-17.5-101, Et seq. By signing this Agreement, CPRW certifies that at the time of the Certification, it does not knowingly employ or contract with any illegal alien who will perform work under this Agreement.

27.1 By signing this Agreement, CPRW certifies that it shall not knowingly employ or contract with any illegal aliens to perform work under this Agreement; nor enter into a contract with any sub-consultant that knowingly employs or contracts with an illegal alien to perform work under this Agreement.

27.2 CPRW has confirmed the employment eligibility of all employees who are newly hired for employment to perform work under this public contract for services through participation in either the E-Verify program or the Colorado Department of Labor and Employment Program.

27.3 CPRW is prohibited from using the E-Verify program or the Department of Labor and Employment Program procedures to undertake pre-employment screening of job applicants while the public contract for services is being performed.

27.4 By signing this Agreement, CPRW affirmatively acknowledges that if CPRW obtains actual knowledge that a sub-consultant performing work under the public contract for services knowingly employs or contracts with an illegal alien, CPRW shall be required to (a) notify the sub-consultant and the contracting state agency or political subdivision within three days that CPRW has actual knowledge that the sub-consultant is employing or contracting with an illegal alien; and (b) terminate the subcontract with the sub-consultant if within three days of receiving the notice required pursuant to sub-subparagraph (a) of this subparagraph the sub-consultant does not stop employing or contracting with the illegal alien; except that CPRW shall not terminate the Agreement with the sub-consultant if during such three days the sub-consultant provides information to establish that the sub-consultant has not knowingly employed or contracted with an illegal alien.

27.5 CPRW shall comply with all reasonable requests made in the course of an investigation by the Colorado Department of Labor and Employment.

27.6 CPRW shall, within twenty days after hiring an employee who is newly hired for employment to perform work under this Agreement, affirm that CPRW has examined the legal work status of such employee, retained file copies of the Documents required by 8 U.S.C. § 1324(a), and not altered or falsified the identification documents for such employees. CPRW shall provide

a written notarized copy of the affirmation to the City.

27.7 If CPRW violates any provision of this Agreement pertaining to the duties imposed by Subsection 8-17.5-102, C.R.S. the City may terminate this Agreement. If this Agreement is so terminated, CPRW shall be liable for actual and consequential damages to the City arising out of CPRW's violation of Subsection 8-17.5-102, C.R.S.

27.8 By signing this Agreement, CPRW certifies that it shall in all respects comply with the provisions of C.R.S. § 8-17.5-101, et seq.

28. Electronic Signatures. The Agreement documents may be executed in two or more counterparts, each of which shall be deemed an original but all of which together shall constitute one and the same document. The Agreement documents, including all component parts set forth above, may be executed and delivered by electronic signature by any of the parties and all parties consent to the use of electronic signatures.

29. Notice. All notices required in this Agreement shall be sufficient if sent by certified mail, return receipt requested, or by email if receipt is acknowledged or no notice of delivery failure is received after a period of three days.

If to the City: City of Greeley Water and Sewer Department
Attn: Director of Water and Sewer
1001 11th Avenue, 2nd Floor
Greeley, Colorado 80631
Phone: (970) 350-9811
Email: sean.chambers@greeleygov.com
jennifer.petrzelka@greeleygov.com

If to CPRW: Coalition for the Poudre River Watershed
Attn: Hally Strevey, Interim Executive Director
320 East Vine Drive, Suite 317
Fort Collins, Colorado 80524
Telephone: (970) 222-5754
Email: hallys@poudrewatershed.org

IN WITNESS WHEREOF, the City of Greeley and Coalition for the Poudre River Watershed have executed this Cameron Peak Wildfire Project Management Professional Services Agreement as of the date first set forth above.

COALITION FOR THE POUDRE RIVER WATERSHED,
a Colorado nonprofit corporation

By: _____

Date: _____

Name: _____

Title: _____

THE CITY OF GREELEY, COLORADO,
a Colorado home rule municipal corporation
acting by and through its Water Enterprise

By: _____
City Manager

Date: _____

AS TO LEGAL FORM:

By: _____
City Attorney

AS TO AVAILABILITY OF FUNDS:

By: _____
Director of Finance

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 7

TITLE: APPROVE REIMBURSEMENT AGREEMENT
FOR WILDFIRE MITIGATION AND
REHABILITATION SERVICES WITH CPRW

RECOMMENDATION &
PROPOSED MOTION: APPROVE REIMBURSEMENT AGREEMENT
FOR WILDFIRE MITIGATION AND
REHABILITATION SERVICES WITH CPRW
AND DELEGATE AUTHORITY TO THE
DIRECTOR TO MAKE MINOR AMENDMENTS
TO THE AGREEMENT BEFORE EXECUTION

ADDITIONAL INFORMATION:

Greeley and the Coalition for the Poudre River Watershed (CPRW) have a strong common interest in the protection of the upper Cache la Poudre River watershed, and desire to coordinate on recovery measures and mitigation efforts being employed in response to the Cameron Peak Fire. CPRW has received funding from the Northern Colorado Community Foundation and the Colorado Conservation Board that it wished to provide to Greeley for post-fire recovery and mitigation efforts. This agreement details the process for CPRW to reimburse Greeley for this work.

Reimbursement Agreement for Wildfire Mitigation and Rehabilitation Services with Coalition for the Poudre River Watershed



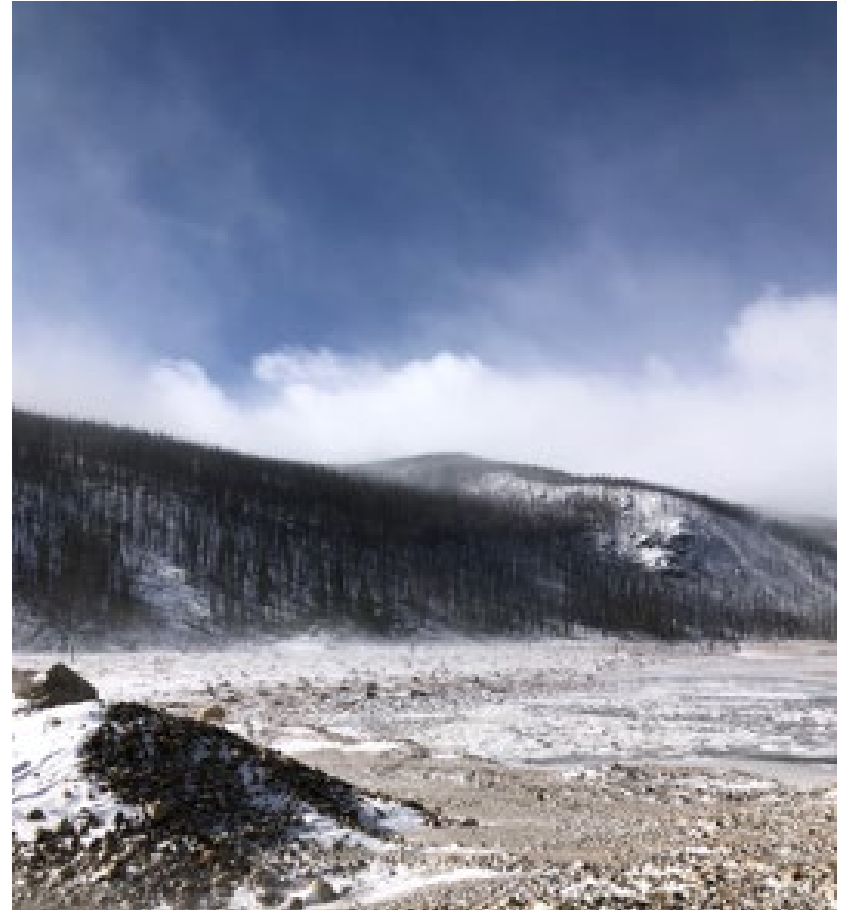
Background

- Greeley hired various contractors for post-fire recovery work
- CPRW was awarded grants for work
 - N. Community Foundation (\$500,000)
 - CWCB (\$1.5 million)
 - Applying for additional funds
- CPRW agreed to help pay for work



Terms of Agreement

- CPRW will reimburse Greeley for agreed upon mitigation work
- 1 year with option to renew annually



Greeley

Questions?



REIMBURSEMENT AGREEMENT FOR
WILDFIRE MITIGATION AND REHABILITATION SERVICES

This REIMBURSEMENT AGREEMENT FOR WILDFIRE MITIGATION AND REHABILITATION SERVICES (“Agreement”) is entered into this ____ day of _____ 2021, by and between THE CITY OF GREELEY, a Colorado home rule municipal corporation acting by and through its Water Enterprise (“Greeley”) and COALITION FOR THE Poudre RIVER WATERSHED, a Colorado non-profit corporation (“CPRW”).

Recitals

WHEREAS, the 2020 Cameron Peak Fire burned over 200,000 acres in the watersheds of the Cache la Poudre and Big Thompson Rivers, including acreage upon both public and private properties, and caused severe impacts to public infrastructure serving properties throughout Larimer and Weld Counties, including, without limitation, water supply infrastructure; and

WHEREAS, CPRW has been awarded by the Community Foundation of Northern Colorado (“Community Foundation”) and the Colorado Water Conservation Board (“CWCB”) grant funding that may be used for mitigation and rehabilitation measures in response to the Cameron Peak Fire (“CPRW Grants”); and

WHEREAS, in accordance with the terms and conditions of the CPRW Grants, such measures may include, without limitation, mitigation of hillslope erosion and sediment delivery in the watershed via landscape-scale mulching, post-fire monitoring of water supply infrastructure and water quality impacts, and the education and engagement of affected landowners and stakeholders concerning post-fire land stewardship; and

WHEREAS, Greeley and CPRW have a strong common interest in the protection of the upper Cache la Poudre River watershed, and desire to coordinate on recovery measures and mitigation efforts being employed in response to the Cameron Peak Fire; and

WHEREAS, coordination by Greeley and CPRW, including on the engagement of one or more contractors to undertake recovery measures and mitigation efforts in the upper Cache la Poudre River watershed, will increase the efficiency of such efforts and significantly reduce the likelihood of duplicative and counterproductive efforts in response to the Cameron Peak Fire; and

WHEREAS, Greeley and CPRW have reached an understanding regarding their coordination on recovery measures and mitigation efforts in response to the Cameron Peak Fire, and desire to reduce their understanding to writing;

NOW THEREFORE, for good and valuable consideration, the receipt and adequacy of which is acknowledged by both parties, Greeley and CPRW agree as follows.

Agreement

1. Term of Reimbursement Agreement. The term of this Agreement commences on the date it is mutually executed and expires after a period of one (1) year (“Initial Term”). Upon

expiration of the Initial Term, this Agreement will automatically renew for successive terms of one (1) year each, unless and until terminated by either Greeley or CPRW in accordance with paragraphs 5 and 6 below. Additionally, CPRW may terminate this Agreement with immediate effect at any point that reimbursement funds to which CPRW may be entitled under the CPRW Grants are fully expended or otherwise no longer available.

2. Sources of Funding; General Compliance with CPRW Grants. As of the execution of this Agreement, CPRW has been awarded \$500,000 in grant funding by the Community Foundation from its Northern Colorado Fires Fund. Of this amount, and subject to the terms of this Agreement, CPRW will make \$454,545 available for reimbursement to Greeley. CPRW has also been awarded \$1,500,000 in grant funding by the CWCB from its Watershed Restoration Program. Of this amount, and subject to the terms of this Agreement, CPRW will make \$1,336,706.16 available for reimbursement to Greeley. Greeley and CPRW agree that any coordinated and collaborative activities undertaken pursuant to this Agreement, and any potential reimbursement to Greeley for such activities, are expressly subject to compliance with the terms and conditions of the CPRW Grants. Greeley acknowledges that CPRW is engaged in multiple watershed protection projects in response to the Cameron Peak Fire, and that accordingly, nothing in this Agreement obligates CPRW to commit the full entitlement of its grant awards related to the Cameron Peak Fire to mitigation efforts undertaken by Greeley pursuant to this Agreement. Nothing in this Agreement should be construed to prevent either CPRW or Greeley from seeking additional grant funding for the recovery measures and mitigation efforts contemplated herein.

3. Coordination on Mitigation Efforts; Apportionment of Costs and Duties. Greeley will select one or more contractors to perform services necessary to mitigate existing and future damage to the upper Cache la Poudre River watershed caused by the Cameron Peak Fire ("Mitigation Tasks"), and remit payment for such services directly to the selected contractor(s). CPRW will then reimburse Greeley for such funds paid to the selected contractor(s) for Mitigation Tasks, subject to the terms and conditions in this Agreement and the CPRW Grants.

3.1 Greeley shall coordinate with CPRW, and also the Community Foundation or CWCB as necessary or appropriate, in the selection of the contractor(s) to perform the Mitigation Tasks to ensure that such selection is consistent with the terms and conditions of the CPRW Grants.

3.2 Greeley shall provide CPRW, and also the Community Foundation or CWCB as necessary or appropriate, with an opportunity to review in advance any designs, plans, scopes and schedules of work, and any other materials associated with the Mitigation Tasks to be performed by the selected contractor(s), to ensure that such designs, plans, scopes and schedules of work, and any other materials are compliant with the terms and conditions of the CPRW Grants.

3.3 Greeley shall provide CPRW, and also the Community Foundation or Colorado Water Conservation Board as necessary or appropriate, with an opportunity to inspect the Mitigation Tasks performed by the selected contractor(s), to ensure compliance with the terms and conditions of the CPRW Grants.

3.4 Promptly after remitting payment to the selected contractor(s) for Mitigation Tasks, Greeley shall provide to CPRW a copy of any invoice for which it is seeking reimbursement pursuant to this Agreement, along with any necessary supporting documentation. CPRW shall then promptly forward the invoice and supporting documentation to the Community Foundation or CWCB as necessary or appropriate for reimbursement consideration, in accordance with the terms and conditions of the CPRW Grants. Subject to and upon confirmation from the awarding entity that any invoice forwarded as described herein contains costs eligible for reimbursement pursuant to the CPRW Grants, CPRW shall reimburse Greeley within thirty (30) days of such confirmation.

3.5 CPRW shall not be obligated under any circumstances to reimburse Greeley for costs determined by the Community Foundation or the CWCB to be ineligible under the CPRW Grants, or costs for which CPRW itself will not ultimately be reimbursed by the Community Foundation or CWCB. Reimbursements made by CPRW to Greeley shall not under any circumstances exceed the total amount of grant funding to which CPRW is entitled pursuant to the CPRW Grants.

3.6 Greeley shall undertake reasonable efforts to complete any other task required of it by the Community Foundation or the CWCB to ensure compliance with the CPRW Grants, provided that Greeley shall not be required to incur any material expense in the course of such efforts.

3.7 Notwithstanding any other provision of this Agreement, CPRW's sole responsibility regarding the Mitigation Tasks and associated activities is to reimburse Greeley for those Mitigation Tasks and associated activities that are eligible for reimbursement under the terms of the CPRW Grants and this Agreement. CPRW shall have no input on, and does not warrant, the suitability, safety, effectiveness, appropriateness, or integrity of such Mitigation Tasks and associated activities for their intended purpose, which is strictly the responsibility of Greeley and its contractors.

4. Restriction on Assignment. Neither Greeley nor CPRW may assign this Agreement without prior written consent from the other party. Such consent may be given or withheld in the sole discretion of the other party.

5. Notice. Greeley and CPRW shall give any notice required under this Agreement using the contact information listed below. Such notice is adequate if (a) hand-delivered, (b) provided by certified or registered mail, return receipt requested, or (c) sent via email, if receipt is acknowledged or no bounce back or other notice of delivery disruption is received by the sender within three (3) days after transmittal. Greeley and CPRW shall promptly notify the other party if the appropriate contact information for notice changes.

If to Greeley: Greeley Water and Sewer Department
Attention: Water Resources Division
1001 11th Avenue, 2nd Floor
Greeley, Colorado 80631

Telephone: (970) 350-9811
Email: jennifer.petrzelka@greeleygov.com
adam.jokerst@greeleygov.com

With a copy to: Greeley City Attorney's Office
Attention: Environmental and Water Resources
1100 10th Street, Suite 401
Greeley, Colorado 80631
Telephone: (970) 381-7408
Email: daniel.biwer@greeleygov.com

If to CPRW: Coalition for the Poudre River Watershed
Attn: Hally Strevey, Interim Executive Director
320 East Vine Drive, Suite 317
Fort Collins, Colorado 80524
Telephone: (970) 222-5754
Email: hallys@poudrewatershed.org

With a copy to: John Kolan
Otis & Bedingfield, LLC
2725 Rocky Mountain Avenue
Loveland, Colorado 80538
Telephone: (970) 663-7300
Email: jkolan@nocoattorneys.com

6. Default and Termination; Waiver. In the event either Greeley or CPRW fails to comply with the terms and conditions of this Agreement, such failure constitutes a default of this Agreement and the non-defaulting party may give notice of the perceived default in accordance with paragraph 5 above. The defaulting party is then entitled to a period of thirty (30) days from receipt of the notice within which to cure the default. Upon the cure of any such default during this period, this Agreement will remain in full force and effect.

6.1 If any declared default remains uncured after the thirty-day cure period described above, or after any extension of the cure period mutually agreed to by the parties, the non-defaulting party may immediately terminate this Agreement with written notice to the defaulting party. Nothing in this Agreement should be construed to limit either party from seeking damages or pursuing available remedies upon the termination of this Agreement for default, including the recovery of reasonable costs and attorneys' fees.

6.2 The failure of either Greeley or CPRW to declare a default does not establish a precedent nor constitute an implied waiver of any subsequent breach of the terms and conditions in this Agreement. Any such waiver of breach must be made explicitly in writing.

7. Governmental Immunity and Liability. Greeley is a public entity, as that term is defined pursuant to the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, et seq., as it

exists now or is amended in the future (“CGIA”). Nothing in this Agreement should be construed to limit or alter the benefits and responsibilities to which Greeley is entitled pursuant to the CGIA. Greeley and CPRW respectively shall defend any and all claims for injuries or damages, in accordance with the requirements and limitations of the CGIA, which occur as a result of the negligent or intentional acts or omissions of their own officers and employees. Greeley and CPRW respectively shall be responsible for any and all liability for injuries or damages caused by any negligent acts or omissions of their own officers and employees performing functions or activities under this Agreement.

8. Appropriation of Funds Contingency. Any expenditure of funds by Greeley associated with this Agreement is expressly subject to the appropriation of funds sufficient and intended for this purpose by its City Council during the fiscal year in which any such obligation is incurred.

9. Jurisdiction and Venue. This Agreement shall be governed by and enforced in accordance with the laws of the State of Colorado. Proper venue for any dispute between Greeley and CPRW arising out of this Agreement is the Weld County District Court.

10. No Third Party Beneficiaries. The terms and conditions of this Agreement, and all rights of action related thereto, are strictly reserved to Greeley and CPRW. Nothing in this Agreement should be construed to allow any claim, right, or cause of action by any person or entity not a party to this Agreement. Any person or entity other than Greeley or CPRW that realizes a service or benefit under this Agreement is an incidental beneficiary only.

11. Integration and Amendment. This Agreement constitutes a complete integration of the understandings and agreement between Greeley and CPRW with respect to the subject matter herein. No representations, negotiations, or warranties, express or implied, exist between Greeley and CPRW except as explicitly set forth in this Agreement. This Agreement may only be amended in a writing duly authorized and executed by Greeley and CPRW.

12. Severability. In the event that one or more clauses in this Agreement are found invalid or unenforceable by a court of competent jurisdiction, the remainder of this Agreement will nevertheless be valid and binding upon Greeley and CPRW, unless the absence of such clause or clauses would destroy the intent and purpose of this Agreement.

13. Review by Legal Counsel. Greeley and CPRW acknowledge that each party had the opportunity to review this Agreement with its respective legal counsel, and that this Agreement should not be construed nor interpreted against a drafting party.

14. Authority to Contract. This Agreement has been duly authorized by Greeley and CPRW and the undersigned representatives are empowered to execute this Agreement on behalf of their respective organizations.

15. Counterparts. The parties may execute this Agreement in counterparts, each of which and the combination of which when signed by both Greeley and CPRW may be deemed original and together constitute a single contract.

IN WITNESS WHEREOF, the City of Greeley and Coalition for the Poudre River Watershed have executed this Agreement on the date first set forth above.

COALITION FOR THE POUDRE RIVER WATERSHED
a Colorado non-profit corporation

By: _____

Date: _____

Hally Strevey
Interim Executive Director

THE CITY OF GREELEY, COLORADO
a Colorado home rule municipal corporation
acting by and through its Water Enterprise

By: _____

Date: _____

City Manager

Approved as to Legal Form:

By: _____

City Attorney

As to Availability of Funds:

By: _____

Director of Finance

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 8

TITLE: OVERVIEW OF PROPOSED INTERCONNECT
AND TRANSFER OF TRANSMISSION LINE
CUSTOMERS WITH WEST FORT COLLINS
WATER DISTRICT

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

Greeley provides water service to numerous customers served from its transmission lines between the Bellvue Water Treatment Plant and the City. Transmission line customers were provided water service when the pipelines were constructed and prior to the existence of other rural water providers. Serving transmission pipeline customers can be exceedingly difficult. Greeley transmission and distribution staff routinely struggle to ensure transmission line customers receive adequate water and water pressure. At times, the Bellvue Water Treatment Plant must change operations to provide necessary chlorine content to transmission customers. Serving customers from large-diameter transmission lines is simply not best-practice.

Greeley has a long-term plan to transfer transmission line customers to the water districts in which they are located. The most problematic area falls within the West Fort Collins Water District (“WFCWD”). Recently, Greeley and WFCWD have reached terms to transfer Greeley’s transmission line customers to WFCWD. Part of the proposed transaction includes construction of an interconnection between Greeley and WFCWD that will provide redundant supply to each entity. The transfer will also require a transfer of raw water supplies.

This information item will provide background on the issue and an overview of the proposed transaction. Staff will use Water and Sewer Board feedback to develop the necessary legal agreements to proceed with the transfer and interconnect.

Proposed Interconnect
and
Transfer of Transmission Line Customers
to the
West Fort Collins Water District



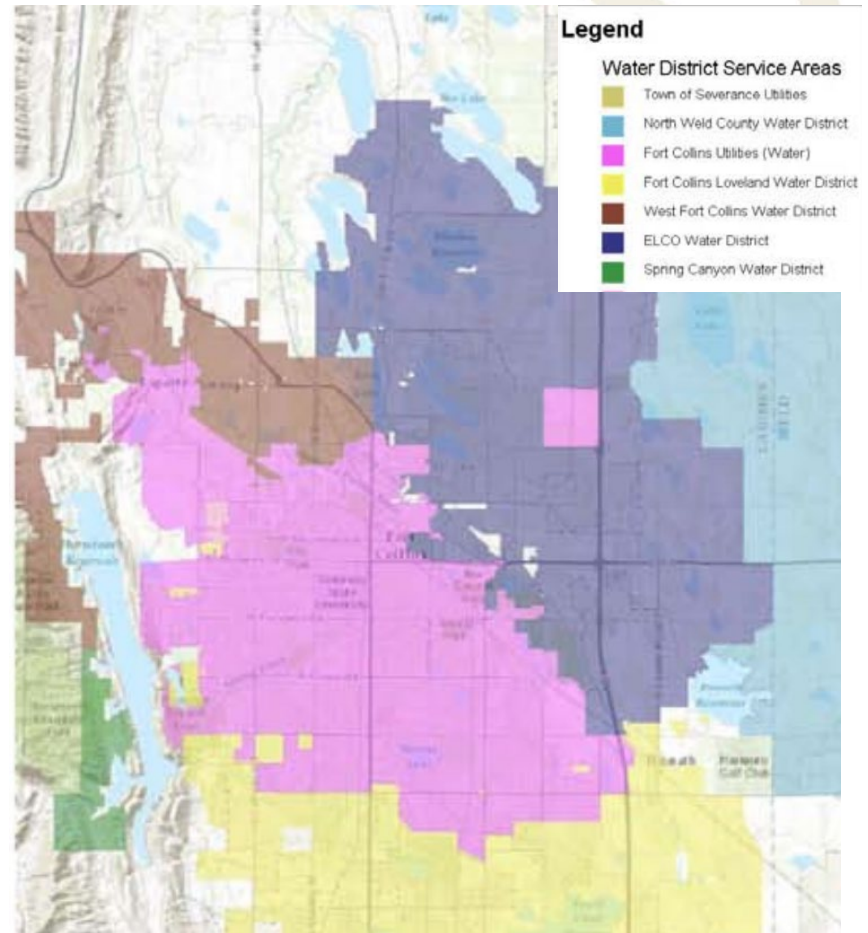
Background

- Greeley granted water taps to customers when transmission lines constructed
 - Primarily Bellvue Lines 1 and 3
 - Taps granted prior to formation of rural water districts
- Serving transmission line customers creates operational challenges
 - Transmission line customers experience pressure drops
 - Requires changing plant operations to maintain chlorine content for small number of customers
 - Increased pipeline maintenance; maintenance can cause outages
 - Numerous complaints over years



Tap Transfer Plan

- Long-term goal to remove transmission line customers and transfer to local water districts
- Start west and work east
- First, and most problematic, conversion area is in Laporte within the West Fort Collins Water District
- 33 transmission customers in WFCWD
- Previous negotiations with WFCWD have failed



Recent Developments

- WFCWD plans to replace main line under Poudre River serving all customers south and west of river
- Will create temporary outage
- Morning Fresh Dairy/Noosa Yogurt/Graves Family is WFCWD's largest customer, and even temporary outages create significant production and financial impacts
- WFCWD and Graves approached Greeley about providing interconnect between Greeley and WFCWD



Greeley Colorado

Interconnect

- Interconnect will provide Greeley redundancy
 - Greeley can use WFCWD water to “prime” the Bellvue treatment plant following shut-downs
 - Back-up to service to customers
 - WFCWD receives treated water from Fort Collins - creates Greeley to Fort Collins interconnect
- Will require pump station to match pressures



Greeley



Deal Terms

Greeley

- Transfer 9 shares of the North Poudre Irrigation Company (NPIC)
- Construct interconnect pump station at Greeley's cost
- Connect pump station to Greeley transmission line(s)

WFCWD

- Take over all 33 Greeley transmission customers in WFCWD service area
- Pay to connect all customers (some customers 1,000+ feet from nearest WFCWD water line)
- Connect pump station to WFCWD transmission line(s)

Greeley COLORADO



Financial Considerations

- WFCWD charges:
 - 1 CBT unit per residence
 - WFCWD uses 100% CBT
 - 1 unit of CBT = 0.7 AF (average)
 - \$14,000 plant investment fee per residence
- For 33 taps:
 - 33 CBT units or 23.1 AF
 - \$462,000 PIF payment
- NPIC share transfer:
 - Greeley owns 90 NPIC shares
 - Includes both a native and CBT component
 - Average yield is 2.6 AF/share of CBT
 - 9 NPIC shares yield 23.4 AF
- Interconnect:
 - Preliminary cost estimate is \$400,000 to \$500,000
 - Use of existing equipment

Greeley



Other Considerations

- Graves to provide land for interconnect without charge
- Fee schedule for water transferred via interconnect
- Construction of interconnect ahead of WFCWD main replacement – winter 2022/2023



Greeley

Next Steps

- Seek Board feedback (today)
- Develop legal agreements (this fall)
- Commence pump station design (fall, winter)
- Pump station construction (2022)
- Tap transfer (2022 – 2023)





Questions & Discussion

Greeley

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 9

TITLE: APPROVE AND RECOMMEND THE 2021 NON-
POTABLE WATER MASTER PLAN

RECOMMENDATION &
PROPOSED MOTION: APPROVE AND RECOMMEND TO CITY
COUNCIL ADOPTION OF THE 2021 NON-
POTABLE WATER MASTER PLAN AND
INCORPORATION OF THE SAME BY
REFERENCE AS AN AMENDMENT TO THE
2018 COMPREHENSIVE PLAN AND TO THE
PLANNING COMMISSION
RECOMMENDATION OF THE SAME TO CITY
COUNCIL

ADDITIONAL INFORMATION:

Water and Sewer Department launched the process of completing a Non-Potable Water Master Plan in 2018 with CDM Smith. CDM has extensive master planning experience with Greeley completing work in 2008 and 2014. The two primary goals of the project are to reduce use of potable water for irrigation and increase non-potable use. The development of the master plan started with inventorying all 45 different wells and pump stations within the existing system. This critical step allowed the project team to evaluate the existing system for deficiencies and where the system has capacity for expansion. Next step in the project, development of the existing system model for all sites based on historical usage, piping configurations, and pumping capacity. The project progressed to utilizing the system model to look at existing conditions of the system and planning for the expansion of the system in the 5-year, 20-year, and full system build-out time frames. The expansion of the system was coordinated with the RAS BBC report and matched the middle adoption rates.. The adoption scenarios are dependent on final City policy's and should be developed to meet or enhance the adoption rates. The expansion of the system focused on expanding the non-potable system at existing and future parks as the hubs of the systems. The final steps included developing CIP projects throughout the system and making sure it was coordinated with the other two Water & Sewer master plan projects and other City Department CIP projects. The project team conducted work sessions with Westminster, Denver Water, Evans, and Windsor to learn about their systems and

examine opportunities for collaboration. The final aspects of the project included coordinating outreach efforts to discuss the planned master plans with different community members and groups interested in participating in reviewing the City's draft master plan and providing critical input or comments. This different feedback and input has now been incorporated into the master plan final report completed in June 2021.



FINAL

Greeley Non-Potable Water Master Plan

June 2021



**CDM
Smith**

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Acronyms and Abbreviations

\$/LF	dollars per linear foot
AF	acre-feet
AFY	acre-feet per year
BBC report	City of Greeley Population and Water Demand Projections
cfs	cubic feet per second
CMMS	computerized maintenance management system
C-H	commercial high intensity
C-L	commercial low intensity
CIP	capital improvement plan or program
City's Specifications	City of Greeley Design Criteria and Construction Specifications
Dev	development
EDR	engineering development review
EPS	extended period simulation
ENR-CCI	Engineering News Record Cost Construction Index
fps	feet per second
ft	feet
GIS	Geographic Information System
gpm	gallons per minute
gpm/acre	gallons per minute per acre
gpd/acre	gallons per day per acre
GPS	Global Positioning System
GLIC	Greeley-Loveland Irrigation Company
GIC	Greeley Irrigation Company
HOA	homeowners association
HDD	horizontal direct drilling
in	inches
I-L	industrial low intensity
I-M	industrial medium intensity
I-H	industrial high intensity
LREGA	long-range expected growth area
MG	million gallons
MGD	million gallons per day
NPMP	Non-Potable Water System Master Plan
NP	non-potable
OPCC	opinion of probable construction cost
O&M	operations and maintenance
psi	pounds per square inch
Poudre Ponds	Poudre Ponds Complex Project
PLC	Programmable Logic Controller
RTU	Radio Telemetry Unit
R-E	residential estate
R-H	residential high density
R-L	residential low density

R-M	residential medium density
SA	Service Area
SSMP	Sanitary Sewer Master Plan
SCADA	supervisory control and data acquisition
VFD	Variable Frequency Drive
W/S	City of Greeley Water and Sewer Department
WTDMP	Water Transmission and Distribution Master Plan

Definitions

Adoption rate - an estimate of the amount of land that could potentially be irrigated that is expected to use NP irrigation; this value is based on customer type and should only be used for planning level estimates, not design

Buildout - the theoretical point in time where the City has experienced complete development within the LREGA, expected to be sometime after year 2090

Bulk area - the total area of a parcel, including both the irrigated area and the impermeable area (such as buildings and parking lots)

Capital improvement - a recommended construction project to improve or expand the water system, summarized in the capital improvement plan

Conversion area - a previously developed parcel that is currently irrigated by potable water, but may consider switching to NP irrigation in the future; the amount of irrigated area for this type of customer is typically known

Diurnal curve - a pattern of peaking factors applied to a base demand (the typical demand for an area) that shows how demands vary by pattern throughout the day; the diurnal curve typically includes the peak hour

Extended period simulation - a hydraulic modeling methodology that shows how the system performs over a set timescale, during which demands and operating conditions can vary

Flow factor - value used to estimate the water demand that a given amount of land will produce once it's developed, depending on its land use

Hub-and-spoke - methodology for NP infrastructure design where a future pond and pump station (usually located at a park) is not connected to other pump stations and becomes an individual system with distribution piping extending out from it

Irrigated area - the portion of a parcel that requires irrigation (i.e. only permeable area)

Long range expected growth area - the limits of the City's expected growth and where it plans to provide water and wastewater services

Non-potable water - raw (untreated) water from agricultural ditches used to irrigate certain areas within the City

North of the River - the geographic area north of the Poudre River and within the City's LREGA

Opinion of probable construction cost - the costs borne by the contractor to construct a capital project

Peak day demand - the maximum demand anticipated to occur during a one-day period expressed as the daily average

Peak hour demand - the average demand anticipated during a maximum one-hour period for a typical year; this is considered to be a conservative value for infrastructure sizing

Peak month demand - the average demand anticipated during a maximum one-month period for a typical year, typically experienced during July

Planning horizon - a timeframe used to estimate expected demands and infrastructure needs; for this master plan, the three planning horizons are 5-year (2025), 20-year (2040) and buildout

Service area - the general geographic area that is served by or expected to be served by an individual NP system

Shoulder month/season - the periods in early spring and late fall where NP customers begin to require some irrigation water, but the agricultural ditches are not yet operational, occasionally resulting in the NP system being supplied by potable water

Shoulder tap - locations where the NP system can take water from the potable water distribution system during the early spring and late fall shoulder months

Summer water use - the amount of water used in summer months, defined as July and August

Tier 1, 2 or 3 - tier of information used to distribute future flow parameters to currently undeveloped areas or areas of redevelopment

Undeveloped land - land that does not currently have development, but may be eligible for NP irrigation when construction is completed in the future; the amount of irrigated area for this type of customer is unknown and therefore estimated.

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Executive Summary

The City of Greeley, Colorado (the City) is in Weld County approximately 60 miles northeast of Denver, east of Fort Collins and Loveland. The City is the twelfth largest city in Colorado and has developed into a cultural and academic hub, hosting educational institutions such as the University of Northern Colorado and Aims Community College. The City offers an affordable cost of living with many options for housing and economic growth. The City's population grew from 20,354 in 1950 to an estimated population of 108,175 in 2019. The City continues to experience strong growth in population through both infill and also through an expansion of residential, industrial, and commercial development within the City's defined service area.

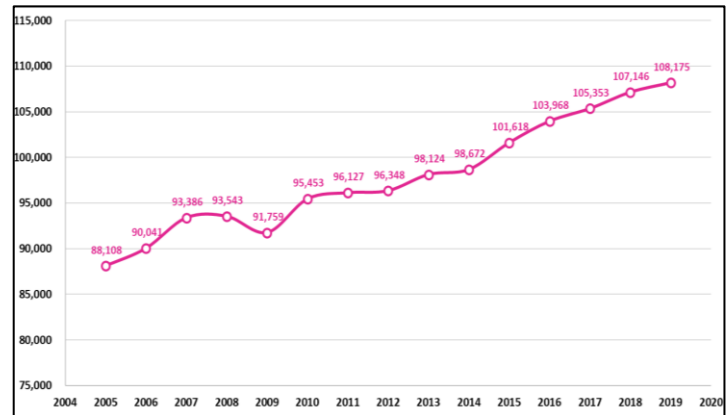


Figure ES-1 Historical Population for the City of Greeley

The 2020 Non-Potable Water System Master Plan (NPMP) is intended to plan for infrastructure growth and develop a capital improvement plan (CIP) for the City's non-potable (NP) irrigation system. The CIP plan will help the City plan for future development and costs both in the short-term and long-term. Continuing to grow and improve the NP system works in tandem with other water conservation efforts to decrease the total potable demand of the City as it experiences ongoing growth through buildout in a semi-arid environment.

ES.1 Greeley Master Plan Integration

To address existing and future system needs, the City developed their 2004 Non-Potable Water Master Plan to forecast water resources and infrastructure needs. The NPMP update occurred concurrently with updates to both the City's Sanitary Sewer Master Plan (SSMP) and the City's Water Transmission and Distribution Master Plan (WTDMP). This provided an ability to use consistent data for population and growth, common planning horizons and an integrated planning approach to CIP development. This approach to integrated master planning provides the City with a defensible and coordinated CIP and allows for the scheduling of CIP projects in ways that minimize the impacts to citizens.

Figure ES-2 illustrates the critical points of coordination between the three master plans.

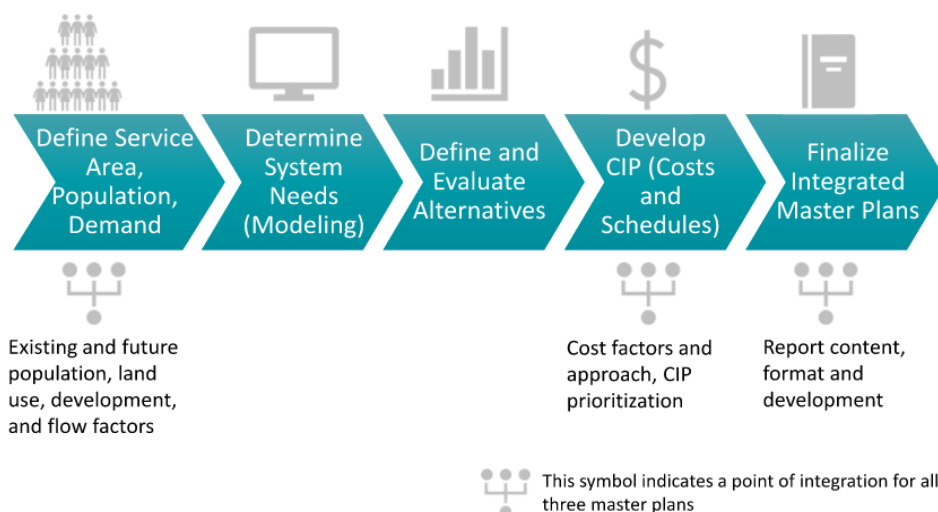


Figure ES-2 Master Plan Approach and Integration with Other Master Plans

ES.2 Existing System Information and Data Collection

The City's NP irrigation system is unique and advanced, particularly for raw water suppliers. In the current system, raw (untreated) water is supplied throughout the City via a system of agricultural ditches and gravity-fed pipes. The water typically flows from these ditches into an intermediate pond before entering a pumped distribution system, which includes 37 disconnected pump stations. This type of system is sometimes referred to as a hub-and-spoke layout. Through this system, the City is able to serve over 100 customers. Growing the NP system and offsetting more potable demands with NP irrigation water is a key goal for the City's water and sewer department.

City-provided data, including mapping, asset information, planning data, development plans, draft policy, and historic records, were used to inform the development of the NPMP. Additionally, a field inventory was conducted to supplement the City's existing geographic information system (GIS) database by geolocating key NP infrastructure, such as pumps, ponds, and valves. All of this information was compiled into a hydraulic model that accurately reflects the existing system. Existing demands were based on billing data and pumping records from July and August in 2018 and 2019 and were calibrated to available supervisory control and data acquisition (SCADA) data.

ES.3 Administrative Considerations

In addition to infrastructure construction and expansion efforts, certain administrative improvements can help the City continue to grow its NP system and act as a leader in potable water conservation and sustainable irrigation practices along the Front Range. The most significant change the City could make to promote NP irrigation would be implement and enforce the revised NP policy, included in **Appendix K**.

Historically, comprehensive data collection has been difficult for NP systems nationwide. Additional studies or data collection, along with more standardized record keeping practices, can

help the City keep track of the overall system. This can include enforcing standards related to construction record drawings, developing and maintaining an internal record-keeping system, creating a plan for regular updates to the GIS database, and/or implementing a computerized maintenance management system (CMMS) for NP infrastructure. Installing SCADA systems at new or rebuilt pump stations can also help with data collection and control.

ES.4 Service Area, Population, and Demand Projections

The City's Long-Range Expected Growth Area (LREGA) is the area where it plans to provide water and sewer services. The future population, and resulting demands, that were distributed over the LREGA for each planning horizon used the "middle" projection from the *City of Greeley Population and Water Demand Projections* (BBC Research & Consulting 2018), referred to as the BBC report, as shown in **Figure ES-3**. Because the 2075 projection does not represent the buildout year for the City within the LREGA boundary, a buildout population was extrapolated using planning data and factors.

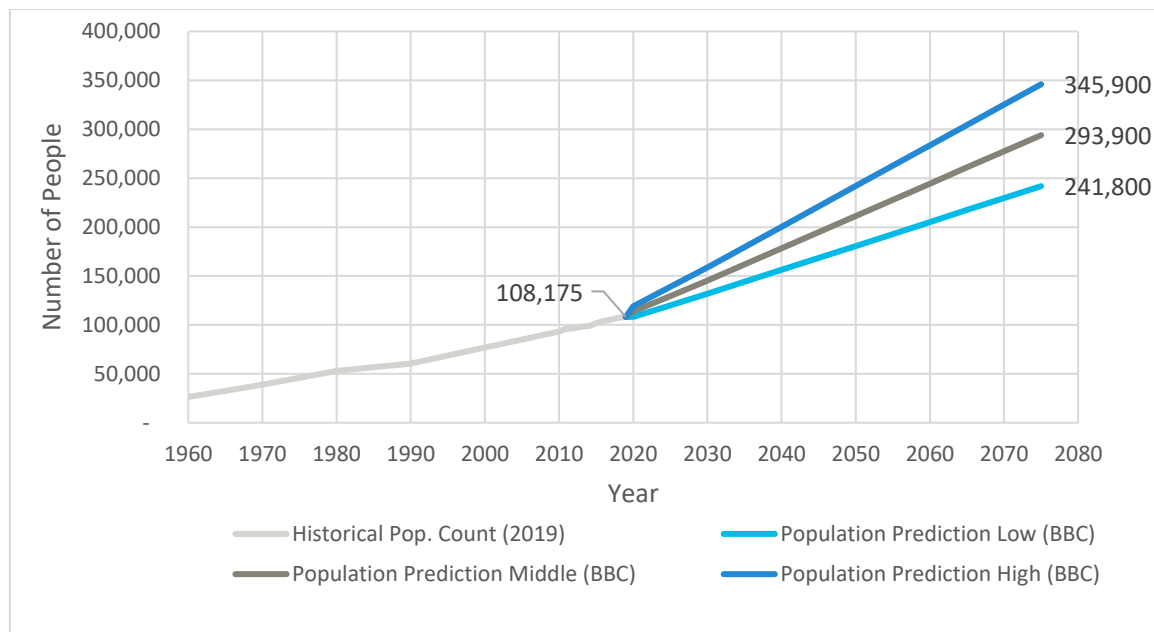


Figure ES-3 Historical and Projected Population

Future NP demand comes from two places: 1) undeveloped land that will use NP irrigation when it develops, and 2) existing areas that may switch from potable to NP irrigation, which are referred to as "conversion areas." Undeveloped land was identified and categorized by land use as part of the WTDMP and SSMP; these land use designations were used to predict NP demand in these areas. Conversion areas were based on the City's knowledge of potential customers; conversion areas are only potential areas that may benefit from NP irrigation but are currently not required to convert.

A set of flow factors were developed that show the expected demand per acre of a certain land use category, or customer type. There are flow factors for irrigated land (defined as the actual acreage of land that is irrigated on a given lot) and bulk land (defined as the total acreage of a

given parcel, including impervious areas). However, just because an area could use NP irrigation, it does not guarantee that it will. To account for this, an adoption rate was applied to each flow factor, which designated the amount of that land that is expected to actually use NP irrigation. The adoption rates were coordinated with the BBC report. It is therefore recommended to use this NPMP for infrastructure planning, and the BBC report for all water resources planning. The total demand projected for both the potable and NP water systems is shown by planning horizon in **Table ES-1**.

Table ES-1 Peak Month Demand by Planning Horizon

Planning Horizon	Total Water Demand (MGD)	Potable Water Demand (MGD)	Non-Potable Water Demand (MGD)
Existing	47.3	46.0	1.3
2025	51.8	49.4	2.4
2040	61.0	56.9	4.1
Buildout	106.3	93.5	12.8

While the NPMP is primarily focused on planning for infrastructure needs based on peak summer demands, it is also important for the City to plan for the total annual water demands through buildout. Water conservation methods, such as improved landscaping practices and the encouragement and adoption of NP water for irrigation, may help reduce the City's annual water demands. The BBC report focused on developing three alternative scenarios for annual water demands. The total annual demands developed for the WTDMP under the NP offsets demand scenario at buildout are captured in **Table ES-2**.

Table ES-2 NPMP Annual Demand Projections at Buildout

Demand	Total Water Demand (AFY) ²	Potable Water Demand (AFY)	NP Water Demand (AFY)
Existing	30,500	28,600	1,900
Future Demands	33,500	28,300	5,200
New I-H Users (6)	10,300	10,300	0
Total	74,300	67,200	7,100

¹ Potable demand shown in this table is for the NP offsets demand scenario.

² AFY = acre-feet per year

ES.5 Model Evaluation and Infrastructure Planning

The existing and future NP system was analyzed using both a hydraulic model (InfoWater) and various desktop analyses that used existing and projected future demands against the system requirements, as outlined in the City's Design Criteria and Construction Specifications, 2008 (City's Specifications). These requirements are summarized in **Table ES-3**.

Table ES-3 System Evaluation Criteria

Metric	Evaluation Criteria	Comments
Piping		
Pressure	70-100 pounds per square inch (psi)	
Velocity	< 5 feet per second (fps)	
Headloss	< 10 ft / 1,000 ft	
Minimum Main Size	8 inches	Not specified in the City's Specifications, City preference for future.
Maximum Inlet Pipe Headloss	6 inches	Not specified in the City's Specifications, but generally considered to be good practice.
Pumping		
Pumping Capacity	120% of peak hour	
Irrigation Window Assumed	10 hours / day	Not specified in the City's Specifications. For irrigation-only pumps, does not apply to transfer pumps.
Pump Station Layout	No standby pump, however low flow pump required	
Ponds		
Storage Volume	4 times peak day + losses	
Demands		
Daily Irrigation Application Rate	24 gallons per minute per acre (gpm/acre)	Peak season metric used in the design of irrigation systems per the City's Specifications. This value is appropriate for areas where the exact irrigated acreage is known but is not appropriate for planning-level estimates of bulk undeveloped land.

Table ES-4 summarizes the existing infrastructure and identified deficiencies by buildout. Typical deficiencies include a pump station being undersized by buildout, undersized inlet or outlet piping, or undersized taps.

Table ES-4 Summary of Existing System Analysis

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Balsam Park	N/A	290	51	51	No deficiencies were identified for this pump station.
Bella Romero Elementary	N/A	330	109	109	No deficiencies were identified for this pump station.
Bittersweet Park	N/A	1,000	854	1,160	Small diameter pipes may be producing high headloss; limited data is available on pipe sizes. Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Boomerang	Boomerang North	1,500	769	769	No deficiencies were identified for this pump station.
	Boomerang South	1,500	694	0	This system is being replaced by the Boomerang Regional Pump Station.
	Boomerang Transfer	1,800	951	621	Some of the Boomerang transfer lines are undersized; this issue will be resolved by the construction of the Boomerang Regional Pump Station.
	<i>Boomerang Regional Pump Station</i>	<i>3,260</i>	<i>N/A</i>	<i>2,716</i>	<i>This new pump station is part of a larger redevelopment project and will replace the existing Boomerang South pump station. This pump station is identified as a CIP project.</i>
	North Ridge Transfer	1,800	936	936	No deficiencies were identified for this pump station.
	North Ridge School	2,700	1,205	1,752	No deficiencies were identified for this pump station.
	Poudre River Ranch	175	205	205	The lines to Poudre River Ranch and the pump station do not meet hydraulic design criteria but do not appear to hinder system performance. While there are no recommended changes, additional demand should not be added to this area without upsizing.
Cottonwood Park	N/A	115	69	69	No deficiencies were identified for this pump station.
Delta Park	N/A	95	52	52	No deficiencies were identified for this pump station.
East Memorial	N/A	319	314	440	Bringing on all potential undeveloped and conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each new area is brought on to ensure there is still sufficient capacity.
Glenmere Park	N/A	180	135	304	The inlet may be undersized; inlet pipe size data was not available for this system. Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.
Greeley West Park¹	N/A	2,000	72	861	No deficiencies were identified for this pump station.
Highland Hills Golf	N/A	2,001	1,792	1,792	No deficiencies were identified for this pump station.

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Island Grove and Saddle Club	Island Grove West	600	605	605	No deficiencies were identified for this pump station.
	Island Grove East	700	401	401	No deficiencies were identified for this pump station.
	Saddle Club	300	72	138	No deficiencies were identified for this pump station.
Jackson Field Sports	N/A	400	258	317	No deficiencies were identified for this pump station.
Josephine Jones Park	N/A	115	106	161	Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.
Linn Grove Cemetery	N/A	350	95	122	No deficiencies were identified for this pump station.
Luther Park	N/A	530	492	498	The small pipe diameter (4") at the outlet does not meet hydraulic design criteria; while this does not hinder system performance, it should be monitored as demands on the system increase to ensure the wet well is still able to receive sufficient water.
Madison Elementary and Houston Gardens	Houston Gardens	125	310	310	While this system appears to be operating over the pump design capacity, it does not hinder system performance, as this system is designed for low pressures.
	Madison Elementary	500	90	93	No deficiencies were identified for this pump station.
Monfort	N/A	2,400	1,423	1,745	The inlet is slightly undersized (10" diameter); while this does not hinder system performance, it should be monitored as demands on the system increase to ensure the wet well is still able to receive sufficient water.
Peakview Park	Mosier Hill	800	681	681	The pipes at Peakview Park have a small diameter (as low as 4") and do not meet hydraulic design criteria. Although this does not appear to significantly hinder system performance, the City may consider upsizing if other work is already being done in this area.
Promontory Park	Main	2,100	1,270	1,866	No deficiencies were identified for this pump station.
	Transfer	1,600	1,651	1,651	While this pump station sometimes operates over its design flowrate, it is not significant enough to warrant upsizing. If additional demands in this area increase transfer station operations, expanding the length of time the transfer station operates each day will likely maintain an acceptable flowrate.

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Ramseier	N/A	450	734	739	Additional evaluation of this site is needed as outlet pipe size and SCADA data were not available. While current modeling shows that the system is operating over the design head, the peaking factor may be lower than the system-wide diurnal curve, resulting in lower peak demands.
Sanborn Park	N/A	500	268	289	Small diameter lines may be causing high headloss; limited data is available on pipe sizes.
St. Michaels	N/A	1,120	1,121	1,167	This pump station may be undersized. Additional evaluation should be conducted to determine if demand management is effective and whether the pumps can be upsized without replacing the entire station.
Tech Center	N/A	N/A	N/A	N/A	This area is currently only served by a shoulder tap. A pump station is necessary to transition it to NP irrigation (future service area SA-14).
Youth Sports Center	Youth Sports	1,200	941	941	The inlet line does not meet hydraulic design criteria but does not appear to hinder system performance. This line should be evaluated as each new area is brought on to ensure there is still sufficient capacity.
	Twin Rivers Park	4,200	1,314	1,692	No deficiencies were identified for this pump station.

¹ Greeley West Park is planned for replacement before 2025. The values shown in the table represent the design for the new pump station.

Table ES-5 summarizes anticipated future infrastructure through buildout. It is important to note that the majority of future infrastructure will be built by development as the City grows. Future infrastructure is expected to continue using a hub-and-spoke methodology, where future parks are equipped with ponds and pump stations to serve as the hubs of future NP systems.

Table ES-5 Proposed Infrastructure by Planning Horizon

Planning Horizon	Pump Stations ¹	Storage in Ponds (AF) ²	New Pipeline (ft) by Diameter					Total
			8-inch	10-inch	12-inch	16-inch	30-inch	
Existing	37	Unknown	23,100	17,600	12,200	3,400 > 12"		90,000
2025	5	35.1	21,800	18,500	0	19,000	26,700	86,000
2040	10	28.1	26,900	11,500	0	8,200	0	46,600
Buildout	18	75.7	28,300	1,000	200	14,800	0	44,300
Total New	33	139.0	77,000	31,000	200	42,000	26,700	150,200

¹ All new pump stations are expected to have a pond.

² AF = acre-feet

Figure ES-4 shows both the existing and future system by planning horizon. Pump station locations and pipeline alignments are approximate and schematic.

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ES.6 Capital Improvement Plan Projects and Schedule

The opinion of probable construction cost (OPCC) is the anticipated bid cost of a capital project. The project CIP costs include the OPCC and project implementation costs, such as planning and design, administration, and construction management. Assumptions made during CIP development can add to the variability of final bid project costs when compared to the planning level costs. The assumptions are necessary to capture the costs for project elements that cannot be defined at a planning level. Project costs were developed using modeled pipeline quantity estimates and data, then multiplied by unit cost estimates. During design development, the more specific data will be used to inform the design and the resulting project cost estimate. **Table ES-6** provides a breakdown of the different costing factor assumptions used for project implementation and contingency.

Table ES-6 Costing Factors for Construction Bid and Total CIP Project Costs

Category	Item	Costing Factor
Construction Bid Cost (includes infrastructure and contractor overhead, profit, bonds, and insurance)	Erosion Control/Stormwater Pollution Prevention ¹	2%
	Mobilization and Demobilization ¹	5%
	Contingency ²	35%
Project Implementation ³	Feasibility and Site Studies	9% for OPCC ≤ \$1 million 6% for OPCC of \$1 million to \$10 million 5% for OPCC > \$10 million
	Preliminary and Final Design	9% for OPCC ≤ \$1 million 6% for OPCC of \$1M to \$10 million 5% for OPCC > \$10 million
	Engineering Services During Construction	5%
Additional Project-Related Costs ³	Outside Construction Management - not used if OPCC is < \$1M	5%
	Outside Project Management - not used if OPCC value is < \$1M	3%

¹ Construction costing factors for erosion control/stormwater pollution prevention, mobilization, and demobilization are added to the subtotal of unit cost items.

² Contingency is 35% of the subtotal of the unit cost items and contractor born costs determined by costing factors.

³ Project implementation and additional project-related cost categories are determined as a percentage of the construction cost and part of the total CIP project costs.

ES.6.1 Identified CIP Projects

Table ES-7 summarizes the anticipated capital projects through the 5-year and 20-year planning horizons. Costs for some projects are shared proportionally across the City's water and sewer department, the City's parks department, and with development entities. The split shown in **Table ES-7** has been calculated from the anticipated total demands at buildout that each of these parties is responsible for. For each project these costs and splits will need to be refined during the development plan review process.

Table ES-7 Summary of CIP Projects

Projects	Funding Source ¹	Planning Start Year ²	Design Start Year ²	Construction Start Year ²	Total Cost ³	City of Greeley Water/Sewer	City of Greeley Parks	Development
5-Year Planning Horizon								
SA-44 Centennial Park	Service Expansion	W/S, Parks, Dev	2021	2022	\$5,030,000	\$3,488,100	\$1,379,300	\$162,600
Boomerang Regional Pump Station	Service Expansion	W/S, Parks, Dev	2021	2022	\$6,920,000	\$221,300	\$694,000	\$6,004,700
Boomerang Regional Phase 2	Service Expansion	W/S, Parks, Dev	2021	2022	\$2,390,000	\$76,400	\$239,700	\$2,073,900
Greeley West PS Replace	Service Expansion	W/S, Dev	2022	2023	\$7,470,000	\$6,161,400	-	\$1,308,600
Upper Equalizer Project	Shoulder Season Extension	W/S	2023	2024	\$25,620,000	\$25,620,000	-	-
SA-14 Tech Center Supply	Service Expansion	W/S, Dev	2025	2026	\$5,930,000	\$17,100	-	\$5,912,900
Promontory Park Expansion	Service Expansion	Development	2025	2026	\$720,000	-	-	\$720,000
Monfort Expansion	Service Expansion	W/S, Parks, Dev	2025	2026	\$500,000	\$245,300	\$76,000	\$178,700
Twin Rivers Expansion	Service Expansion	W/S, Parks, Dev	2025	2026	\$2,390,000	\$1,172,400	\$363,300	\$854,300
SA-38 1st Ave Pond	Service Expansion	W/S, Dev	2025	2026	\$3,590,000	\$2,881,600	-	\$708,400
SA-25 Westgate Regional Pump Station	Service Expansion	W/S, Parks	2026	2027	\$2,670,000	\$2,038,415	\$631,585	-
SA-25 Westgate Regional Phase 1	Service Expansion	Dev	2026	2027	\$1,160,000	-	-	\$1,160,000
SA-60 Lake Bluffs	Service Expansion	W/S, Dev	2026	2027	\$6,050,000	\$57,000	-	\$5,993,000
5-Year Subtotal					\$70,440,000	\$41,979,015	\$3,383,885	\$25,077,100
20-Year Planning Horizon								
SA-34 30th St/17th Ave	Service Expansion	W/S, Parks, Dev	2028	2029	\$2,880,000	\$1,932,500	\$281,200	\$666,300
Boomerang Regional Phase 3	Service Expansion	W/S, Parks, Dev	2029	2030	\$8,000,000	\$255,900	\$802,300	\$6,941,800
SA-4 35th Ave/O St	Service Expansion	W/S, Dev	2029	2030	\$1,170,000	\$262,400	-	\$907,600
SA-3 35th Ave/AA St	Service Expansion	Development	2030	2031	\$2,190,000	-	-	\$2,190,000
Bittersweet Park Expansion	Service Expansion	W/S, Parks, Dev	2030	2031	\$3,160,000	\$2,475,181	\$684,819	-
SA-35 44th Ave/F St	Service Expansion	W/S, Parks, Dev	2031	2032	\$2,580,000	\$166,000	\$658,300	\$1,755,700
SA-36 59th Ave/10th St	Service Expansion	W/S, Parks, Dev	2032	2033	\$8,190,000	\$3,810,800	\$2,569,500	\$1,809,700
SA-16 95th Ave/16th St	Service Expansion	W/S, Dev	2035	2036	\$5,260,000	\$205,300	\$610,300	\$4,444,400
SA-14 Tech Center Expansion	Service Expansion	W/S, Parks, Dev	2036	2037	\$3,460,000	\$10,000	-	\$3,450,000

Projects	Funding Source ¹	Planning Start Year ²	Design Start Year ²	Construction Start Year ²	Total Cost ³	City of Greeley Water/Sewer	City of Greeley Parks	Development
SA-15 37th St/SH-257 Pump Station	Service Expansion	W/S, Dev	2037	2038	\$3,880,000	-	-	\$3,880,000
SA-12 Cobblestone Regional	Service Expansion	Development	2038	2039	\$4,260,000	\$48,500	-	\$4,211,500
Glenmere Park Expansion	Service Expansion	W/S, Parks, Dev	2038	2039	\$2,200,000	\$1,427,916	\$603,228	\$168,856
SA-25 Westgate Regional Phase 2	Service Expansion	W/S, Dev	2039	2040	\$1,220,000	\$857,400	-	\$362,600
SA-42 23rd Ave/NW C St	Service Expansion	W/S, Parks, Dev	2040	2041	\$6,030,000	\$2,513,300	\$1,421,100	\$2,095,600
20-Year Subtotal					\$54,480,000	\$13,965,198	\$7,630,746	\$32,884,056
Total					\$124,920,000	\$55,944,212	\$11,014,631	\$57,961,156

August 2020 dollars as adjusted by Engineering News Record Cost Construction Index (ENR-CCI) were used for project OPCCs, total costs, and project fund allocations

¹ W/S: City of Greeley Water and Sewer Department, Parks: City of Greeley Parks Department, Dev: Development

² Project planning, design, and construction years are subject to change pending future project updates, development of projects, and/or schedule changes.

³ OPCC and total costs per project are subject to change pending future project updates, development of projects, and/or schedule changes.

ES.6.2 CIP Implementation Schedule

The CIP schedule implementation process considered several factors that influence a project schedule in addition to the hydraulic evaluation. The City provided the Water and Sewer 10-year CIP, public works CIP, and parks CIP to integrate with projects identified in the WTDMP for developing CIP implementation schedules.

The growth-driven projects will be funded by either the City or developer (or combination), depending on the project driver. Based on the 5- and 20-year CIP schedule, annual funding requirements for City NP projects from 2021 through 2040 are shown in **Figure ES-5**.

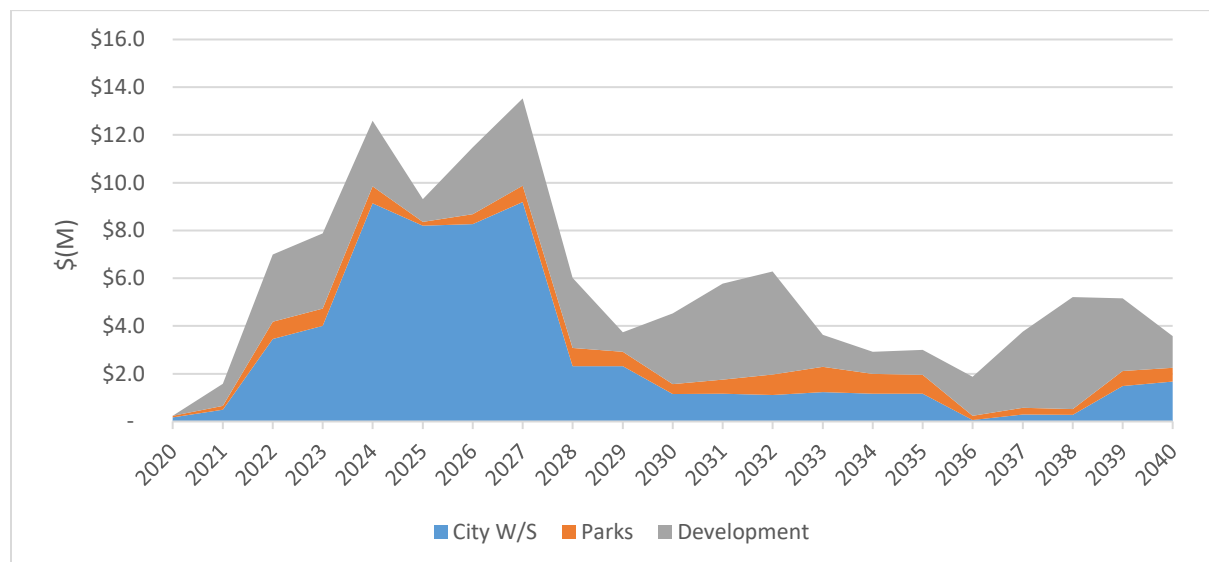


Figure ES-5 Annual NP Funding Projections by Fund

CIP costs are August 2020 dollars from ENR-CCI.

ES.7 Conservatism and Uncertainty in Planning

During master plan development, assumptions were made for existing and future conditions. These included population distribution and flow factors to develop water demand projections for growth and development under future conditions, along with considerations for extreme seasonal conditions that would emphasize higher demands while considering future water conservation planning to help reduce these impacts. The master planning assumptions trended toward conservative values to ensure the potable system was not undersized, which may result in the predicted demands being higher than actual. This NPMP analyzes the existing system and defines future needs, which should be validated by the City as new data becomes available.

The NP water system model, in conjunction with its potable water system companion model, is a tool for analyzing the existing system and defining future capacity needs. Detailed planning and timing of development will inevitably vary from the best planning projections and will result in the need to review areas where the model indicates system deficiencies.

Additional uncertainty can occur during the development of the CIP and, as a result, conservative planning assumptions are used. Planning level cost development considers the major categories

of capital projects but does not include the additional detail available during the preliminary and final design stages of projects. The CIP was developed based on anticipated growth, modeling results, and planning information and is subject to change if the planning information and forecasts shift over time. Prior to COVID-19, a global pandemic, cost inflation tools provided high confidence for predicting unit prices within a given year. However, during and after COVID-19, these cost inflation tools may not be as accurate.

ES.8 Key Findings and Recommendations

The findings and recommendations summarized in this section have been drawn from the planning and evaluation sections of this NPMP. The recommendations identify system needs, actions, and capital improvements through the buildout planning horizon; however, the actual implementation time frame will depend on actual growth rates, order of development, and the level of available capital funding. Additionally, the actual scope and implementation of these recommendations may vary with detailed planning and design.

ES.8.1 Key Findings

Key findings identified as part of the NPMP include the following:

- Discussions with other Front Range stakeholders showed that the City has a unique and advanced NP irrigation system, particularly for raw water suppliers.
- Historically, comprehensive data collection has been difficult for the NP system. Additional studies or data collection, along with more standardized record keeping practices, can help the City keep track of the overall system. Record keeping practices could include recording ditch laterals in GIS, updating and enforcing construction drawing standards, creating a system for regularly updating the NP GIS database, and/or installing SCADA systems.
- Review of historical demands showed that NP usage varied significantly on an annual basis. In particular, demand dropped significantly when parks began the transition process to improved control systems. Future NP demands are expected to come from two sources: 1) undeveloped lands that will use NP irrigation when they develop, and 2) existing areas that will convert to NP irrigation, defined as conversion areas. NP peak season demands are expected to increase by 1.1 million gallons per day (MGD) by 2025, 2.8 MGD by 2040, and 11.5 MGD by buildout. NP adoption is strongly influenced by policy, which is a key step for promoting conservation.
- Some of the existing systems were identified as needing improvement, but no critical deficiencies were identified. These include areas that are expected to have undersized inlet lines, pipes, taps, or pumps by buildout.
- New recommended CIP projects were identified. These primarily consist of new pump stations or expansions of existing pipe systems to serve new areas and customers. New pump stations will be primarily constructed by developers. It is estimated that the system will need 4 new pump stations by 2025, 12 new pump stations between 2025 and 2040, and 19 new pump stations between 2040 and buildout.

ES.8.2 Recommendations

The recommendations for the NPMP include the following:

- Implement and enforce an NP policy to promote and expand NP irrigation practices. It is recommended for this policy to mandate that new developments and redevelopments use NP irrigation and for the policy to generally encourage the growth of the NP system.
- Implement improved operational practices at existing pump stations as it becomes necessary. Also implement improved operational practices during other construction, such as rehabilitating a park irrigation system. Improved operational practices can include items such as increasing the watering window to reduce peak hour demands by decreasing the size of irrigation zones and implementing SCADA where not currently installed. It is recommended for customers to use a watering window of 10 hours a day, where possible, and to use the best landscaping practices included in **Appendix F**.
- Create new standards for data collection and record keeping. This can include enforcing standards related to construction record drawings, developing and maintaining an internal record-keeping system, creating a plan for regularly updating the GIS database, and/or implementing a CMMS for NP infrastructure. It is also recommended that the City conducts a study of ditches and laterals throughout the LREGA and requires developers to include this data in their plans.
- Implement and enforce requirements for the installation of SCADA systems at new or rebuilt pump stations. The City may consider including SCADA requirements in the City's Specifications.
- Continue monitoring and recording demands and pump station flows to identify major changes in operations that may impact system performance.
- Evaluate the St. Michaels pump station to determine whether additional construction is needed at this site to meet higher demands. This evaluation should determine whether demand management could be an effective solution, and whether the pumps can be upsized without replacing the entire pump station.
- Continue maintenance of the InfoWater model. This can include adding new pipes, deleting abandoned pipes, tracking open and closed valves, and reflecting operational changes as the system continues to expand.
- Coordinate this NPMP with other relevant planning documents, such as the WTDMP, SSMP, *Imagine Greeley Comprehensive Plan*, and BBC report. It is recommended to use this NPMP as a guide for infrastructure planning, and to use the BBC report as a guide for water resources planning.
- Continue building the NP system through a hub-and-spoke methodology, as defined earlier. Consider looping or connecting systems where systems are on similar hydraulic grade lines, as looping would improve operational flexibility.

- In areas with limited or interim development, require the construction of NP infrastructure, such as a piped irrigation system, even if a pump station will not be constructed until a later time.
- New pipe and pump station layouts are conceptual in nature and are primarily intended to show hydraulic feasibility for master planning purposes. Conduct a detailed evaluation of pipe alignment and size as well as pump station location and sizing as projects move into design and implementation stages when there is more certainty of development and design criteria. The InfoWater model, if regularly maintained, can be used as a tool to support future planning decisions.
- Complete the capital improvements recommended in **Section 6**, prioritizing the 5-year CIP recommended projects. Coordinate closely with the City's parks department, other utilities, and developers to regularly update the scheduling of these projects. The City should consider using the InfoWater model as a tool to inform developer plans while coordinating with them.
- Update the NPMP every 5 years, including reevaluating demand and population projections every 5 to 10 years. Planning assumptions made for the NP system in the next 20 years and beyond are subject to change with time.

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Section 1

Background Information and Project Purpose

Reliance on NP irrigation and improved irrigation practices is a key part of the City's water conservation plan. The NPMP covered in this report will help the City provide untreated irrigation water to large turf areas, which will help preserve potable water for other uses, reduce treatment costs for the City's water and sewer department, and lower irrigation costs for customers. This master plan update documents the approach and assumptions used to evaluate the system while defining the capital improvements needed for the long-range CIP for the NP system through the year 2040. To plan for the future NP needs of the City, background information was first collected on the historic and current NP water system and is described further below.

1.1 Master Planning Process and Organization

The NPMP was developed in conjunction with the City's SSMP and WTDMP. The City integrated the three master plans, creating a consistent approach to determining existing and future population and water demands and to defining capital projects and costs. A schematic of the City's integrated water system for water, wastewater, and non-potable water is shown in **Figure 1-1**.



Figure 1-1 Greeley's Integrated Water System

The future population projections and associated water demand, planning horizons, and approach to capital and project cost development are consistent between the three master plans, as shown in **Figure 1-2**. This figure also shows the critical points of coordination between the three master plans.

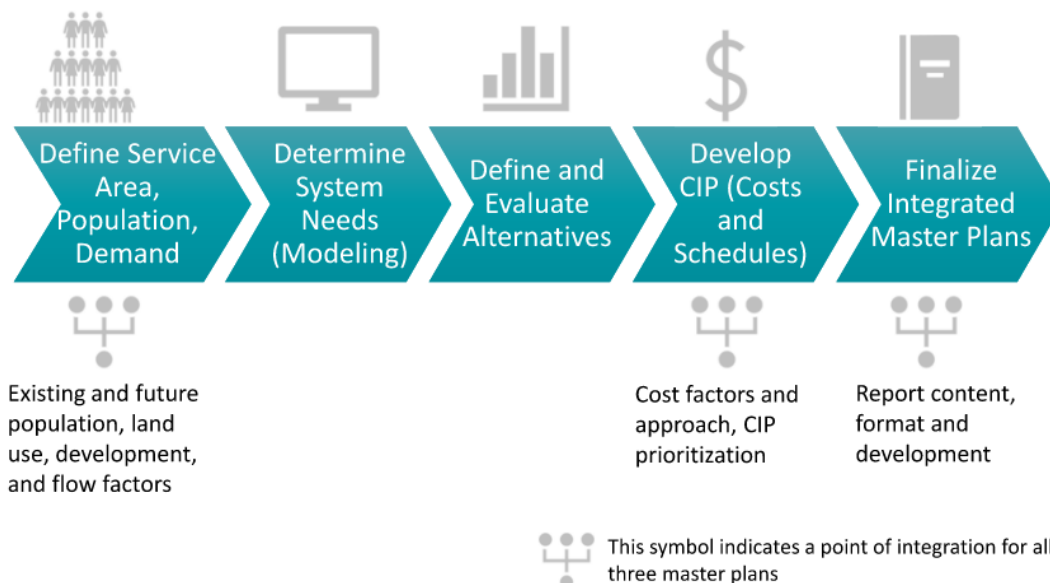


Figure 1-2 Master Plan Approach and Integration with other Master Plans

1.1.1 Report Organization

The NPMP is organized into the following sections:

- Section 1 – Background Information and Project Purpose
- Section 2 – Administrative Considerations
- Section 3 – Demand and Economics
- Section 4 – Development of the Non-Potable System Model
- Section 5 – Existing and Future System Model Evaluation
- Section 6 – Capital Improvement Plan
- Section 7 – Findings and Recommendations

1.2 Review of Existing Data and System

Before any other data gathering was initiated, information on the existing system was collected from the City files. This information primarily came from the two former NPMPs (dated 2002 and 2004), which provided overarching views of the City's goals, strategies, and specific plans for the NP system. These plans analyzed the then current and potential sources of supply and demand, established design and costing criteria for future projects, and examined options for the use of surplus NP water.

Part of the review of the existing system involved examining the records of existing infrastructure and construction projects. This data was checked by field visits and incorporated into the GIS. A new NP tagging and naming convention based on the City's standard naming scheme was established and will be used to describe the existing and future infrastructure. This naming system is included in **Appendix B**.

In general, the City's NP system operates using a "hub-and-spoke" approach, where a pump station (the hub) serves the irrigated areas (the spokes) without any connections to other pump stations or NP systems. Each of the individual systems has a unique setup, as described in **Section 4.1**. A typical NP system is shown in **Figure 1-3**. However, each individual system may differ in whether it pulls from a ditch or well, whether there is an intermediary pond, and how many pumps it has. Detailed descriptions of each system are included in **Table 4-1** and a map of all pump stations is included in **Figure 1-4**.

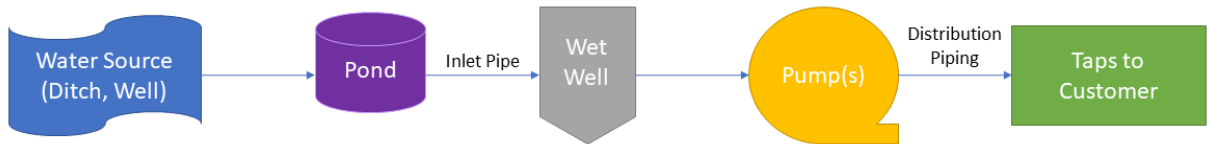
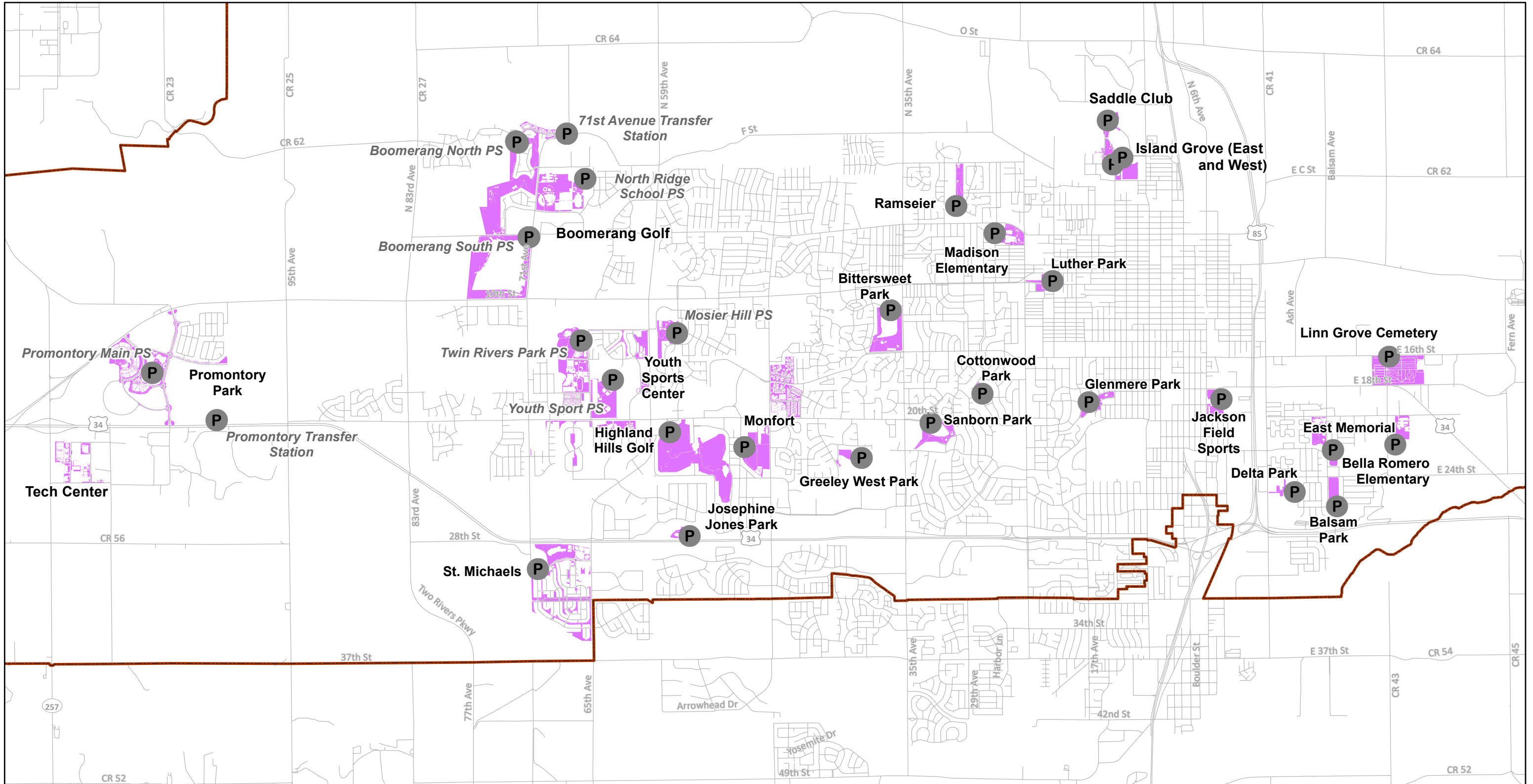


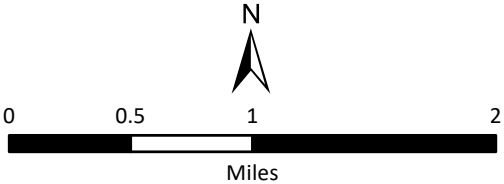
Figure 1-3 Typical NP System Schematic

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Legend

-  LREGA
-  Pump Station
-  Existing NP Irrigated Areas



Existing Non-Potable Service Areas
Figure 1-4
Greeley Non-Potable Water
System Master Plan

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1.3 Field Visit Data

Field data was collected at each site and locations and elevations of features were recorded using a global positioning system (GPS) unit (Trimble Geo 7x). The GPS unit is accurate within a meter of the exact location. Along with the spatial data, specific operational information for each component was also recorded, as well as any of the operators' background knowledge on the specific item. Major system components visited included pump stations, meters, valves, wells, head gates, and storage ponds. For the pump stations, information that was collected included the number of pumps, the model numbers of the pumps and motors, the operating speed, the visual condition of the equipment, and the condition of the pump house. The unique meter number for each meter was also recorded, along with the transmitter number and diameter of the meter piping. The location and elevation of each valve was taken, and a note was made if the valve was equipped with a powered actuator. Notes were taken detailing the control logic for all actuating valves inventoried. The breakdown of components can be found in **Appendix A**. This information was compiled into a single database spreadsheet and used to update the NP GIS database.

1.4 GIS Mapping and System Inventory

Previously existing GIS data contained spatial locations for both point and linear NP water infrastructure. The point data included wells, pump stations, meters and valves. NP lines, ditches and irrigation areas were all contained in the linear data. Within the attribute table of each shapefile, there is additional information corresponding to each individual component within that infrastructure category. This information is summarized in **Table 1-1**.

Table 1-1 Previously Existing GIS Information

Type of Information	Number of Features	Relevant Attributes
Wells	51	Location, Type of well
NP pump stations	37	Names, Approximate addresses (incomplete)
NP meters	73	Customer number, Transmitter number, Meter number, Approximate addresses (incomplete)
Valves	383	Type of valve, R angle
NP irrigation areas	42	Name of well that supplies the area, Surface area
NP pipes	563	Length, Material, Installation year, Diameter
NP ditches	66	Name, Length, Above or below ground

Review of the GIS data with the operations team revealed that much of this information was either incomplete or out-of-date, especially the wells, ditches, and NP irrigation areas. The data from the field inventory was used for the wells, pump stations, and valves. The GIS data did not include a ponds shapefile; instead, information on ponds was included from the field data or historical documents and drawings. For the pump stations that were not included in the original GIS data, the data from the field inventory or historic documents was used. The NP GIS system should continue to be updated and maintained in the future. The NP pipelines are summarized by diameter in **Table 1-2**.

Table 1-2 Non-Potable Pipe Lengths from City GIS Data

Pipe Diameter (in)	Total Length (ft)
0 (Blank) ¹	4,296
1	17
2	4,022
3	739
4	5,114
6	19,515
8	23,094
10	17,616
12	12,238
14	706
15	370
18	2,106
20	140
24	49
Total	90,022

¹ Pipes with no diameter were reconciled as part of model connectivity updates, described in **Section 4.1.1**.

Review of the NP pipelines shapefile showed that the file was not fully representative of the current system. This shapefile was updated extensively to support model connectivity and an updated shapefile was provided to the City. The following assumptions and key fixes were used to support connectivity:

- Pipes that were within 3 feet of another feature, such as collected field data, were rerouted to connect through that point.
- Pipes without a diameter were assigned a diameter based on design drawings or the diameter of connected features, such as pumps or valves.
- Areas with other NP infrastructure, but no pipes, had pipes added based on design drawings, City operator knowledge, or typical layouts for NP pump stations.
- Two-inch lines were drawn from main lines to meters where relevant.
- Topology checks were used to reconcile pipes that were not connected to each other, identify duplicate features, etc.

Operations and Maintenance (O&M) data for each pump station, as available, was also reviewed. This included original constructions documents, O&M manuals (including pump curves), equipment details, photos of the site, and other historical information. Some of this data was outdated and reflected historic construction, not current conditions. The data provided also contained discrepancies and gaps, due to obsolete data mixed with current data. The data was further reviewed in team meetings to ensure that a comprehensive and accurate understanding of the system was being incorporated into the model.

Additionally, hourly SCADA data was used for the past five years (September 2015 to September 2020) to evaluate the accuracy of the model of the existing NP system and to create diurnal curves that reflect current system usage. SCADA data was not available for all sites. **Table 2-5** includes a list of available SCADA data collected by location.

1.5 Zoning and Land Use Information

Current and planned land use and zoning data in GIS format, along with maps of zoning and land use available through previous master plans, was used to map existing NP customers and irrigation areas, and to identify potential new customers, such as parks, golf courses, and cemeteries.

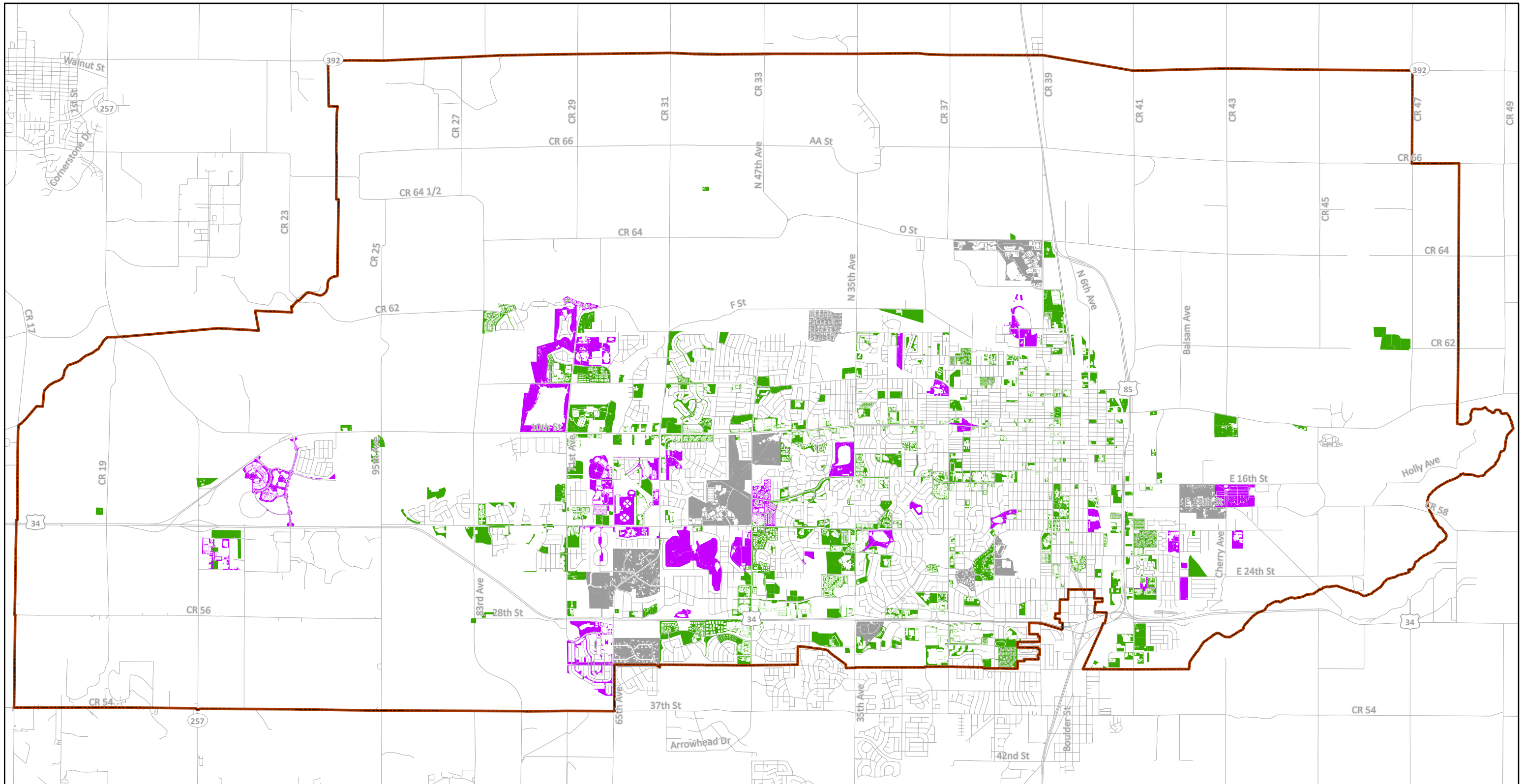
Additional sources of information included planned unit development reports, a revised version of Greeley's Comprehensive Plan map, as well as other information developed in conjunction with the City's planning department as a part of the water and sewer master plans that contained detailed land use information. This information was used to develop future potable water and sewer demands, which are the basis for the development of future NP demands.

Parks represent a crucial existing and future demand, so the 2016 Parks, Trails, and Open Lands Master Plan was used to address future park demands. This master plan provides information on current parks, as well as park service goals and potential locations for future parks. These details were used to establish park demands for the future planning scenarios.

Current potable water customers were evaluated to determine areas that would be suitable for conversion to NP irrigation. These areas, referred to as conversion areas, were provided on three shapefiles and two PDF maps that showed the names of many of the systems. Conversion areas are discussed in **Section 3** of this report.

The City's NP water system currently serves several areas of varying land use, which includes residential areas, golf courses, parks, and schools with a combined total irrigation area of 890 acres. The current irrigation areas, including areas that are irrigated by private systems, can be seen in **Figure 1-5**. Private systems were not addressed as part of the master plan, as the master plan focused solely on City-owned infrastructure.

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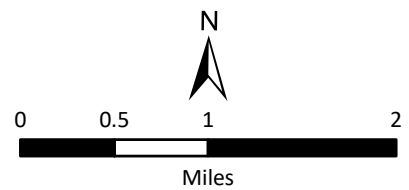
City of Greeley
Great. From the Ground Up.



CDM Smith
February 22, 2021

Legend

-  Long-Range Expected Growth Area (LREGA)
-  Existing NP Irrigated Areas
-  Private NP Systems
-  Conversion Areas



0 0.5 1 2
Miles

Non-Potable Water
Master Plan Area
Figure 1-5
Greeley Non-Potable Water
System Master Plan

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1.6 Review of Supply and Demand

To determine reasonable expectations for supply and demand projections, historic projections were examined. The BBC report was also considered for supply and demand projections. The BBC report projects the NP water demand for an assumed buildout year of 2065 under three scenarios: low, middle, and high. As noted in the report, the middle projection represents the most likely demand scenario. Notably, the middle scenario for total water consumption produces the highest NP consumption. The BBC report included total projected demand at five-year increments, as well as the likely adoption rates per customer type. The results of the NP water demand projections from the BBC report are summarized in **Figure 1-6**.

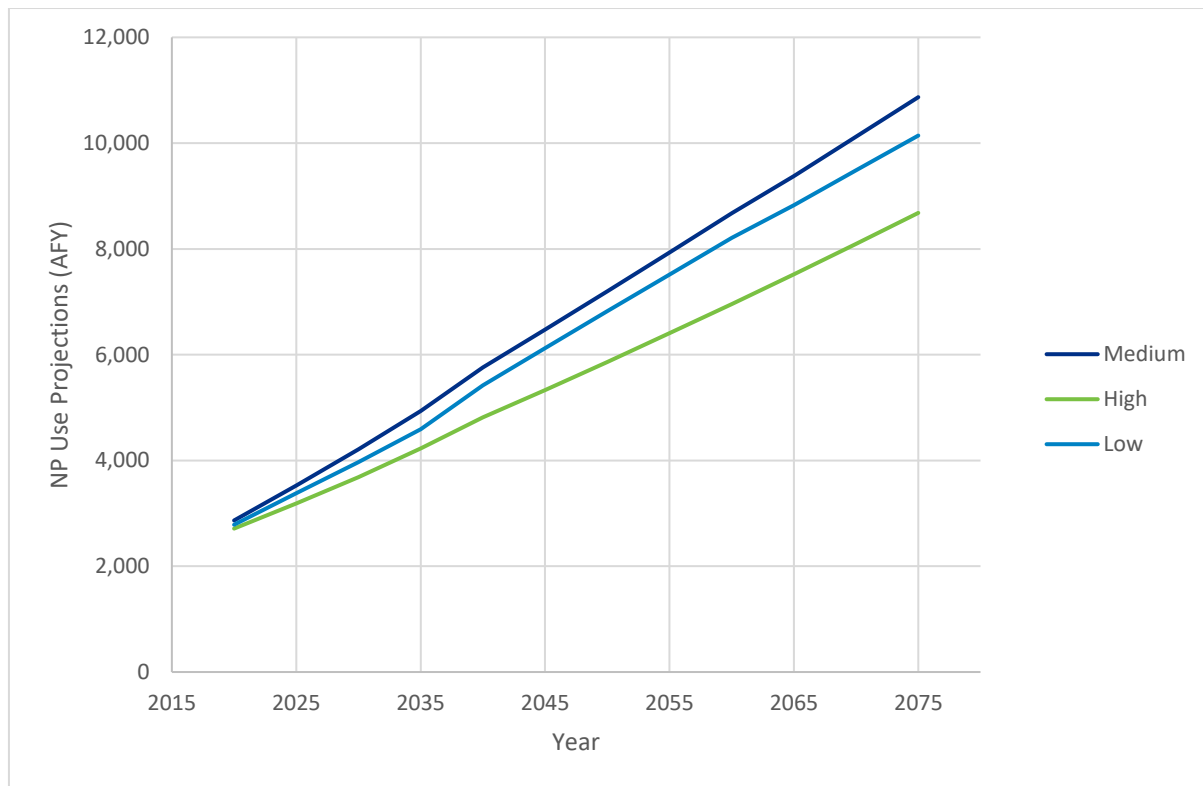


Figure 1-6 Non-Potable Use Projections (BBC Report, 2018)

To determine the actual NP water demand, the most recent water billing data was used. Billing data provided monthly demands from 2014 through 2019. The analysis of the provided data revealed a significant annual variation in demands, as shown in **Figure 1-7**. This annual variation could be due to changes in the City's irrigation control systems which significantly improved irrigation efficiency, especially in parks. As a result, only 2018 and 2019 billing data was used for the development of the models.

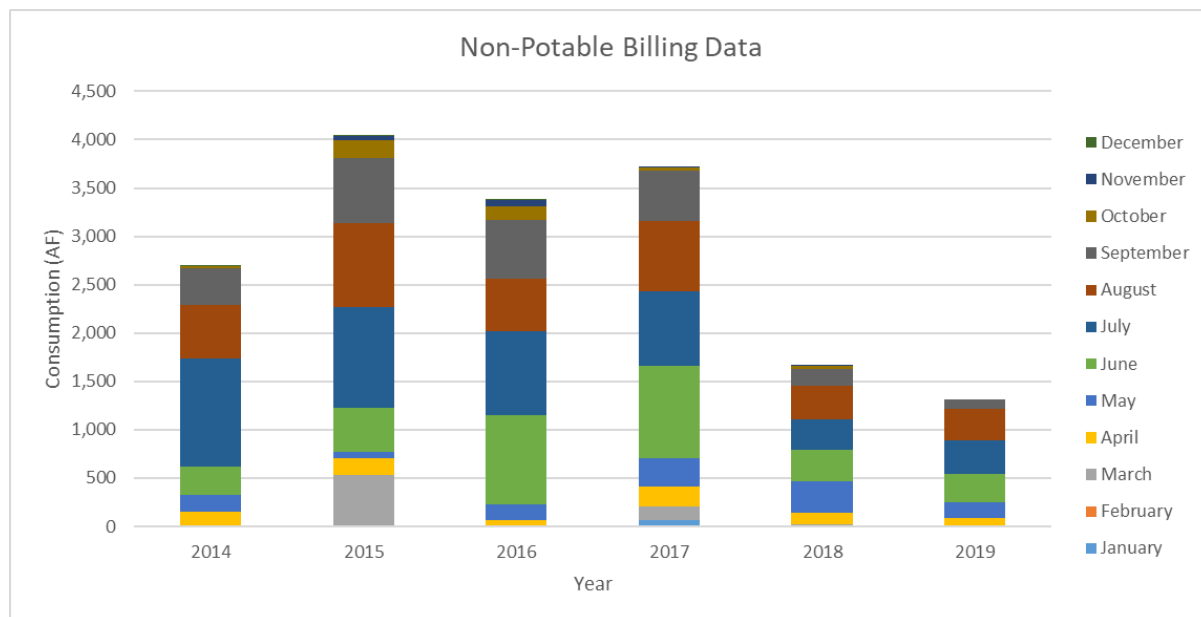


Figure 1-7 Non-Potable Demands (Billing Data)

The billing data was used to project NP demands through buildout. The demand that cannot be supplied by current NP infrastructure helped determine the necessary projects for the CIP. NP water demands were allocated with greater detail and are described further in **Section 3** of this report.

1.7 Costing

Data was collected for the pricing of CIP projects from several sources. This data was consistent across all three master plans. These sources included previous City bid tabs, City CIP databases (such as Greeley's CIP database for water, wastewater, and NP water projects), bid tabs from past CDM Smith projects along the Front Range and in Texas, as well as a consultant project cost estimator. Incorporating multiple data sources makes typical unit costs more robust. Analysis and selection of these line item unit costs are covered in **Section 6** of this report.

In the future, the City may consider mandating NP irrigation for new developments based on economic feasibility, and/or subsidizing NP infrastructure to make it economically feasible. Because of this, City policy could have a large impact on NP adoption. The City provided its draft policy, which was used as a basis for economic considerations. As of writing, the final policy has not been approved by the Water and Sewer Board. As a result, revisions to the draft policy may affect economic feasibility calculations. The final policy is attached in **Appendix K**.

1.8 Ongoing Projects

There are two ongoing projects considered in the NPMP: the Poudre Ponds Complex Project (Poudre Ponds) and the Upper Equalizer project. The information on both these projects is based on the 2016 City of Greeley Non-Potable Water Supply Upper Equalizer Infrastructure Feasibility Study. The Poudre Ponds project is also studied in greater depth in the 2021 Poudre Ponds

Reclamation and Restoration Improvements Project Mini Master Plan, which evaluated plans based on 2030 and 2065 demand scenarios.

The Poudre Ponds project seeks to expand an existing storage site by constructing a gravel pit pond and pump station on a newly acquired parcel. Project goals include improving water supply reliability, NP storage, and community assets via site enhancements for wildlife and recreation. This new pump station will convey 23 cubic feet per second (cfs) to the Greeley No. 3 Ditch or 27 cfs to the Poudre River, returning water back to its source as part of a water rights exchange.

The Upper Equalizer project seeks to expand an existing NP pump station, which currently provides irrigation to a golf course and high school. This project will transfer 31 cfs peak flow from the Greeley No. 3 Ditch to the Greeley-Loveland Irrigation Company (GLIC), which is 4 miles away, with about 200 feet in elevation gain. As 71st Avenue was paved since the writing of the feasibility report, the routing of the pipeline was changed to 83rd Avenue. The NPMP was coordinated with the ongoing design as available and the 31 cfs transfer was incorporated into the plan.

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Section 2

Administrative Considerations

In addition to the infrastructure construction and expansion, certain administrative improvements can help the City continue to grow its NP system and act as a leader in water conservation along the Front Range. This section describes recommendations related to policy, operations, monitoring, and data collection.

2.1 Stakeholder Engagement

Stakeholder engagement efforts were conducted with several local communities and municipalities in the Front Range to identify current system practices, user trends, planning recommendations, and economic considerations surrounding design and expansion of NP systems. These included the City of Westminster, Denver Water, the City of Evans, and the Town of Windsor. Through this process, it was discovered that the City's current NP system is more developed than many other surrounding raw-water suppliers.

Discussion topics during these meetings included factors for site selection, best practices for NP implementation, and potential challenges of NP use. Considerations for site selection include picking high acreage areas with a preference for larger customers, limitations based on pressure zones, economics (cost savings associated with cheaper irrigation water compared to potable), land use/zoning laws, and regulations regarding water reuse. Common best practices include the use of design standards to regulate construction, irrigating at night, use of subsidies to encourage implementation, and NP promotion through sustainability campaigns. Potential challenges with operating an NP system include the variability of supply of reuse water (raw water is less variable), water quality impacts on the distribution system and vegetation, additional education and focus on public perception, more training required for employees, and higher cost of treating NP water for communities that use potable reuse.

2.2 NP Policy Considerations

Modeling considerations and factors used for the hydraulic modeling of existing and future systems were developed with consideration of the City's current NP water supply policies. The City is currently working on drafting a policy related to NP adoption and standards. Policy-related decisions are a large driving force behind NP adoption, conversion, and expansion, and are a key part of the City's water resources conservation strategy. The NPMP is based on a draft version of the policy, and certain assumptions used throughout may be subject to change, depending on the final version. The following are key points to note from the draft policy and recommendations for the final policy:

- The final policy should mandate NP irrigation for new developments and redevelopments where technically and economically feasible. Mandating and enforcing NP irrigation will help promote sustainability for the potable water system and avoid unnecessary upsizing.

- The City should develop NP water rates based on a cost-of-service study to incentivize NP adoption by reducing the price of NP water compared to potable water.
- Growth should pay for growth. The policy should clarify how new developers participate in the construction of new NP infrastructure.
- Large users should be required to plan for at least an 8-hour watering window. The policy should clarify when this is required and should encourage users to use an even larger watering window, to reduce peak hour demands on NP infrastructure.
- The policy should require new developments to construct NP infrastructure, such as separate irrigation pipelines, even if an NP pump station will not be available until after construction is complete. Information should be included on when and how the City's water and sewer department will pay to upsize infrastructure to accommodate future demands.
- The City should develop an impact fee structure that encourages NP adoption and allows for City investment in upsizing the NP system to be repaid in the future.

2.3 Improved Operational Practices

The existing systems are operated efficiently and proactively. The pump stations are rebuilt on a timed cycle and maintenance is performed annually over the winter. The field inspection confirmed that the systems look and are reported to be well maintained and operated.

As the system expands in the future, some operational practices may need to be modified to expand with the system. Some improvements that would help minimize the operational needs of the future system may include:

- Improved SCADA control and monitoring. Generally, sites must be physically visited to monitor pond levels and check for operational issues. Improved SCADA could allow remote monitoring and automatic control of some processes allowing existing staff to operate additional sites. A suggested "default" SCADA system is listed in the next section.
- Implementing a CMMS to improve data and optimize maintenance activities. Adding NP infrastructure to an existing City CMMS will be considered in the future.
- The following systems have high peaking factors, or very high variability, which means the pump stations are limited by maximum flow but only operate for a short irrigation window. These systems could benefit from a longer watering window which would free up capacity for additional demands. Note that lengthening the water window in some cases may only require reprogramming the irrigation controller, but in many cases may require dividing the irrigation system into additional zones. Therefore, these modifications are likely best accomplished during major irrigation system maintenance or replacement. These systems include the following:
 - Mosier Hill (extremely varied)
 - Bittersweet Park

- Madison Elementary
- Saddle Club (extremely varied)
- Luther Park (extremely varied)
- Island Grove West
- Island Grove East
- Twin Rivers Park
- North Ridge School

2.4 Improved Monitoring Systems and Practices

The current NP system includes basic SCADA status communication. Each pump station is controlled by a vendor provided and programmed “island” programmable logic controller (PLC) that monitors pressure and flow. The PLC also monitors station health and protects the pumps from operating outside of safe ranges. Each station has a radio telemetry unit (RTU) that communicates limited status and data. **Table 2-1** summarizes the available data from each of the existing stations. Ultimately, it is recommended for the City to include SCADA for all existing and future pump stations, and eventually add ditch measurements and controls to the SCADA.

Table 2-1 Available SCADA Data from Existing Systems

Service Area	Pump Station	Flow	Pressure	Wet Well Level	Influent Flow
Promontory Park	Main	X	X	X	
	Transfer	X	X	X	
Greeley West Park	N/A				
St. Michaels	N/A	X	X	X	
Boomerang Golf	Boomerang North				
	Boomerang South				
	Boomerang Transfer	X	X		
	North Ridge Transfer	X			
	North Ridge School	X	X	X	
	Poudre River Ranch	X	X		
Youth Sports Center	Youth Sports	X	X	X	
	Twin Rivers Park	X	X	X	
Highland Hills Golf	N/A	X			
Josephine Jones Park	N/A				
Peakview Park	N/A	X	X	X	
Monfort	N/A	X	X	X	
Sanborn Park	N/A				
Cottonwood Park	N/A				
Bittersweet Park	N/A	X	X	X	
Ramseier	N/A	X	X	X	

Service Area	Pump Station	Flow	Pressure	Wet Well Level	Influent Flow
Madison Elementary and Houston Gardens	Madison Elementary	X	X		
	Houston Gardens	X	X		
Luther Park	N/A	X	X		
Glenmere Park	N/A				
Jackson Field Sports	N/A	X	X	X	
Delta Park	N/A	X			
Balsam Park	N/A	X			
East Memorial	N/A	X	X	X	
Bella Romero Elementary	N/A	X	X		
Linn Grove Cemetery	N/A				
Stoney Brook	N/A	X			
Poudre Ponds	N/A	X	X	X	X
Island Grove and Saddle Club	Island Grove West	X	X	X	
	Island Grove East	X	X	X	
	Saddle Club	X	X		

As existing pump stations are replaced and new pump stations are installed, a unified approach to SCADA communication should be followed to allow for future operations flexibility.

Newly installed or replaced stations should be capable of using the City's preferred Modbus TCP/IP communication protocol. It is anticipated that over time the City's fiber network (or at least broadband) will be extended to all pump stations. Broadband network connectivity will allow both data-rich SCADA, as well as the implementation of monitoring and security systems at each site. Alarms should be capable of custom alarm priorities and call-outs. Generally, any status or control available on the local operator interface should be accessible via SCADA. At a minimum, the datapoints for new equipment should include:

- Status to SCADA
 - Mode (local/off/remote)
 - Running (each pump)
 - Motor speed (each pump)
 - Setpoints (pressure, flow)
 - Station flow
 - Station pressure
 - Wet well level
 - Filter flush

- Alarms
 - All alarms available on the vendor package
 - Fault monitoring
 - Power monitoring
 - Communication lost (outside of vendor package, network side)
 - Intrusion (outside of vendor package)
 - Space temperature (may be outside of vendor package)
 - Smoke/fire (outside of vendor package)
- Control from SCADA
 - Mode (in auto)
 - Run
 - Percent speed
 - Setpoints (pressure, flow)
 - Filter flush interval

In some locations, additional information such as ditch level, pond level, headgate position, or other datapoints may be desirable for remote monitoring and operation.

The overall control philosophy will continue to be stations operated in “island” mode, with the local PLC controlling the system to maintain the operational setpoint and protect equipment. In the future, the capability should be retained for SCADA control and orchestration of multiple pump stations, while the local PLC continues to provide equipment protection.

2.5 Data Collection and Record-Keeping

Historically, comprehensive data collection has often been difficult or impossible for distributed NP systems that were built by multiple parties. However, the City’s unique and advanced system calls for improved data collection and record-keeping practices to be implemented. Master planning efforts revealed certain gaps in data that could be remedied with further studies. The following recommendations may help the City to efficiently keep track of its system, pass on important knowledge and history to future employees, and fill in missing datasets:

- Conduct a study of the ditches and laterals throughout the LREGA. This will help identify good locations for future pump stations in undeveloped areas. Additionally, update the current ditches dataset in GIS to capture all stormwater runoff systems that are actually NP ditches, and vice versa. The City may also suggest having developers provide information on existing ditch laterals in a proposed development area as part of the existing conditions report.

- Update and enforce standards related to construction drawings and record keeping after construction or upgrades of an NP pump station, or other infrastructure. Require that developers provide detailed drawings showing the pump station, irrigation pipelines, and pump curves. The City should also develop and maintain its own internal record-keeping system to identify which documents are the most up to date. A CMMS including NP infrastructure could meet this intent.
- Create a system for regularly updating the NP GIS database. While some NP systems have detailed GIS information, other NP systems are not represented in GIS at all. Designating specific staff members with the task of updating the database after a new project and providing them with standard operating procedures may help with this effort.
- Install SCADA systems at new pump stations and pump stations that do not currently have it, to allow for further monitoring of flows and pressures.

Section 3

Demand and Economics

To plan for the future NP needs of the City, existing and future demands were established, and an analysis of economic feasibility of future expansion was completed. The NP water demands established were used in the WTDMP to show how potable water demand can be lowered by meeting demands that do not require the quality of potable water quality with NP water (e.g., irrigation or construction).

3.1 Existing System Demands

The first step in allocating demands in the NP water model is to examine how the City currently uses NP water. NP water is currently used mostly for irrigation, although it may be possible to expand the system so that it can meet some other demands that do not require potable service, such as construction. Information on NP demands was primarily found in the billing data and GIS data, as discussed in **Section 1** of this report.

3.1.1 Review of Billing Data and GIS Data

The existing irrigated areas were examined in GIS and the existing billing data was geolocated and categorized by customer type. Through this process, 99.3% of the total NP demands from the 2019 billing data were allocated to a geolocated meter. Additionally, the City requested that one “customer” be removed from the total, as it is a shoulder tap that feeds other billed customers. Shoulder taps are locations where the NP system can take water from the potable water distribution system during the early spring and late fall shoulder months, when the ditches may not have water but there are still irrigation demands. **Table 3-1** summarizes the billing customers and their associated demands by their City-assigned category. Categories were subsequently adjusted to match water and sewer customer categories.

Table 3-1 Categorized Billing Customers

Customer Category	Number of Billed Meters	Peak Month Consumption ¹ (MG)	Percentage of Total Consumption
Church/Commercial	1	0.8	0.7%
Commercial	36	8.5	7.3%
Golf Course	5	41.4	35.9%
Multifamily Homeowners Association (HOA)	2	0.3	0.3%
Non-Potable	1	0.1	0.1%
Parks	16	34.4	29.9%
Residential	22	13.6	11.9%
School	13	16.0	13.9%
Total	96	115.1	

¹ Average of 2018 and 2019 billing data, in million gallons (MG)

Some NP irrigated sites, such as certain parks, were not included in the billing system. These demands were accounted for with historical pumping data collected weekly through most of August 2019. This data was used for 33 locations (including three wells) across 12 sites, where metered billing data was not available. **Table 3-2** contains the pumping data for these areas.

Table 3-2 Pumping Data

Site Name	Pumped Peak Month Demand ¹ (1,000 gal)
Balsam Park	2,171
Bittersweet Park	4,585
Cottonwood Park	719
Delta Park	712
Glenmere Park	1,401
Greeley West Park	745
Island Grove	3,459
Island Grove Ball Field	3,300
Josephine Jones Park	1,102
Linn Grove	8,328
Saddle Club	69
Sanborn Park	2,783

¹ Average of 2018 and 2019 recorded pumping data

3.1.2 Variability in Demand

NP demands are much more irregular than potable water and wastewater demands. They are largely influenced by seasonal weather patterns, since most NP water is used for irrigation. In general, NP demand is highest in the summer and lowest in the winter. Both potable and NP demands were allocated based on summer usage. However, these seasonal variations do not account for year-to-year variability. This year-to-year variability is shown in **Figure 3-1**, where consumption based on billing data can more than double in certain years. A comparison with annual rainfall did not show a strong correlation to account for the annual variation.

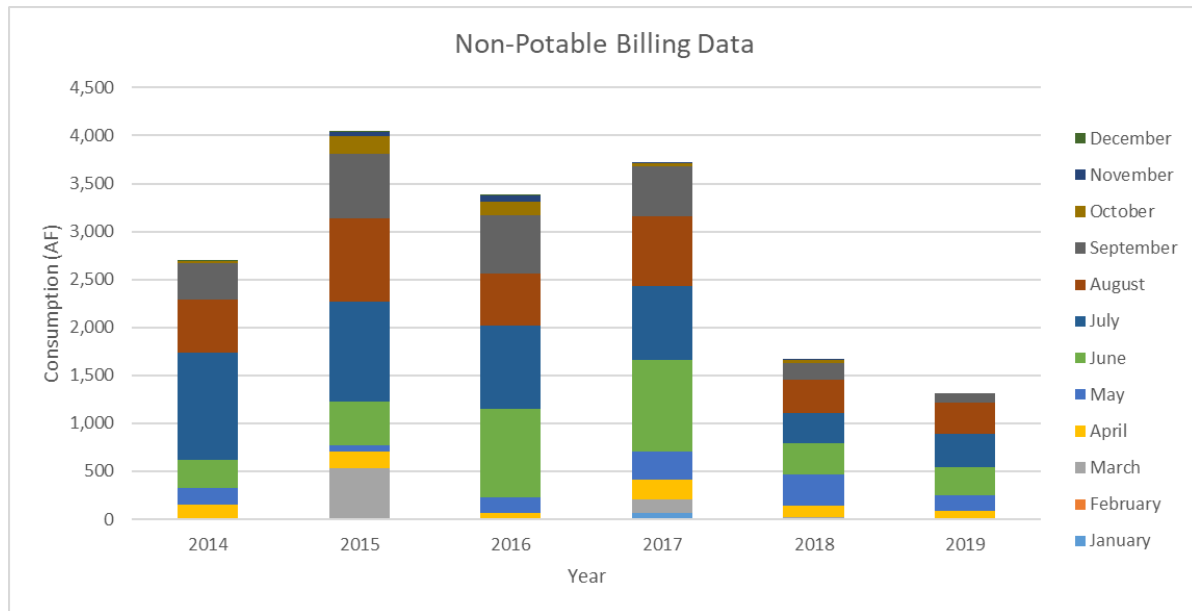


Figure 3-1 Variability in Annual Non-Potable Demand

Based on discussions with the City, it was determined that the reduction in annual demand was due to increased conservation efforts, especially the installation of water-efficient irrigation systems and smart irrigation controllers throughout City parks. To account for these changes, only billing data from 2018 and 2019 was considered for the development of this NPMP.

3.1.3 Flow Factor Development

To calculate future demand projections, it was necessary to establish flow factors. A flow factor is defined as the value used to estimate typical NP demand per acre for a given land use category. The historic billing data and the current NP irrigated areas shapefile were combined to produce flow factors by customer category. These flow factors were then used to estimate future NP demand scenarios through buildout based on land use projections established during the WTDMP.

Flow factors were calculated based on conversations with City staff to determine which areas were irrigated, and by which meters. The meters, and their associated area, had been previously categorized by the City, which was the basis for the flow factor categories. The peak month billed consumption by category was divided by the total irrigated acreage by category. This supplied the Irrigated Land peak month flow factor, as shown in **Table 3-3**. These values represent the amount of consumption for a site where the exact acreage being irrigated is known.

However, in undeveloped areas, the exact irrigated acreage is not known. To account for this, the percent of land that is irrigated out of a total parcel was estimated by category type. The total irrigated land by category was divided by the total (bulk) parcel area by category. These resulted in a Bulk Land peak month flow factor, also shown in **Table 3-3**. The flow factor calculation process is illustrated in **Figure 3-2**.

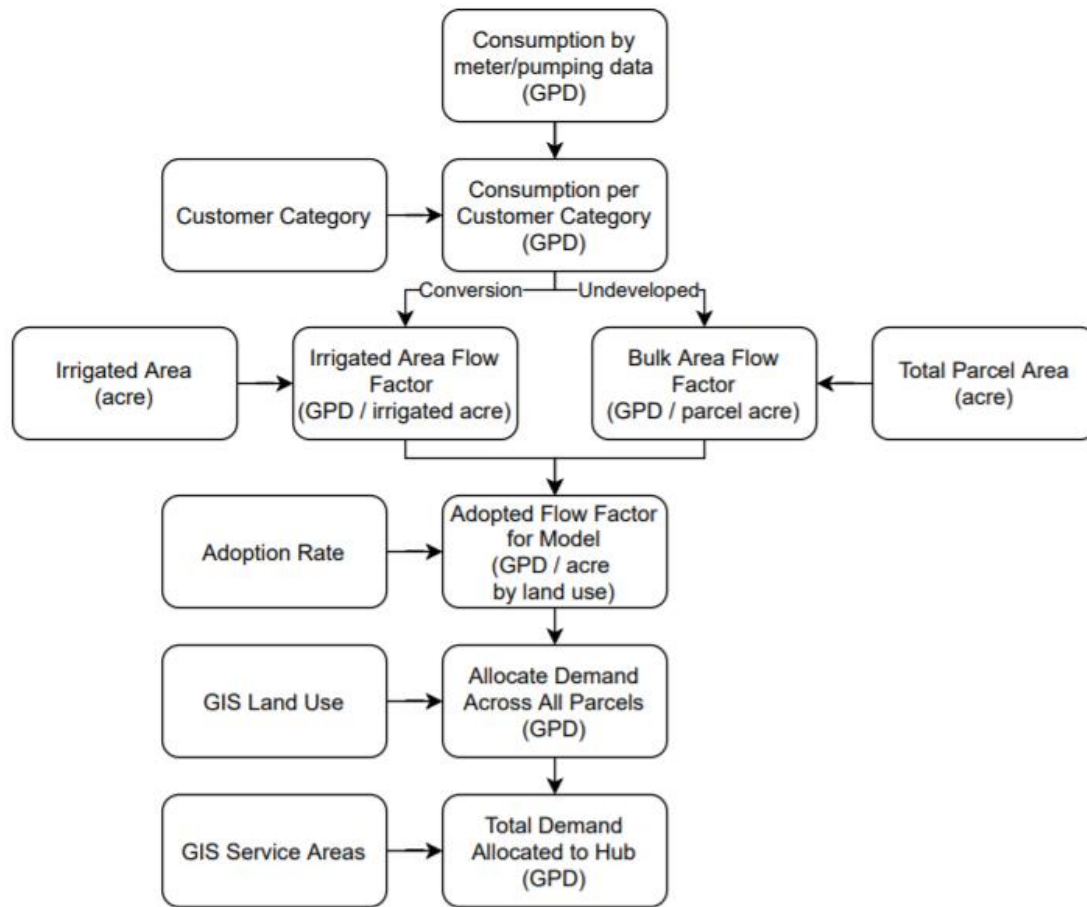


Figure 3-2 Flow Factor Calculation

These customer categories were coordinated with the WTDMP land use projections to examine areas throughout the LREGA. Generally, the Multifamily HOA category was associated with residential high density (R-H) land use category, the Residential customer category was associated with residential medium density (R-M), residential low density (R-L), and residential estate (R-E) land use categories, and the Commercial customer category was associated with commercial high intensity (C-H) and commercial low intensity (C-L) land use categories. However, because the existing NP system serves a limited number of areas, this process did not fully account for all types of land use within the City. The following changes were included in the final flow factors:

- Some land use types in the City do not currently have any examples of NP irrigation. This includes the industrial low intensity (I-L), industrial medium intensity (I-M), and R-E areas. For these areas, a flow factor was based on the difference between the summer and winter flow factors, as developed in the WTDMP and SSMP, respectively.
- Because schools are zoned as R-L, the R-L flow factor was based on a combination of the Residential and School flow factors.

- Because churches are considered commercial, the Commercial flow factor also includes churches. The Church category is used for conversion areas only. There are not many churches currently served by NP irrigation, so the Church flow factor also looks at existing churches that are only served by potable water and compares summer versus winter demand to determine an estimated flow factor.

Losses due to evaporation or seepage were not included in these calculations, as they primarily occur in the ponds and ditches rather than in the distribution system. These losses are estimated at 30%, based on operator knowledge, and are necessary for determining NP supply into ditches.

Table 3-3 Flow Factors

Category	Description	Peak Month Flow Factor for Irrigated Land (gpd/acre) ³	Percent Irrigated	Peak Month Flow Factor for Bulk Land (gpd/acre)	Peak Month Flow Factor for Irrigated Land (in/week)	Annual Flow Factor for Irrigated Land (in/year)	Adoption Rate ²
Church	For conversion areas only	2,000	63%	1,300	0.5	10.9	75%
Commercial	C-H and C-L; includes churches	3,200	42%	1,300	0.8	17.5	20%
Golf Course ¹	Golf course (NP category only)	5,000	87%	4,400	1.3	27.3	N/A
I-L	Industrial Low; Summer vs. winter flow factor	N/A	N/A	500	N/A	N/A	20%
I-M	Industrial Medium; Summer vs. winter flow factor	N/A	N/A	125	N/A	N/A	20%
Multifamily HOA	R-H	4,400	34%	1,500	1.1	24.0	15%
Parks	Parks (NP category only)	3,500	47%	1,600	0.9	19.1	90%
Residential	Single family residential; also used for R-M	5,200	17%	900	1.3	28.4	20%
R-E	Residential Estate; Summer vs. winter flow factor	N/A	N/A	80	N/A	N/A	15%
R-L	Residential Low; Residential and School average flow factor	4,700	26%	1,200	1.2	25.7	20%
School	For conversion areas only	4,300	48%	2,100	1.1	23.5	75%

¹ No additional golf courses are expected in the City through buildout.

² Adoption rates based on the BBC report; see **Section 3.2.1**.

³ gpd/acre = gallons per day per acre

3.2 Future Usage and Demand Projections

Using a combination of the City's planning data, land use projections from the WTDMP, and flow factors developed during the existing demands allocations, future NP demands through the buildout scenario were projected and allocated. This section captures the assumptions and calculations used to arrive at this value.

3.2.1 Adoption Rates

The adoption rates are the estimate of the amount of land that could potentially be irrigated that is expected to use NP irrigation. Future scenarios used the adoption rates, as shown in **Table 3-3**, for undeveloped land and most conversion areas. Undeveloped land had the factors applied per land use category including churches in Commercial and Schools in R-L. Conversion used the same factors, although schools and churches used a 75% adoption rate to account for a push to convert existing large irrigated areas to NP.

3.2.2 Infill and Conversion Areas

As the NP system expands, it may become both feasible and beneficial for some areas that are already developed to convert from potable to NP irrigation. These areas, referred to as conversion areas, were identified by the City based on knowledge of the individual customers, its current usage, and open irrigated acreages. The City identified over 400 individual areas that could be eligible for NP conversion. These areas were then categorized to identify which flow factors best fit them. The total acreage expected to convert to NP by category is summarized in **Figure 3-3** and shown in **Figure 3-4**. Areas that were identified as undeveloped land, roads, or non-irrigated areas were not included in the categorization. This is because undeveloped land is captured in the demand projections for undeveloped land, and roads or medians are too small to be accurately categorized.

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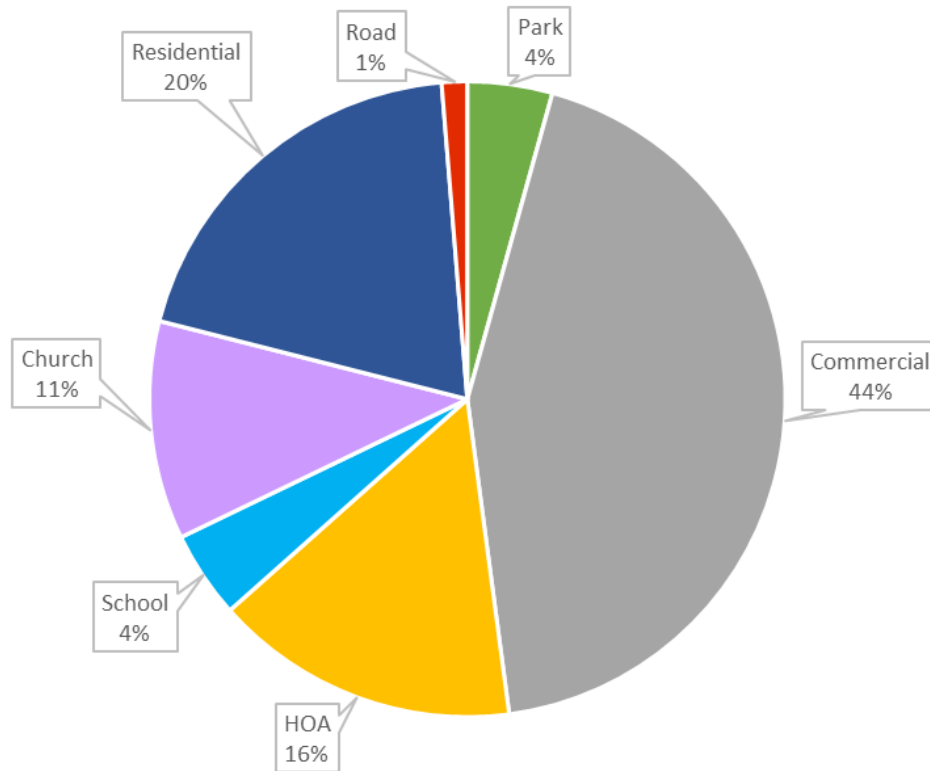
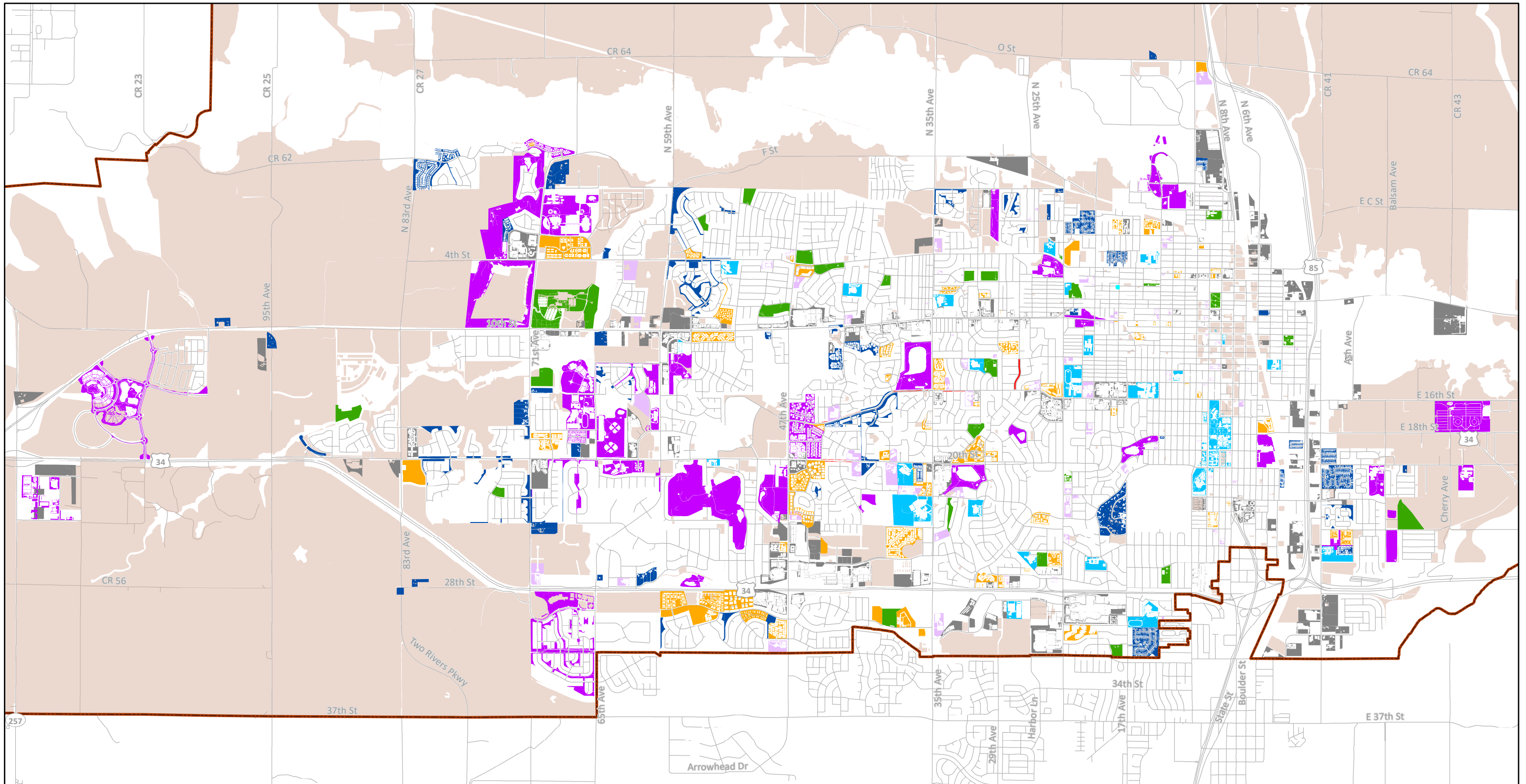


Figure 3-3 Conversion Area Categorization by Acreage

The conversion areas represent irrigable land; therefore the irrigable land flow factor was applied to each area for its category. It is not expected that all of these areas will convert to NP, and inclusion on this list is meant to identify a potential conversion, not set a requirement for conversion. To account for this, the adoption rates were applied to these areas.

Existing customers may be considered good candidates for potential conversion when they have a large irrigated area (greater than 15 acres), higher estimated demands (3,500 gallons per minute [gpm] per irrigated acre or higher), and/or are near existing or planned NP infrastructure. While a customer does not have to meet all these criteria to be eligible for conversion, the City should prioritize these properties. The City may also consider prioritizing customers that are public entities, such as parks and schools. Continued outreach to existing water customers can show them how NP irrigation can benefit them by lowering their water bill. For the purposes of the NPMP, it was assumed that all potential conversion areas will eventually convert to NP irrigation at the adoption rates noted above, regardless of whether they would be considered high priority or not.

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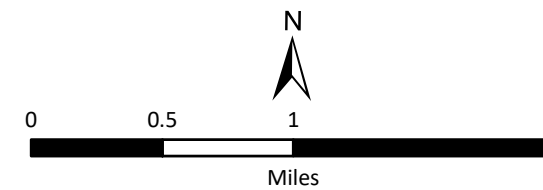
Legend

- LREGA
- Existing NP Irrigated Areas
- Future Development

Conversion Areas

- Church
- Commercial
- HOA
- Park

- Residential
- Road
- School



Potential Conversion Areas (Categorized)

Figure 3-4

Greeley Non-Potable Water
System Master Plan

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3.2.3 Parks and Schools

Two land use types required special attention due to their high NP consumption: parks and schools.

Park locations and sizes were primarily based on the City's Parks, Trails, and Open Lands Master Plan (2016). This document identified potential park locations for the next 20 years. These locations were supplemented by park locations included in this NPMP in order to extend parks service through the LREGA. It should be noted that the location and size of these parks is subject to change in future park master plans. The size of each park was based on population projections from the water and sewer master plans, and the park service goal of 8.25 acres/1,000 people from the 2016 Parks MP. This methodology was approved by the City's parks department.

Figure 3-5 shows all future park locations. Parks will serve as the hubs of the future NP system, and ponds serve both storage and aesthetic purposes.

Because schools represent large irrigable areas, it was desired to incorporate the location of future schools into the future demand projections. However, limited information is available as to the locations, numbers, and size of future schools. Because of this uncertainty, it was considered impractical to select a defensible number, and it was therefore decided to not include schools as a separate source of future demand projections. As schools are generally zoned as R-L, the R-L future flow factor was calculated as a weighted average between Residential and Schools flow factors. In this way, the NP demand from future schools is spread across the future land use areas where schools will eventually be planned.

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3.2.4 Other Land Uses through the LREGA

Outside of conversion areas and parks, NP demand projections for undeveloped land throughout the LREGA were coordinated with the water demand projections. The WTDMP and SSMP used a complex land use categorization methodology to identify around 60 different land uses within the City, which were used to categorize all currently undeveloped areas or areas of redevelopment. Based on discussions with the City and a review of the available information, three tiers were used for the potable water demands, as described below:

1. **Tier 1: Planned Developments.** This data was taken from development reports and planning documents for twelve known developments, which are in various stages of design. These areas represent the most detailed planning information available.
2. **Tier 2: City of Greeley Land Use (Sub-Areas) and Zoning Markup Map (Greeley Markup).** After review of this data, the City marked up 11 areas of growth to apply a specific growth distribution to each area, based on trends developed after the creation of the document. The City's planning department assigned percentages of land use type to each growth area. These areas were then split into sub-areas to better align with the density distribution of the original *Imagine Greeley Comprehensive Plan*.
3. **Tier 3: Zoning and Comprehensive Plan Information.** For all remaining areas, including infill areas, zoning and land use information was used to distribute future populations and water demands. This data was taken from the following sources:
 - a. Zoning from the *Annual Growth & Development Projections Report* (City of Greeley, 2019).
 - b. Land use guidance from the *Imagine Greeley Comprehensive Plan* (City of Greeley Community Development Department, 2018).

Using this data, each parcel in the City was assigned with a residential and nonresidential (i.e. commercial or industrial) future water demand based on its land use category. For detailed information on the potable demand calculations, please see the WTDMP.

The water and sewer land use types were then coordinated with the NP flow factor categorizations to develop separate NP and potable water flow factors for each land use type. These flow factors were applied throughout the LREGA to determine total NP demand.

3.2.5 Buildout Projections Summary

The conversion areas, parks, and undeveloped land were combined to produce a total NP demand set for peak month at buildout. This was incorporated into the future water model to aid in appropriately sizing infrastructure. The peak month buildout demand projections for potable vs. NP are summarized in **Table 3-4**. The NP demand density is shown in **Figure 3-6**. The NP demands comprise 19.5% of all future peak month water demands through buildout. NP demands may decrease if planning shows that it is not hydraulically or economically feasible to serve certain areas or, conversely, NP demands may increase if aggressive NP use policies are adopted.

Table 3-4 Peak Month Buildout Demands Summary

Development Type	Total Future Water Demand (MGD)	Future Potable Water Demand (MGD)	Future Non-Potable Water Demand (MGD)
Existing Demand	47.3	46.0	1.3
Future Development	56.7	47.5	9.2
Conversion Areas	2.3	0	2.3
Total	106.3	93.5	12.8

3.3 Demand Estimates by Planning Horizon

To distribute the future demand parameters in the model at each planning horizon, the percent to which each future development tier is built out at the end of each planning horizon was estimated. The basis for these estimates is the BBC report. At the 2025 and 2040 planning horizons, the calculated population is matched to the BBC report. The overall buildout population is assumed to exceed the 2075 BBC projected population. The total buildout population is projected to be 425,271. For more information on the percentages used, please see the WTDMP. The total phased potable and NP demands are shown in **Table 3-5**.

It is assumed that the Tier 1 projects will be completed first. For this reason, the majority of the Tier 1 projects are assumed to be complete at the 2025 planning horizon, and all of them complete at the 2040 planning horizon.

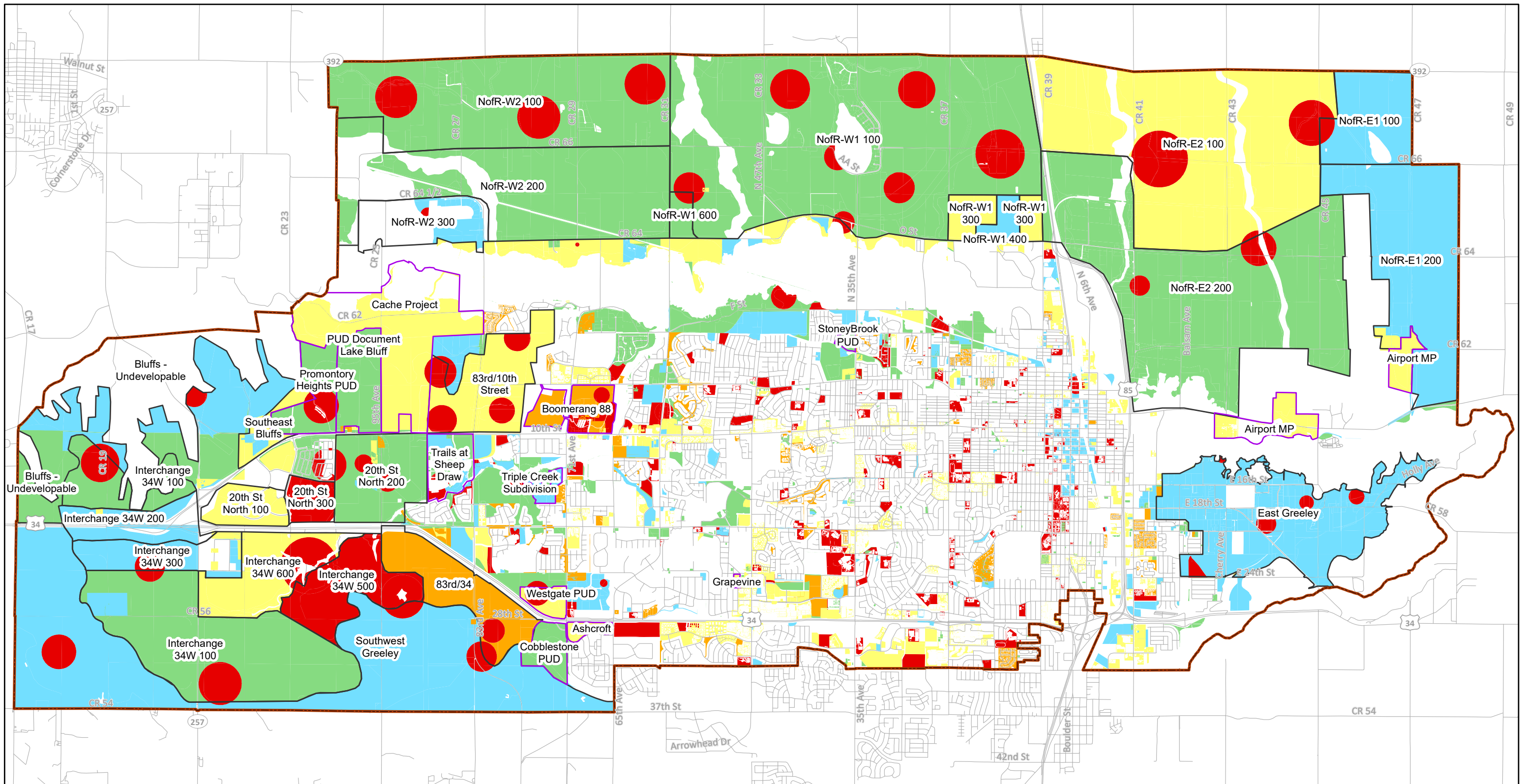
Because of the large areas within the Tier 2 projections category, the Tier 2 percent complete values for the 2025 and 2040 planning horizons have been developed through close discussions with the City. The Tier 2 areas identified for growth at the 2025 and 2040 planning horizons are the areas that the City's planning department have identified as the most likely growth areas.

The Tier 3 growth identified below for the 2025 planning horizon was chosen through discussions with the City. Tier 3 growth included in the 2040 planning horizon was assumed to include all of the infill around the Tier 1 and Tier 2 projected growth areas.

The rate at which existing developments will convert to NP irrigation will vary location-by-location based on economic feasibility, proximity to NP infrastructure, and the willingness of the owner to participate in conservation efforts. To estimate the rate of conversion areas, it was assumed that demand from conversion areas will increase at a similar rate to the total additional water projections. The percentage of water demands increase, as compared to the buildout projections, at each planning horizon was calculated, and this same percentage was applied uniformly to the conversion areas.

Table 3-5 Peak Month Demand by Planning Horizon

Planning Horizon	Total Future Water Demand (MGD)	Future Potable Water Demand (MGD)	Future Non-Potable Water Demand (MGD)
Existing	47.3	46.0	1.3
2025	51.8	49.4	2.4
2040	61.0	56.9	4.1
Buildout	106.3	93.5	12.8

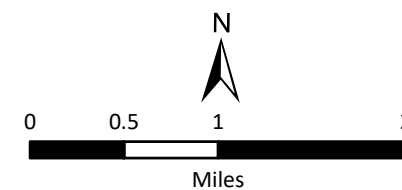


Legend

- LREGA
- Tier 1 (PUDs)
- Tier 2 (Comprehensive Plan)

NP Water Parcels Density

- <250 gpd/ac
- 250 - 500 gpd/ac
- 500 - 750 gpd/ac
- 750 - 1,000 gpd/ac
- >1,000 gpd/ac



Demand Density (Peak Month, Buildout)

Figure 3-6

Greeley Non-Potable Water
System Master Plan

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3.4 Economic Feasibility for Future Projects

In most developments, the decision on whether or not to use NP irrigation is based on economic feasibility, meaning whether the cost savings from using NP over potable outweighs the initial cost of infrastructure construction. This evaluation should consider the current cost of infrastructure against the long-term benefits of reducing potable system expansion, reduced cost of treatment, and freeing up more valuable treatable water rights for potable use. Long-term savings to the eventual owners/occupants of the property should also be considered when evaluating feasibility.

3.5 Water Resources Correlation

It is important for the City to plan for the total annual water demands through buildout. Water conservation methods, such as improved landscaping practices and the encouragement and adoption of NP water for irrigation, may help reduce the City's annual water demands. The City previously conducted a water resources planning study (BBC report), which focused on developing three alternative scenarios for annual water demands. The NPMP primarily focused on planning for future infrastructure needs based on peak summer demands. **Table 3-6** provides a comparison summary between the BBC report and the NPMP.

Table 3-6 NPMP and BBC Report Comparison

NPMP Approach	BBC Approach
Focused on infrastructure sizing, particularly during peak month demands	Focused on supply-side annual demands for water resources planning
Used a peak month: average month ratio of 1.8 for potable demands and 2.5 for NP demands to estimate annual demands from the calculated peak month demands	Only calculated annual demands, and did not calculate demands for peak seasons
Separated residential and nonresidential potable water demands to account for different customer diurnal curves and peak hours	Established a universal gpcd value that included commercial, industrial, and residential demands
Correlated population projections to the BBC report and other City planning department data	Developed three population projections (low, medium, high)
Geolocated demands based on land use to incorporate demand density for infrastructure planning	Used bulk demands for water resources planning, and did not spatially locate demands within the City
Estimated a single most-likely demand scenario for 2025, 2040, and buildout based on historic data and planning data	Provided detailed water resources planning for three scenarios every five years through 2075 and a less detailed buildout scenario

The total annual demands developed for the WTDMP under the NP offsets demand scenario at buildout are captured in **Table 3-7**. These demands are within the range established by the BBC report of 62,000 to 84,000 AFY for total water demands at buildout. Although the six industrial high intensity (I-H) users are included in these totals, these users were not used for modeling purposes, as their location is unknown and could lead to oversizing the system. Each large user's location will require a specific evaluation as to whether each additional user could use NP irrigation, and whether additional infrastructure would be necessary to supply this water.

Table 3-7 NPMP Annual Demand Projections at Buildout

Demand	Total Water Demand (AFY)	Potable Water Demand (AFY)	NP Water Demand (AFY)
Existing	30,500	28,600	1,900
Future Demands	33,500	28,300	5,200
New I-H Users (6)	10,300	10,300	0
Total	74,300	67,200	7,100

¹ Potable demand shown in this table is for NP offset scenario

It is recommended that The City rely on the BBC report for supply-side planning, and the WTDMP and NPMP for infrastructure and distribution system planning.

Section 4

Development of the Non-Potable System Model

Two system models, existing and future, were developed to plan for the future NP needs of the City. These two system models used the same inputs and assumptions as the existing system; projection growth rates and water demands, future service areas, and pipe and infrastructure sizing constraints.

The supply and demand data, asset and infrastructure inventory, and land use analysis were used to develop a model of the existing and future NP system. The future NP system model was created in line with the City's Specifications for NP systems.

4.1 Development of the Existing System Model

A hydraulic model of the existing NP system was developed in InfoWater to simulate current conditions and identify areas that may need short or long-term improvements.

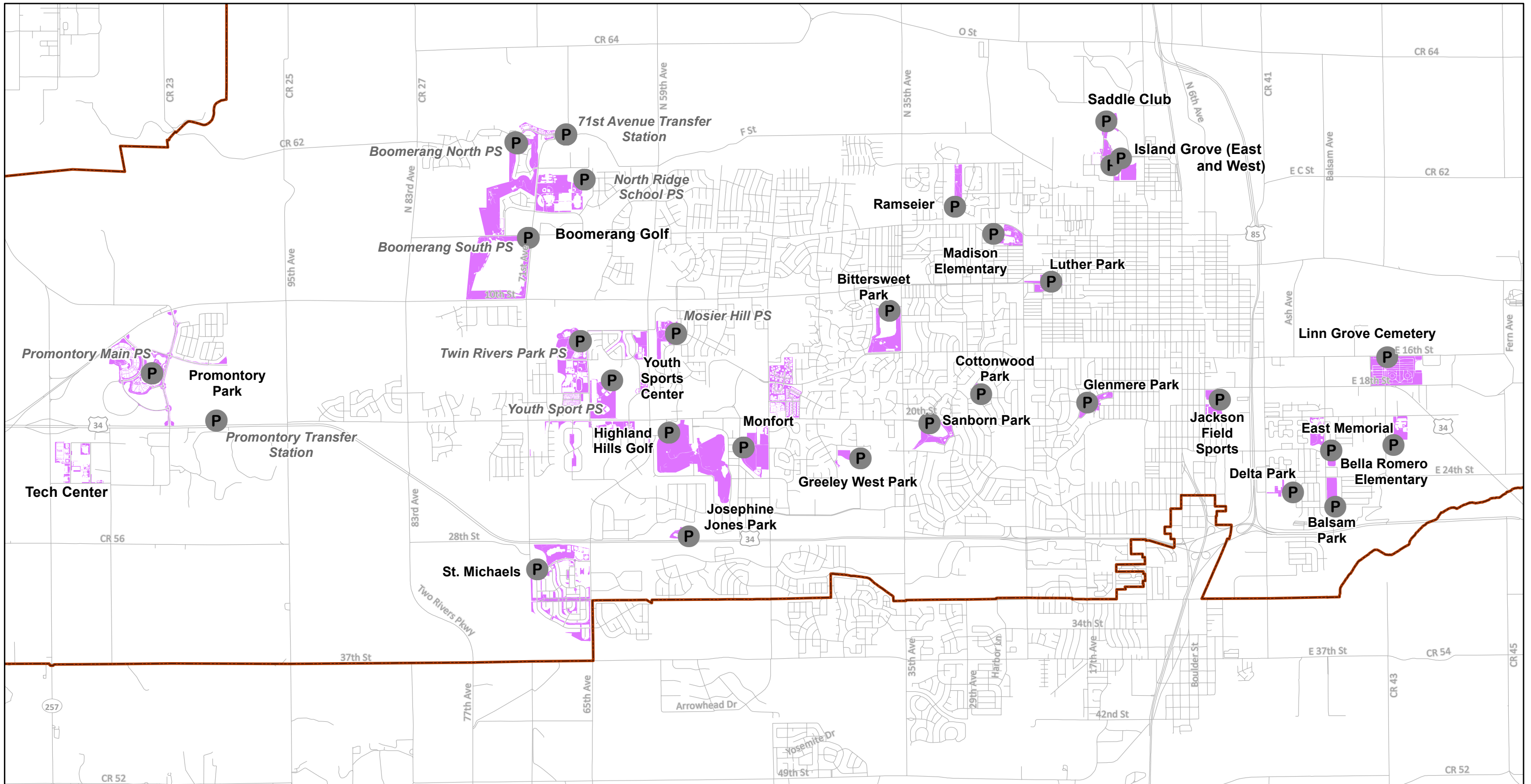
The NP system currently consists of 32 pump stations, including transfer stations, serving over one hundred customers. Most of these pump stations operate independently from other stations, creating 24 individual service areas. The systems at each service area are described in **Table 4-1**, and are shown in **Figure 4-1**. In a typical system, water flows by gravity from an irrigation ditch into a pond. From there, the water enters the wet well of the pump station and is pumped throughout the rest of the pressurized irrigation system.

Table 4-1 NP System by Service Area

Service Area	General Description
Balsam Park	A single pump station irrigates this park. This pump station pulls directly from the ditch, without a pond.
Bella Romero Elementary	A single pump station irrigates this park. This pump station pulls directly from a well, without a pond.
Bittersweet Park	A single pump station irrigates this park.
Boomerang Golf	The 71 st Avenue Transfer Station provides water to Boomerang Golf Course (north and south), North Ridge High School, and Poudre River Ranch. The Boomerang Transfer pumps provide water specifically to Boomerang North and Boomerang South, while the North Ridge Transfer pumps provide water specifically to North Ridge High School. Boomerang North, Boomerang South, and North Ridge High School receive water from the 71 st Avenue station into ponds, and then pressure pump from there. Poudre River Ranch has a dedicated irrigation pump at the 71 st Avenue station.
Cottonwood Park	A single pump station irrigates this park.
Delta Park	A single pump station irrigates this park.
East Memorial	A single pump station irrigates this park. The pond can be filled by the ditch, a shoulder well, or a shoulder tap.
Glenmere Park	A single pump station irrigates this park.
Greeley West Park	A single pump station irrigates this park.
Highland Hills Golf	A single pump station irrigates this golf course.

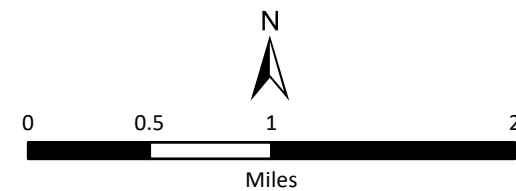
Service Area	General Description
Island Grove and Saddle Club	Island Grove East, Island Grove West, and Saddle Club pump stations all pump from individual wells and irrigate separate areas. Saddle Club also has a truck filling station in addition to general irrigation.
Jackson Field Sports	A single pump station irrigates this park. This pump station pulls directly from the ditch, without a pond.
Josephine Jones Park	A single pump station irrigates this park.
Linn Grove Cemetery	A series of three wells pump either into the irrigation system directly or fill a pond. A pump station on the pond also serves the cemetery's pressurized irrigation system.
Luther Park	A single pump station irrigates this park. This pump station pulls directly from the ditch, without a pond.
Madison Elementary and Houston Gardens	A single pump station with two separate pumping systems irrigates this area, splitting into two pipes to serve the school and gardens. This pump station pulls directly from the ditch, without a pond.
Monfort	A single pump station irrigates this area, splitting into three pipes to serve the park, school, and residential/commercial areas.
Peakview Park	A single pump station (Mosier Hill Pump Station) irrigates this park.
Promontory Park	A transfer pump station moves water from the ditch into the main ponds. The main pump station provides irrigation to the park, offices, and residential area. A small water circulation pump at the main station moves water from the lowest pond to the highest pond (not included in the model), creating the water feature.
Ramseier	A single pump station irrigates this park. This pump station pulls directly from the ditch, without a pond.
Sanborn Park	A single pump station irrigates this park.
St. Michaels	A single pump station irrigates this development.
Tech Center	This area is currently fed by potable water at a shoulder tap and does not have an NP pump station. Eventually, it will be transferred to NP water service.
Youth Sports Center	Two pump stations operate independently, but in a similar area: Twin Rivers Park and Youth Sports. Together, they serve two major recreational areas, schools, businesses, and residential areas.

In addition to these areas, Poudre Ponds, Stonney Brook, and the future Upper Equalizer transfer water from one ditch into another. Because these systems do not represent demand, they were not analyzed in depth.



Legend

- LREGA
- P Pump Station
- Existing NP Irrigated Areas



Existing Non-Potable Service Areas

Figure 4-1

Greeley Non-Potable Water
System Master Plan

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4.1.1 Infrastructure Connectivity Updates

Before the existing system could be hydraulically modeled, the City's NP GIS data needed to be updated to reflect current infrastructure. As discussed in **Section 1**, a GIS field survey was conducted to document the existing system. This task identified the location of features such as valves, pumps, and ponds, but did not capture how these features were connected to each other, as most NP piping is underground.

To accurately represent the system, historic operational data was analyzed and translated into GIS updates. As discussed in **Section 1**, the City compiled O&M data for each pump station. The construction documents, photos of the site, and other O&M data was integrated with the GIS field data and the City's original GIS data to fully capture the system. These GIS updates do not represent the full extent of piping through areas such as parks. All GIS updates were verified with City staff. The following overarching assumptions were used to update the system connectivity:

- Where meters appeared to be offset from the main lines, 2-inch laterals were added.
- For areas where the pipe or valve diameter was unknown, the diameter was assigned based on adjacent infrastructure (pipes, pumps, valves, etc.).
- In areas where infrastructure was within a meter of a pipe, it was assumed that this was due to the one-meter accuracy of the GPS unit used to collect the field inventory data. Because the field inventory data is considered to be the most up to date information, the pipes were realigned to connect through the field data.

4.1.2 Modeling Inputs and Assumptions

In general, the NP modeling methodology attempted to follow the same methodology as the potable water system model, to facilitate future integration. However, because the NP system has unique features (such as ditches, shoulder taps, etc.) and because it represents a series of separate systems instead of one larger interconnected distribution system, a unique methodology was needed to accurately depict these features. This section discusses this methodology.

Ditches. When an NP system draws directly from a ditch without an intermediate storage pond, the ditch was modeled as a fixed head reservoir. Because transfer systems are not included in the model, there are no places where water flows into a ditch.

Pipes. All existing and future pipes have of roughness of $C = 130$, to represent PVC.

Ponds. For most systems, the distribution system begins at a pond. For these systems, the pond is modeled as a fixed head reservoir. The fixed head was based on the field inventory, construction drawings, or ground surface elevation, depending on what information was available. For the purposes of modeling, it was assumed that the ponds can supply water to meet the system demands at all times during peak season.

Shoulder Taps. Shoulder taps are locations where the NP system can take water from the potable water distribution system during the early spring and late fall shoulder months, when the ditches may not have water but there are still irrigation demands. These are modeled as a fixed head reservoir with a normally closed valve that prevents it from flowing. The head on the

reservoir is set at peak month operating head in the potable water distribution system model. Notably, the shoulder taps do not typically operate during peak month conditions; therefore, this setting is considered conservative.

Wells. Like ditches, when an NP system draws directly from a well without an intermediate storage pond, the well suction conditions are modeled as a fixed head reservoir. The fixed head is the design pumping depth, as found in the O&M documents. The above ground well pump was modeled using available well pump curves, and submerged well pumps were not included in the model.

Pumps. Where available, the pump curve for each existing pump was used in the model, as provided in the O&M documentation. For pumps without a curve, a design point (defined as design head and flow) was used. Many NP pump stations also include a maintenance pump to maintain pressure during low flow. These are not included in the model.

4.1.3 Existing Demands Allocation

Existing demands were based on historic billing data and pumping data, as discussed in **Section 3**. To establish the peak month base demands used for this model, an average of demands, either billed or pumped, was taken for July and August of 2018 and 2019. The base demand derived from billing data was allocated to the appropriate meter and included in the model. For areas with demand based on pumping data, the demand was allocated to a node directly downstream of the pump station.

4.2 Extended Period Simulation Setup

Both the existing and future models were evaluated under extended period simulation (EPS) to examine how they perform throughout the day, instead of at a single point in time. All model scenarios had a 48-hour time duration. This section describes the methodology used to simulate EPS, including SCADA data calibration, diurnal peaking curves, and the approach to pump controls.

4.2.1 SCADA Data Calibration

As mentioned in **Section 1**, hourly SCADA data from September 1, 2015 to September 5, 2020 was used to calibrate the model. Not all SCADA data was available at all sites, and some sites do not have any SCADA data. For both the overall system and individual systems, a peak week with the highest usage was selected from the July and August 2018 and 2019 dataset. This peak week was selected to align with billing data used for demand projections. The data from the peak week was used for model calibration and diurnal curve development for each system.

Hourly pressure data, where available, was used to set up pump controls. The pump controls were set up to match pressure ranges that are typical to a given system. Diurnal curves were used to derive simple time-based controls to match typical pressure ranges for each system. For areas without available pressure data, pump controls were set so that pressures stayed within the 70 – 100 psi pressure range required by the City's Specifications.

4.2.2 Peaking Factors and Diurnal Curves

Diurnal curves were created from the SCADA data described above to show how the demands change on an hourly basis. These diurnal curves include the peak hour, which is the primary point in time used to evaluate the capacity of pumps and pipes. Ponds are sized on peak day.

The hourly data from the peak week for each system was used to create diurnal curves based on peaking during each day. Individual curves were created for pump stations that had their own SCADA data. These individual curves are included in **Appendix C**. Many of these individual diurnal curves revealed operational inefficiencies, such as watering during the day instead of only at night. Inefficient irrigation practices can increase costs and counteract water conservation goals. For more information on NP best practices, please see the City's WaterWise Landscaping Best Practices Manual Criteria in **Appendix F**.

A system-wide diurnal curve, shown in **Figure 4-2**, was created as a more generalized curve. It was based on SCADA data from the following pump stations: Promontory Main (not transfer), St. Michaels, Youth Sports Center, Monfort, Mosier Hill, Madison Elementary, Ramseier, Island Grove East and West, Luther Park, Jackson Field Sports, Bella Romero Elementary, East Memorial, Balsam Park, Delta Park, Highland Hills Golf, Twin Rivers Park, and North Ridge School (not transfer). The curve average is 1.35, which represents the ratio from peak month to peak week based on SCADA data so that the curve can be applied directly to the peak month demands developed. The individual curves each have different averages based on their own peak week: peak month ratios.

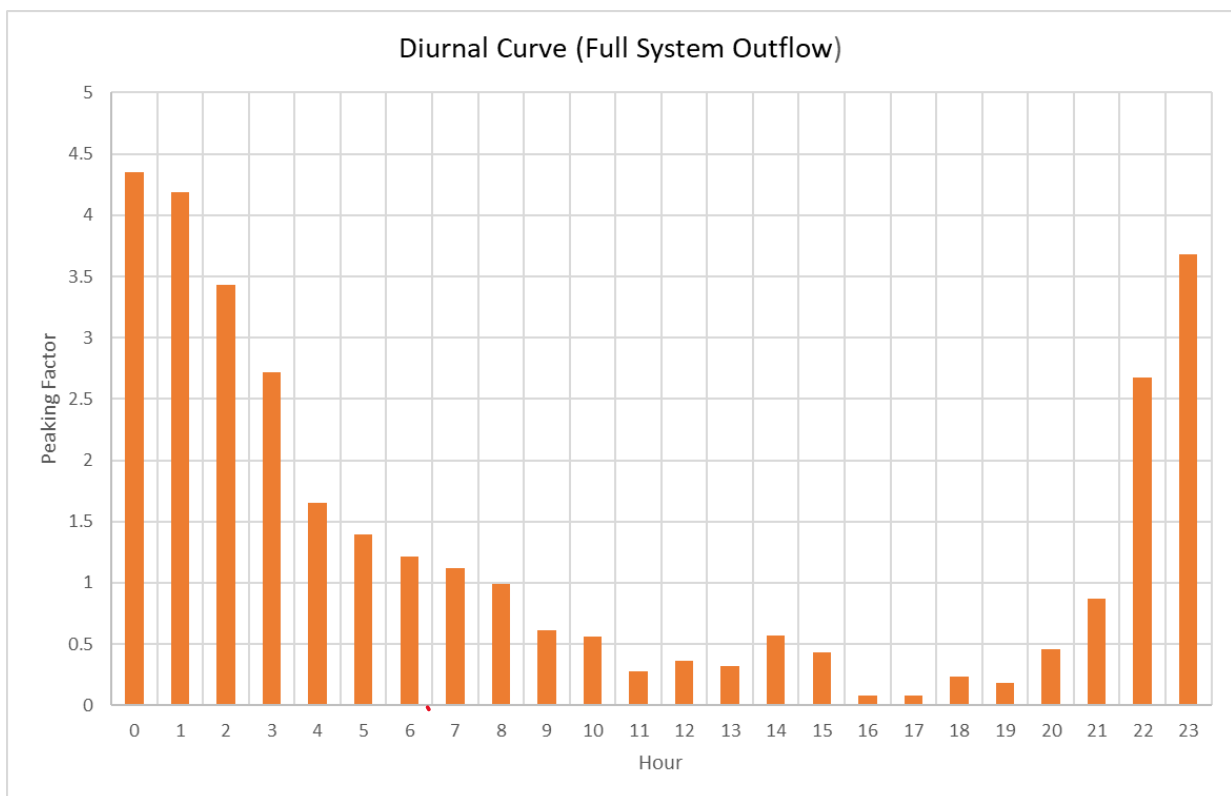


Figure 4-2 System-Wide Diurnal Curve

The peak hour of the system-wide diurnal curve occurs at midnight (hour 0) and has a peaking factor of 4.34. Limited watering appears to occur between 9 am and 8 pm, which aligns with the City's irrigation ordinances and best practices. This curve was applied to existing areas that do not have an individual curve, and to future developments.

For EPS modeling, these diurnal curves are repeated during a 48-hour runtime, in order to align with the potable water system model.

4.2.3 Pump Controls

Because each system is not connected and has unique demands and demand patterns, the modeled pump controls are also unique for each system. In general, pump controls are set by clock time based on the diurnal curve used by the system. For example, if demand drops to zero at hour 4, pumps will turn off or drop to a lower speed at hour 4 to accommodate this change. Because the NP pump stations use variable frequency drives (VFDs), the pumps may vary from 70% to 100% speed. At points where there is no demand in the system, the pumps are modeled as operating at the shutoff point; in real operations, this time period would likely be served by the maintenance pump. This methodology was used for both the existing system and the future system to ensure that appropriate pressures are maintained at all timesteps. This section is specific to modeling methodology; for more information on recommended operation of pump stations, see **Section 2.3** and **Section 2.4**.

4.3 Development of the Future System Model

Future infrastructure was projected throughout the LREGA to show how all areas through the City could be met with NP demand. This section discusses how future infrastructure, including pump stations and piping, was planned and modeled in InfoWater at each planning horizon. All planning horizons (2025, 2040, and buildout) were modeled using the same methodology.

4.3.1 Future Service Areas

In general, it is expected that the NP system will continue to operate as a set of independent systems using a hub-and-spoke methodology. The future parks, as shown in **Figure 4-3**, will serve as the hubs of the future system, as locating the pond and pump station in a park offers both recreational and aesthetic benefits, and provides the open space required for infrastructure.

Because of this, the land through the LREGA was divided into service areas based on the locations of the future parks and the existing NP system. The service areas were initially based on Thiessen polygons around the parks which were then reviewed and customized. The nearest source of NP water was identified, taking topography into account. This informed which areas should have their own pump station (those with a feasible NP source), and which should be served via pressure piping from another NP pump station. Final pump station and pond locations would ultimately be dependent on proximity to a ditch lateral or other water source during the design stage. The following assumptions were used to further refine the future service areas:

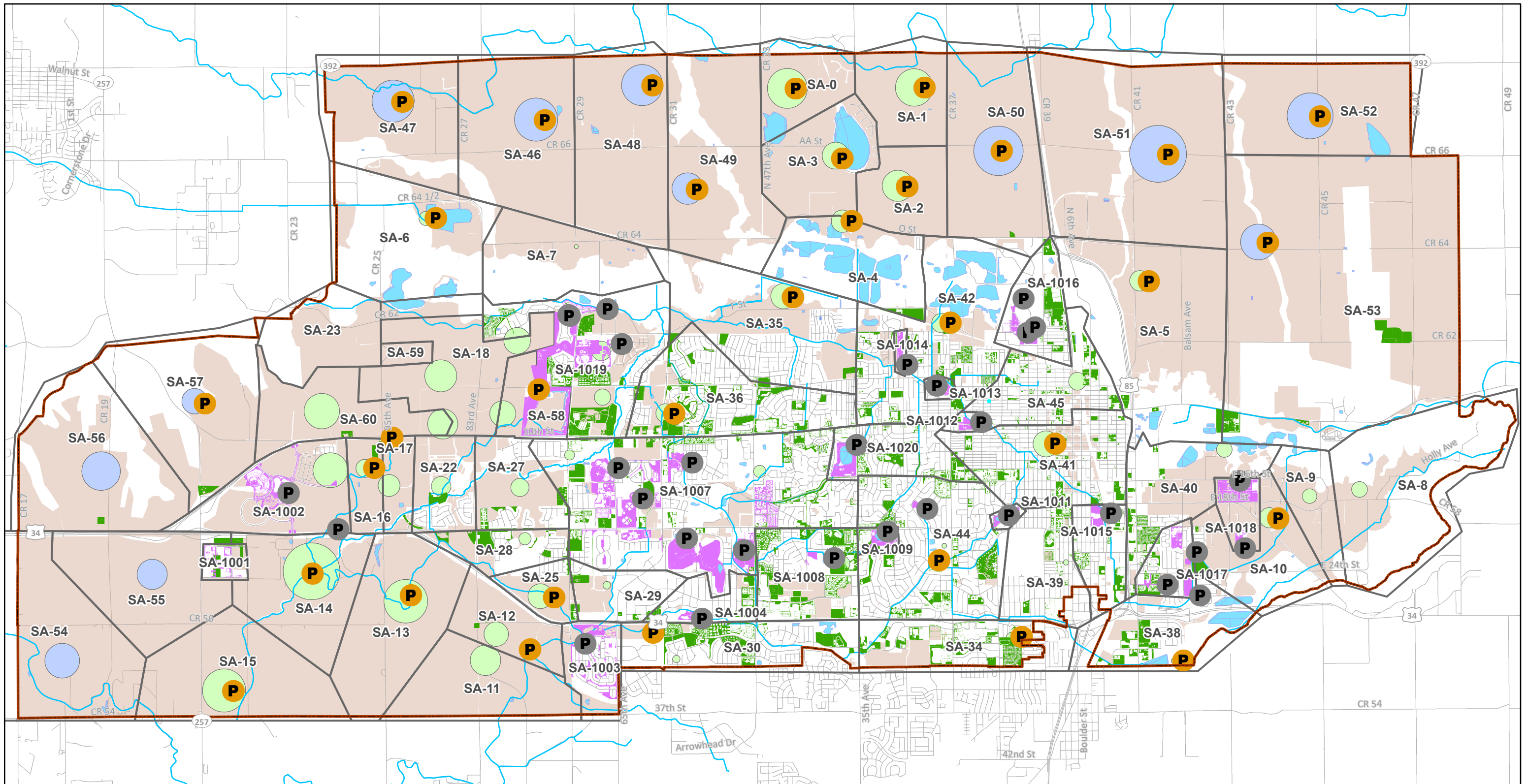
- Looping and connections between existing and future systems were attempted where possible. This can include systems with a similar hydraulic grade line or areas where it is less expensive to construct connecting pipe instead of installing new pumps or a new pump station.

- Railroad, river, and major road crossings were minimized where possible.
- NP water will flow by gravity into the ponds, located within parks, then will flow under pressurized conditions from the pump stations at the ponds.

A map of the future service areas, including future pump stations, is included in **Figure 4-3**.

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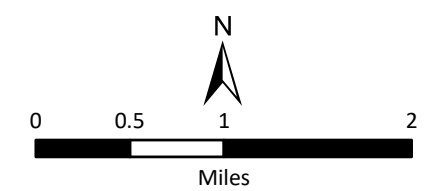
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Legend

- LREGA
- Existing NP Irrigated Areas
- Future Pump Station
- Existing Pump Station
- Future NP Demand Parcels
- Greeley Ditch
- Potential Park Location (2016 Parks MP)
- Potential Park Location (Approx. for Planning)

- Service Areas
- Lakes and Ponds
- Conversion Areas



**Future Service Areas
(Buildout)**
Figure 4-3
**Greeley Non-Potable Water
System Master Plan**

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4.3.2 Model Inputs and Assumptions

The preliminary future model was setup for the buildout scenario, which involves setting up infrastructure through the LREGA to account for a more than 800% increase from existing demands. The current City limit is 31,346 acres, while the LREGA is 58,306 acres, representing an 86% increase in land area by buildout, along with those areas that may convert from potable to NP irrigation. While it is impossible to perfectly predict future development needs, the model should provide a roadmap for future pump station locations and sizing, main pipe sizing, and potential interconnections between key areas. Developers should work with the City's engineering development review (EDR) and water and sewer department to discuss how new developments fit into the City's overall plan to provide NP irrigation service at acceptable pressures in both new and existing areas.

In order to establish infrastructure through the LREGA, pump stations were added into the model at each of the locations identified in **Figure 4-3**. Each pump station draws from a pond, modeled as a reservoir, and has two identical pumps in parallel. A typical pump station is shown in **Figure 4-4**. It is expected that each pump station would also have a smaller maintenance pump, not included in the model. Per the City's Specifications, pumps are required to operate with at least 80% efficiency; therefore, the pumps were modeled uniformly as 80% efficient. Pumps are expected to operate using a lead/lag methodology.

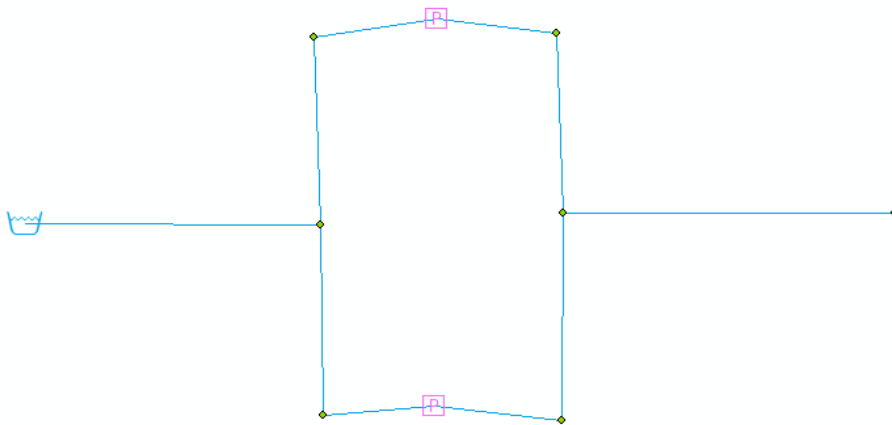


Figure 4-4 Typical Future Pump Station Configuration

In some areas, longer pipelines were drawn from the pump stations to serve undeveloped or conversion areas. These pipelines sometimes end at an anticipated parks location that is not expected to require its own pump station due to distance from a water source or proximity to another pump station. In other cases, the lines are expected to serve higher priority conversion areas, as described in **Section 3.2.2**. As with other infrastructure, these pipes do not represent final layout or sizing and should be reevaluated during the design stage.

The elevation of future nodes, including pumps and ponds, was based on ground surface elevation. Like the existing system, future pipes were modeled with a hydraulic roughness ("C") of 130.

4.3.3 Future Demand Allocation

After the piped network was established, the future demands were set up in the model for the new service areas. Details on demand projections through buildout can be found in **Section 3**.

Future demand datasets were created for each planning horizon, using the existing demand set with future peak month demands for both new developments and conversion areas. Existing and future demands were set as separate demands within the InfoWater demands database to allow for different diurnal curves for existing versus future demands. Each future demand point was tagged with the service area it is in, and all the demand was summed to produce a total demand per service area. This was allocated to the node downstream of the pumps. When there were multiple pump stations within a single service area, the demand was divided evenly between them.

4.3.4 Piping and Infrastructure Sizing Criteria

The hydraulic model is helpful in providing the preliminary sizing of infrastructure such as pump stations, storage ponds, and pipe sizes. These initial models are intended for planning purposes only, and do not constitute a preliminary design plan. Developers should work with the City's EDR and water and sewer department to discuss how new developments fit into the City's overall plan to provide NP irrigation service at acceptable pressures in both new and existing areas. All future infrastructure must comply with the City's Specifications.

As noted previously, each future pump station is modeled with two pumps in parallel. The City's Specifications state that NP pump stations must have a capacity of 120% of peak hour demand. All future pumps are therefore sized where the two pumps are identical, with a combined flow of 120% of the peak hour. An iterative process is used to identify the required design head for these pumps, so that pressure requirements are met downstream.

Per the City's Specifications, NP irrigation mains can be 4-, 6-, or 8-inch, and NP transmission mains can be 10 inch and larger. Per the City's direction, 8-inch will be the smallest pipe size recommended for the City's future NP system. After the meter, developers may use whatever size is required. Additionally, pressures are required to be 70 – 100 psi at each NP irrigation service meter and have a peak flow velocity less than 5 fps and headloss less than 10 ft/1,000 ft. Pipes within the model were sized large enough to meet these pressure and velocity requirements, without incurring extra costs by oversizing. Developers may use any line size that meets the hydraulic requirements described in the City's Specifications.

Ponds are designed to store four days of peak day flow, per the City's Specifications. Storage was calculated using peak day demand to provide preliminary pond sizes for the analysis phase of the project.

Section 5

Existing and Future System Model Evaluation

Existing and future system models were developed to plan for the future NP needs of the City. These models were analyzed for system-wide deficiencies and improvements for the current, the 2025, 2040, and buildout planning horizons. The NP model was incorporated into the potable models for evaluating overall potable and NP water system needs. This Section discusses the way the existing and future systems were analyzed.

5.1 Evaluation Criteria

The existing and future systems were analyzed through a combination of hydraulic modeling in InfoWater and desktop analyses, as discussed on **Section 4**. This section discusses how the various parts of the NP system (such as pipes, pumps, and storage) were evaluated to determine whether existing systems needed improvements and to determine project design points for future systems.

Because the NP system provides primarily irrigation waters, only the peak day was analyzed (which represents peak irrigation season during the summer), using EPS. This is discussed further in **Section 4.2**. Please see **Section 1** for more information on the development of the peak month demands, and **Section 3** for more information on their allocation in the model.

Per the City's Specifications, the NP system must generally provide a pressure between 70 – 100 psi at all meters, and must maintain a velocity of less than 5 fps and headloss of less than 10 ft/1,000 ft in all pipes. While the City's Specifications say that irrigation mains can be as small as 4 inches, it was determined after conversations with the City that all future systems will be designed with a minimum pipe diameter of 8 inches. Additionally, it is considered a best practice to upsize the inlet pipe, from pond to wet well, in order to account for any additional expected demands. A recommended but not required design criteria is to design for less than 6 inches of headloss throughout the length of the pipe. For this NPMP, the inlets were designed for the 10 ft/1,000 ft headloss criteria, which will ensure that the total headloss remains below 6 inches as long as the inlet is less than 50 ft long.

NP pump stations must have a capacity of 120% of the peak hour, per the City's Specifications. The design flow of the future pumps was based on this parameter, and the design head for the future pumps was based on the pressure requirements throughout the modeled system.

Also per the City's Specifications, "ponds shall be sized to accommodate a minimum four (4) days of supply during peak irrigation periods, plus losses." For the NPMP, this means that storage requirements will be 4 times the peak day flow determined, plus 10% for evapotranspiration losses. While 10% losses was used for master planning purposes, developers should ensure that they incorporate calculated losses into their own storage calculations for a design-level report.

Table 5-1 summarizes the evaluation criteria.

Table 5-1 System Evaluation Criteria

Metric	Evaluation Criteria	Comments
Piping		
Pressure	70-100 psi	
Velocity	< 5 fps	
Headloss	< 10 ft / 1,000 ft	
Minimum Main Size	8 inches	Not specified in design criteria, City preference for future
Maximum Inlet Pipe Headloss	6 inches	Not specified in design criteria, good practice
Pumping		
Pumping Capacity	120% of peak hour	
Irrigation Window Assumed	10 hours / day	Not specified in design criteria. For irrigation-only pumps, does not apply to transfer pumps.
Pump Station Layout	No standby pump, however low flow pump required	
Ponds		
Storage Volume	4 times peak day + losses	
Daily Irrigation Application Rate	24 gpm/acre	Peak season metric used in the design of irrigation systems per the City's Specifications. This value is appropriate for areas where the exact irrigated acreage is known but is not appropriate for planning-level estimates of bulk undeveloped land.

5.2 Existing System Evaluation

The existing model was evaluated in both the InfoWater model and through various desktop analyses. The existing model helped identify concerns with pressure and velocity, while desktop analyses helped identify pumps that are at or over capacity and the pond design storage requirements. Existing deficiencies are summarized in **Table 5-2**, and a description of the recommended upgrades and solutions can be found later in this section. For more detailed information on the analysis results for the existing system, including recommended pond sizing, please see **Appendix D**.

The existing system evaluation was limited to the available data on pipe diameters and SCADA data. Refer to **Section 1** for more information about the background data, including the system inventory and SCADA data. Existing pump capacity was based O&M data such as pump curves, along with information from City operators.

The identified deficiencies included possible undersized inlet lines at some areas. However, the inlet pipe size should be confirmed in the field. Another commonly identified deficiency was that in some areas, while the main NP pipelines are sized correctly, the individual taps off to the irrigation systems (which can have diameters as small as 1 inch) are undersized. This produces high velocities and headloss. However, because there is only monthly data available at these taps, rather than hourly data, they may not be experiencing the high peak hours predicted by modeling based on SCADA readings at the pump station and may actually be appropriately sized. (For example, the hourly flows from the pump station have higher peaking factors than the small

diameter tap). If a customer notices low pressure, they may consider upsizing the tap off the mainline to mitigate this issue. Most pump stations (26 out of 34) were found to have sufficient capacity, even through buildout. However, increased NP irrigation adoption may lead to pump stations reaching capacity sooner than expected; flows should be continually monitored to note when pumps are getting close to capacity.

Table 5-2 Summary of Existing System Analysis

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Balsam Park	N/A	290	51	51	No deficiencies were identified for this pump station.
Bella Romero Elementary	N/A	330	109	109	No deficiencies were identified for this pump station.
Bittersweet Park	N/A	1,000	854	1,160	Small diameter pipes may be producing high headloss; limited data is available on pipe sizes. Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.
Boomerang	Boomerang North	1,500	769	769	No deficiencies were identified for this pump station.
	Boomerang South	1,500	694	0	This system is being replaced by the Boomerang Regional Pump Station.
	Boomerang Transfer	1,800	951	621	Some of the Boomerang transfer lines are undersized; this issue will be resolved by the construction of the Boomerang Regional Pump Station.
	Boomerang Regional Pump Station	3,260	N/A	2,716	<i>This new pump station is part of a larger redevelopment project and will replace the existing Boomerang South pump station. This pump station is identified as a CIP project.</i>
	North Ridge Transfer	1,800	936	936	No deficiencies were identified for this pump station.
	North Ridge School	2,700	1,205	1,752	No deficiencies were identified for this pump station.
	Poudre River Ranch	175	205	205	The lines to Poudre River Ranch and the pump station do not meet hydraulic design criteria but do not appear to hinder system performance. While there are no recommended changes, additional demand should not be added to this area without upsizing.
Cottonwood Park	N/A	115	69	69	No deficiencies were identified for this pump station.
Delta Park	N/A	95	52	52	No deficiencies were identified for this pump station.

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
East Memorial	N/A	319	314	440	Bringing on all potential undeveloped and conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each new area is brought on to ensure there is still sufficient capacity.
Glenmere Park	N/A	180	135	304	The inlet may be undersized; inlet pipe size data was not available for this system. Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.
Greeley West Park ¹	N/A	2,000	72	861	No deficiencies were identified for this pump station.
Highland Hills Golf	N/A	2,001	1,792	1,792	No deficiencies were identified for this pump station.
Island Grove and Saddle Club	Island Grove West	600	605	605	No deficiencies were identified for this pump station.
	Island Grove East	700	401	401	No deficiencies were identified for this pump station.
	Saddle Club	300	72	138	No deficiencies were identified for this pump station.
Jackson Field Sports	N/A	400	258	317	No deficiencies were identified for this pump station.
Josephine Jones Park	N/A	115	106	161	Bringing on all potential conversion areas may cause this pump station to be undersized after 2040. While no improvements are expected to be necessary before 2040, the system should be evaluated as each conversion area is brought on to ensure there is still sufficient capacity.
Linn Grove Cemetery	N/A	350	95	122	No deficiencies were identified for this pump station.
Luther Park	N/A	530	492	498	The small pipe diameter (4") at the outlet does not meet hydraulic design criteria; while this does not hinder system performance, it should be monitored as demands on the system increase to ensure the wet well is still able to receive sufficient water.
Madison Elementary and Houston Gardens	Houston Gardens	125	310	310	While this system appears to be operating over the pump design head, it does not hinder system performance, as this system is designed for low pressures.
	Madison Elementary	500	90	93	No deficiencies were identified for this pump station.

Service Area	Pump Station	Existing Capacity (gpm)	Existing Peak Hour Demand (gpm)	Buildout Flow – Peak Hour (gpm)	Comments and Identified Deficiencies
Monfort	N/A	2,400	1,423	1,745	The inlet is slightly undersized (10" diameter); while this does not hinder system performance, it should be monitored as demands on the system increase to ensure the wet well is still able to receive sufficient water.
Peakview Park	Mosier Hill	800	681	681	The pipes at Peakview Park have a small diameter (as low as 4") and do not meet hydraulic design criteria. Although this does not appear to significantly hinder system performance, the City may consider upsizing if other work is already being done in this area.
Promontory Park	Main	2,100	1,270	1,866	No deficiencies were identified for this pump station.
	Transfer	1,600	1,651	1,651	While this pump station sometimes operates slightly over its design flowrate, it is not significant enough to warrant upsizing. If additional demands in this area increase transfer station operations, expanding the length of time the transfer station operates each day will likely maintain an acceptable flowrate.
Ramseier	N/A	450	734	739	Additional evaluation of this site is needed as outlet pipe size and SCADA data were not available. While current modeling shows that the system is operating over the design head, the peaking factor may be lower than the system-wide diurnal curve, resulting in lower peak demands.
Sanborn Park	N/A	500	268	289	Small diameter lines may be causing high headloss; limited data is available on pipe sizes.
St. Michaels	N/A	1,120	1,121	1,167	This pump station may be undersized. Additional evaluation should be conducted to determine if demand management is effective and whether the pumps can be upsized without replacing the entire station.
Tech Center	N/A	N/A	N/A	N/A	This area is currently only served by a shoulder tap. A pump station is necessary to transition it to NP irrigation (future service area SA-14).
Youth Sports Center	Youth Sports	1,200	941	941	The inlet line does not meet hydraulic design criteria but does not appear to hinder system performance. This line should be evaluated as each new area is brought on to ensure there is still sufficient capacity.
	Twin Rivers Park	4,200	1,314	1,692	No deficiencies were identified for this pump station.

¹ Greeley West Park is planned for replacement before 2025. The values shown in the table represent the design for the new pump station.

5.3 Future System Evaluation by Planning Horizon

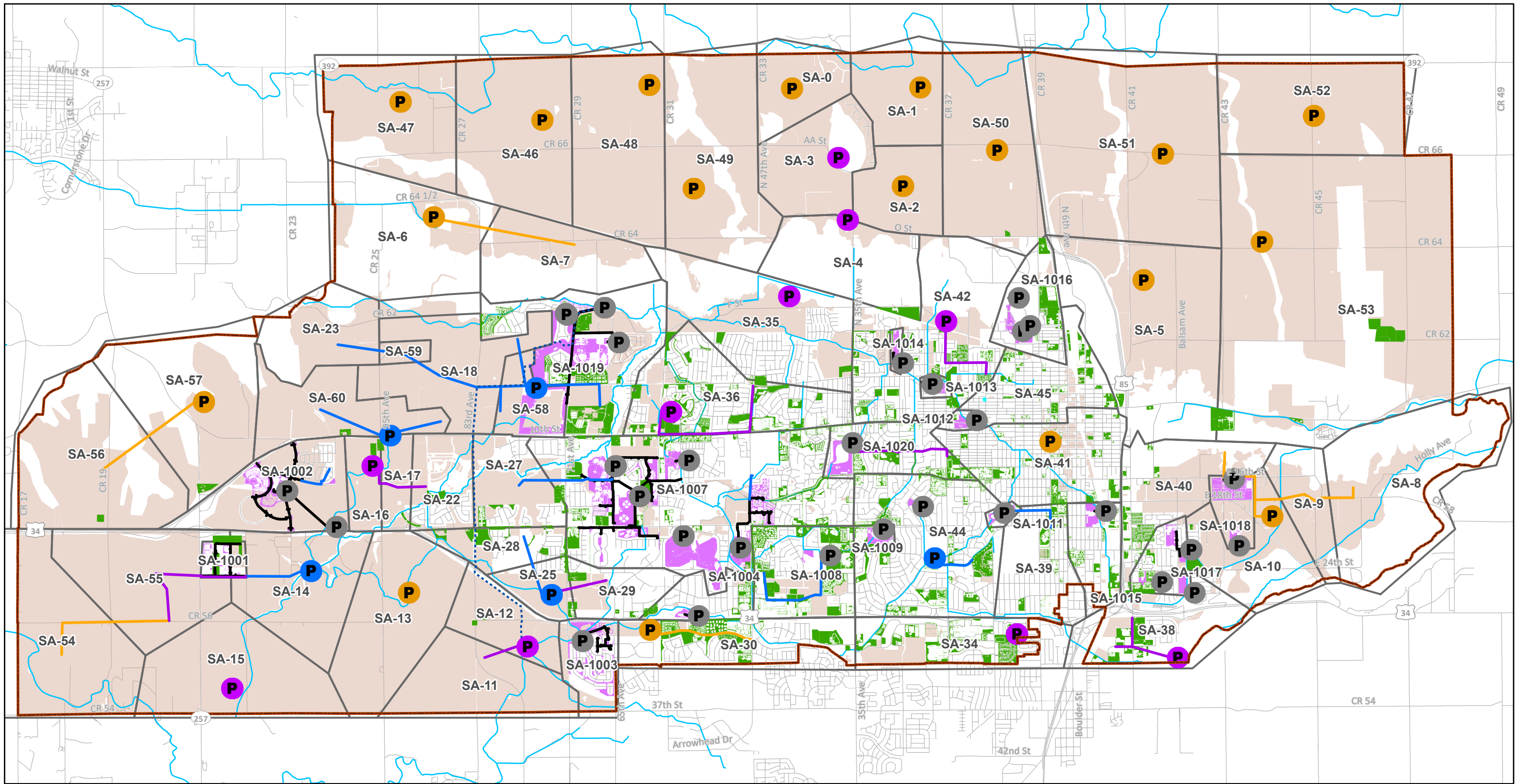
This section provides an overview of the preliminary results for sizing the pipes, pumps, and ponds to meet the design and evaluation criteria described above. For details on the sizing for each pump station, please see **Appendix E**. A map of all pump stations by planning horizon is shown in **Figure 5-1**. **Table 5-3** summarizes the proposed infrastructure (such as pipes and pump stations) by planning horizon. Only major piping (8 inches and larger) is accounted for in this plan. Detailed distribution piping will be per developer, City water and sewer department, and/or parks department plans. For some systems, it is expected that their pipelines will be expanded after construction as development occurs. For example, the pump station will be constructed to serve a smaller area, then the pipes will be expanded as development continues. It was assumed that pump stations will only be constructed after 20% of the potential buildout demand is met. The City should work with developers to determine best timing for construction of a new pump station as development projects become planned. All proposed projects described below were found feasible using the InfoWater methodology described in **Section 4**, but further design and confirmation is required for each system before construction.

Table 5-3 Proposed Infrastructure by Planning Horizon

Planning Horizon	Pump Stations ¹	Storage in Ponds (AF)	New Pipeline (ft) by Diameter					
			8-inch	10-inch	12-inch	16-inch	30-inch	Total
Existing	37	Unknown	23,100	17,600	12,200	3,400 > 12"		90,000
2025	5	35.1	21,800	18,500	0	19,000	26,700	86,000
2040	10	28.1	26,900	11,500	0	8,200	0	46,600
Buildout	18	75.7	28,300	1,000	200	14,800	0	44,300
Total New	33	139.0	77,000	31,000	200	42,000	26,700	150,200

¹ All new pump stations are expected to have a pond.

All existing and planned future pump stations are shown in **Figure 5-1**. Pump station locations and pipeline alignments are approximate and schematic.





Great. From the Ground Up.



May 17, 2021

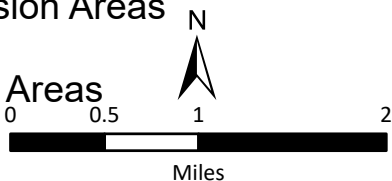
Legend

 LREGA	 Existing Pump Station	 Existing NP Pipes	 Upper Equalizer Project
 Existing NP Irrigated Areas	 2025 Pump Station	 2025 Proposed NP Pipes	 Conversion Areas
 Future NP Demand Parcels	 2040 Pump Station	 2040 Proposed NP Pipes	 Service Areas
 Greeley Ditch	 Buildout Pump Station	 Buildout Proposed NP Pipes	

Recommended Capital Improvements

Figure 5-1

Greeley Non-Potable Water System Master Plan



0 0.5 1 2 Miles

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5.3.1 2025 System Evaluation

The 2025 planning horizon includes improvements to the existing system. The improvements include new pump stations in areas that are already developed (but may experience conversion or infill) and new pump stations in areas that are expected to develop by 2025, especially planned developments. In total, 4 new pump stations are expected by the 2025 planning horizon. Please see **Table 5-4** and **Appendix E** for detailed information on these pump stations. The following are notable projects that are expected to be completed by 2025:

- Upper Equalizer Project¹. This project will expand NP service further into the shoulder seasons by transferring water from the Greeley Irrigation Company (GIC) to the GLIC ditches. The proposed piping will be routed along 83rd Avenue.
- Boomerang Regional Pump Station. This project will be part of a larger project, which involves redevelopment of the southern 9 holes of the Boomerang Golf Course, construction of a new school, and residential development. The piping from the Boomerang Regional Pump Station is expected to serve far to the west, including past 95th Avenue.
- Upsizing of the Greeley West pump station to serve the Centerplace development, as well as other conversion and infill areas.
- Construction of a pump station to serve the Tech Center and adjacent undeveloped areas.
- Expansion of piping (new pipeline) from Glenmere Park along 8th Avenue to serve additional conversion and infill areas.
- Expansion of piping (new pipeline) from Promontory Park along 16th Street to serve newly developing areas.
- Expansion of piping (new pipeline) from Monfort along 47th Avenue to serve additional conversion and infill areas.
- Expansion of piping (new pipeline) from Twin Rivers Park to the west to serve additional conversion and infill areas.

5.3.2 2040 System Evaluation

The 2040 planning horizon includes 12 new pump stations, primarily in areas that are currently undeveloped. In particular, eight new pump stations are expected in the North of the River area due to potential NP demands through that area starting after 2025. However, very limited development is expected in this area until full buildout. The City may consider constructing the NP distribution pipe system but waiting to put in pump stations until there is further development in the area, similar to how the Tech Center was constructed. The following are notable projects that are expected to be completed between 2025 and 2040:

¹ Supply-side projects such as the Upper Equalizer Project were not studied as part of the NPMP, which was focused on the expansion of the distribution system.

- Westward expansion of pipelines from the Tech Center. It is expected that the southernmost 6 inch existing NP lines along the southern edge of the Tech Center are not sized large enough to handle the additional flows and will need to be either upsized or paralleled. The City may decide to complete this project when the new SA-14 pump station is constructed, depending on future development.
- Construction of a regional pump station west of St. Michaels (Cobblestone Regional).

Table 5-4 and **Appendix E** summarize these and other projects.

5.3.3 Buildout System Evaluation

The buildout planning horizon includes 19 new pump stations in areas that are either not expected to have any development, or have less than 20% development, until after the year 2040. The locations of these pump stations were based on even spacing throughout the LREGA, in coordination with the City's parks department. These locations are not final and should be coordinated with the construction of new parks or open spaces, where the ponds can serve as an amenity. **Table 5-4** and **Appendix E** summarize these and other projects.

Table 5-4 Future System Information

Pump Station Name	Planning Horizon	Pump Station Design		PS Outlet Size (in)	Pond Size (AF) ¹
		Flow (gpm)	Head (ft)		
SA-14	2025	3500	230	16	13.4
SA-25	2025	640	160	8	2.4
SA-44	2025	660	160	8	2.5
SA-60	2025	1120	200	10	4.2
Boomerang Regional PS	2025	3260	170	16	12.5
SA-3	2040	620	160	8	2.3
SA-4	2040	240	180	8	0.9
SA-12	2040	1160	210	10	4.4
SA-15	2040	1400	170	10	5.3
SA-16	2040	1040	180	10	4.0
SA-34	2040	620	160	8	2.3
SA-35	2040	900	170	8	3.4
SA-36	2040	160	180	8	0.5
SA-38	2040	720	180	8	2.7
SA-42	Buildout	780	170	8	3.0
SA-0	Buildout	660	180	8	2.5
SA-1	Buildout	620	170	8	2.4
SA-2	Buildout	360	180	8	1.4
SA-5	Buildout	1000	170	10	3.8
SA-6	Buildout	1220	170	10	4.6
SA-10	Buildout	440	155	8	1.7
SA-13	Buildout	1120	160	10	4.3
SA-30	Buildout	1120	160	10	4.2

Pump Station Name	Planning Horizon	Pump Station Design		PS Outlet Size (in)	Pond Size (AF) ¹
		Flow (gpm)	Head (ft)		
SA-41	Buildout	960	170	10	3.7
SA-46	Buildout	1040	170	10	4.0
SA-47	Buildout	1120	170	10	4.2
SA-48	Buildout	1540	170	12	5.9
SA-49	Buildout	2500	180	16	9.6
SA-50	Buildout	1300	170	10	5.0
SA-51	Buildout	1820	170	12	6.9
SA-52	Buildout	1480	200	16	5.7
SA-53	2025	3500	230	16	13.4
SA-57	2025	640	160	8	2.4

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Section 6

Capital Improvement Plan

6.1 Approach to CIP Development

This Section builds on the capital improvement projects identified in **Section 5** at the 2025 and 2040 planning horizons and defines the approach for development of the 5-year and 20-year CIPs. The identified CIPs were developed with consideration of the City's current and long-range population as well as projected flows, using currently available information. Conditions will change with time and uncertainties will impact the accuracy of each plan in later years. As projects come closer to implementation, it is important that the City reevaluate each CIP to better reflect costs.

This section provides planning level cost estimates for capital improvement project scheduling. Major capital elements are itemized with unit prices. Information from past projects and outside resources, both locally and nationwide, were relied upon to develop unit prices for major capital categories. CIP projects were developed using pipeline quantity estimates and modeling data. GIS mapping was used to identify areas of interest, such as utilities and road crossings. The unit prices were then multiplied by the quantity of each element. Project elements that are difficult to estimate during the planning stage are included in the overall cost as either allowances or as a percentage of the total for the itemized project elements. During design development, the more specific data will be used to inform the design and resulting project cost estimate.

6.2 Cost Development

Unit costs were developed to aid in CIP budgeting, as described below. Cost estimating is considered Association for the Advancement of Cost Engineering (AACE) Class 5 – Conceptual engineering phase.

6.2.1 Project Implementation and Additional Project-Related Costs

Apart from the unit costs used to build-up project material costs (e.g., pipes, pumps, and ponds), several other elements were added as factors. Construction factors include items such as erosion control/stormwater pollution prevention and contractor mobilization and demobilization. These costs are estimated as a percentage of the construction unit costs. Contingency is applied to the subtotal of these construction cost elements to account for variations in unit prices or quantity estimates. Programmatic elements such as engineering, permitting, legal, and administration are estimated as a percentage of the construction cost. **Table 6-1** provides a breakdown of the assumptions used for project implementation and contingency.

Table 6-1 Costing Factors for Construction Bid and Total CIP Project Costs

Category	Item	Costing Factor
Construction Bid Cost (includes infrastructure and contractor overhead, profit, bonds, and insurance)	Erosion Control/Stormwater Pollution Prevention ¹	2%
	Mobilization and Demobilization ¹	5%
	Contingency ²	35%
Project Implementation ³	Feasibility and Site Studies	9% for OPCC ≤ \$1 million 6% for OPCC of \$1 million to \$10 million 5% for OPCC > \$10 million
	Preliminary and Final Design	9% for OPCC ≤ \$1 million 6% for OPCC of \$1 million to \$10 million 5% for OPCC > \$10 million
	Engineering Services During Construction	5%
Additional Project-Related Costs ³	Outside Construction Management - not used if OPCC value is < \$1M	5%
	Outside Project Management - not used if OPCC value is < \$1M	3%

¹ Construction bid cost costing factors erosion control/stormwater pollution prevention and mobilization and demobilization are applied to the subtotal of unit cost items.

² Contingency costing factor is 35% of the subtotal of the unit cost items, erosion control/stormwater pollution prevention, and mobilization and demobilization.

³ Project implementation and additional project-related cost factors are applied to the total construction cost.

6.2.1.1 Erosion Control/Stormwater Pollution Prevention

Project erosion control and stormwater pollution prevention includes the contractor's cost to manage the stormwater during construction through best management practices such as silt fences, rock socks, vehicle tracking, and silt prevention at storm inlets. This category is assumed as 2% of the unit costs and is based on estimator's judgement. This costing factor is added to calculate project OPCC totals.

6.2.1.2 Mobilization and Demobilization

Contractor Mobilization and Demobilization includes the contractor's start-up costs and close-out costs. Start-up costs include items such as moving equipment and personnel to the project location, obtaining permits and bonds, etc. Close-out costs include items such as project cleanup, moving equipment and personnel from the project location, etc. The mobilization and demobilization category is estimated as 5% of the unit costs and is based on estimator's judgement. This costing factor is added to calculate project OPCC totals.

6.2.1.3 Contingency

During the planning phase, the design and field work has not yet been completed for the projects. Therefore, the cost development relies on estimated quantities for each construction element. Project contingency provides for these uncertainties by adding additional costs to the project total. The contingency at the planning level is typically 35% of the OPCC subtotal after the erosion

control/stormwater pollution prevention and mobilization and demobilization costing factors have been included. Project contingency also provides for costs associated with items that are difficult to itemize at a planning level.

6.2.1.4 Feasibility and Site Studies

This cost element includes the planning and field investigations (such as geotechnical, survey, ground sampling, subsurface utility engineering [SUE] and locates, etc.) that are required to implement a project. These are estimated as a percentage of the subtotal of the previous elements and the percentage varies based on the OPCC, plus cost contingency.

6.2.1.5 Preliminary and Final Design

The preliminary and final design cost element includes the cost for engineering services to develop biddable plans and specifications in accordance with applicable standards. This cost is estimated using a percentage of the OPCC, plus cost contingency.

6.2.1.6 Engineering Services During Construction

Engineering services during construction includes the review of contractor submittals, requested changes, and design adjustments that may be required during construction. A percentage of the OPCC is used to estimate this cost element.

6.2.1.7 Additional Project-Related Costs

Outside construction and project management are estimated for projects that are not directly managed by the City. For purposes of this master plan, only projects in excess of \$1 million were assigned these cost elements.

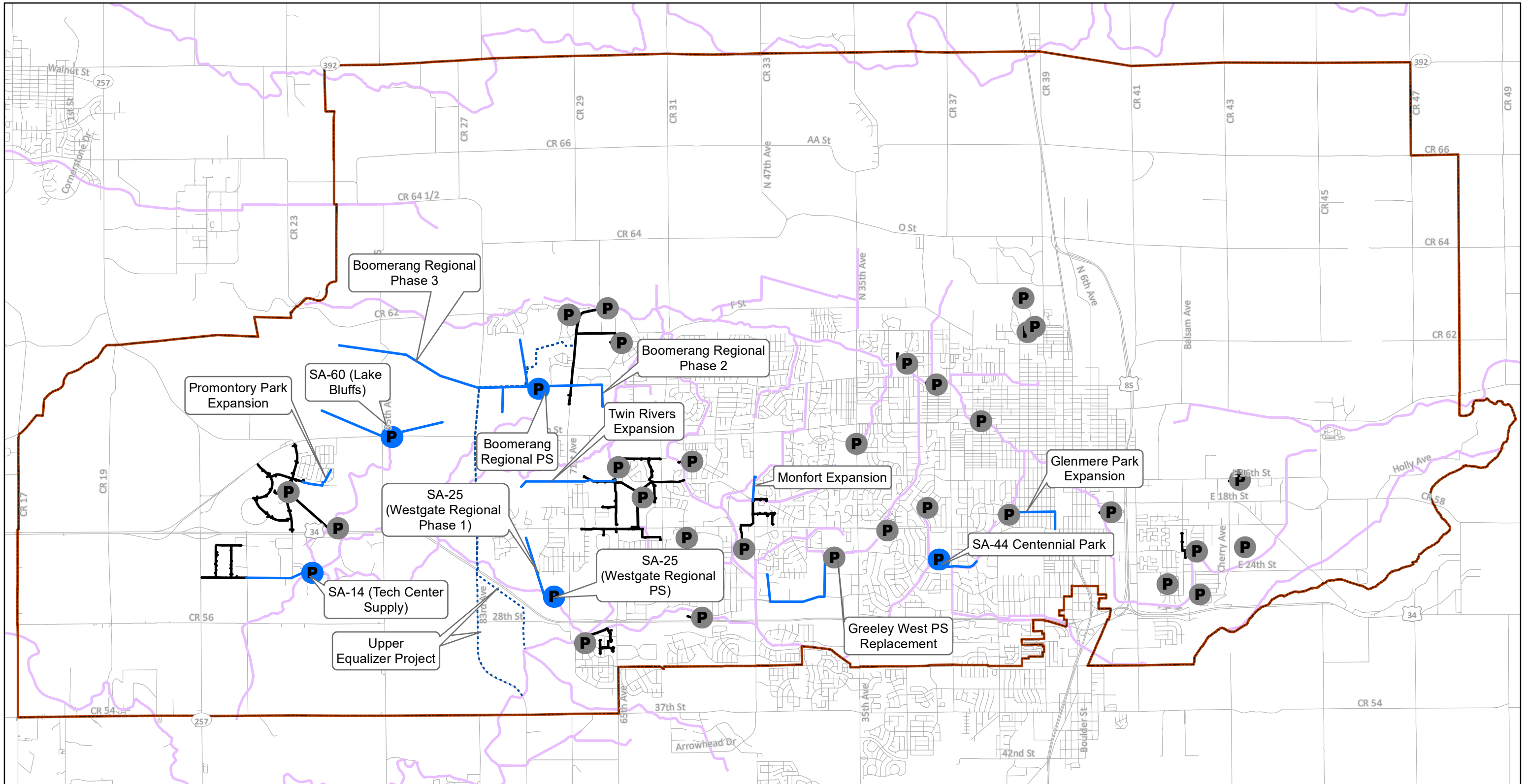
6.3 Identified CIP Projects

Projects are forecast over 5-years (for projects for 2022 through 2025) and 20-years (for projects for 2026 through 2040). Projects were named based on geographic location and service area number. Construction and total project costs were developed for the projects and are described in the following figures and tables.

Figures 6-1 and **6-2** illustrate the locations of the identified projects within the 5-year and 20-year CIPs respectively. For development driven projects, the City will negotiate with developers the cost difference for the installation of a larger pipe diameter or for additional pipe lengths to meet future needs versus the developer's needs.

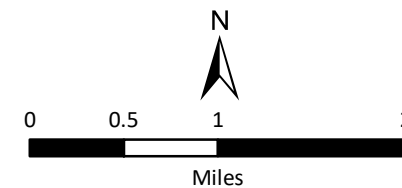
Table 6-2 provides a summary of project drivers. This summary identifies a driver as an existing deficiency or population growth driven, and also whether the project is proposed to be constructed by the City's water and sewer department, the City's parks department, or by developers. In many cases, project costs may be shared between some or all of these three entities. It is assumed that costs will be divided proportionately, based on future demands. Stakeholders for any given NP project should collaborate to develop cost sharing for projects that would mutually benefit all responsible parties.

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Legend

- LREGA
- P Existing Pump Station
- P 2025 Pump Station
- Existing NP Pipes
- 2025 Proposed NP Pipes
- Greeley Ditch
- Upper Equalizer Project



Recommended 5 Year Improvements

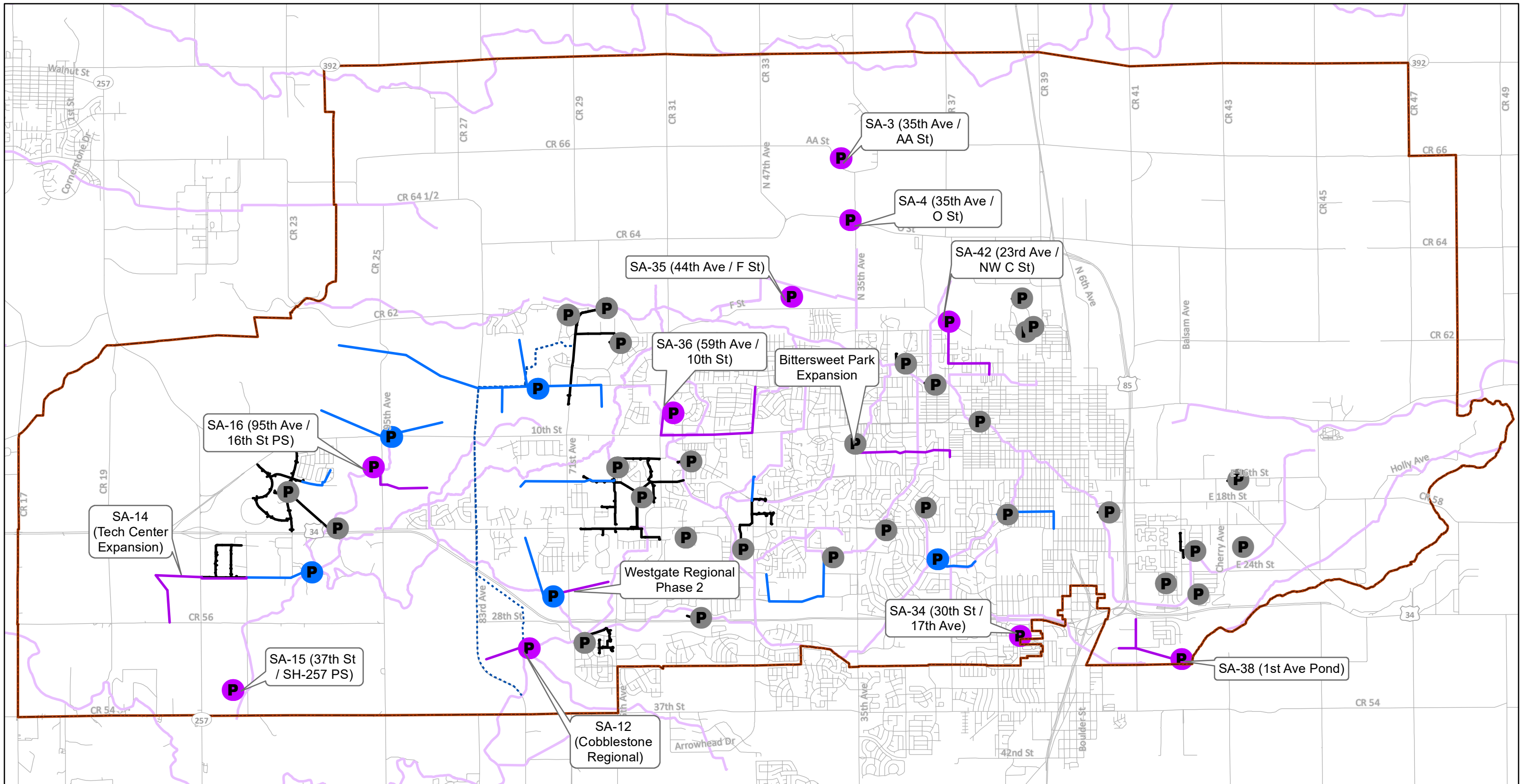
Figure 6-1

Greeley Non-Potable Water
System Master Plan



**CDM
Smith**
June 02, 2021

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Legend

LREGA

Existing Pump Station

2025 Pump Station

2040 Pump Station

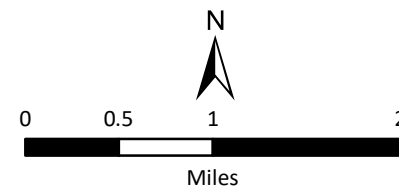
Existing NP Pipes

2025 Proposed NP Pipes

2040 Proposed NP Pipes

Greeley Ditch

Upper Equalizer Project



Recommended 20 Year Improvements

Figure 6-2

*Greeley Non-Potable Water
System Master Plan*



**CDM
Smith**
June 02, 2021

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Table 6-2 Project Information

Projects	Project Driver	Funding Source ¹	Planning Start Year ²	Design Start Year ²	Construction Start Year ²	OPCC ³	Total Cost ³	City of Greeley Water/Sewer	City of Greeley Parks	Development
5-Year Planning Horizon										
SA-44 Centennial Park	Service Expansion	W/S, Parks, Dev	2020	2021	2022	\$4,020,000	\$5,030,000	\$3,488,100	\$1,379,300	\$162,600
Boomerang Regional Pump Station	Service Expansion	W/S, Parks, Dev	2021	2021	2022	\$5,530,000	\$6,920,000	\$221,300	\$694,000	\$6,004,700
Boomerang Regional Phase 2	Service Expansion	W/S, Parks, Dev	2021	2021	2022	\$1,830,000	\$2,390,000	\$76,400	\$239,700	\$2,073,900
Greeley West Pump Station Replacement	Service Expansion	W/S, Dev	2021	2022	2023	\$5,970,000	\$7,470,000	\$6,161,400	-	\$1,308,600
Upper Equalizer Project	Shoulder Season Extension	W/S	2022	2023	2024	\$20,010,000	\$25,620,000	\$25,620,000	-	-
SA-14 Tech Center Supply	Service Expansion	W/S, Dev	2024	2025	2026	\$4,560,000	\$5,930,000	\$17,100	-	\$5,912,900
Promontory Park Expansion	Service Expansion	Development	2024	2025	2026	\$580,000	\$720,000	-	-	\$720,000
Monfort Expansion	Service Expansion	W/S, Parks, Dev	2024	2025	2026	\$400,000	\$500,000	\$245,300	\$76,000	\$178,700
Twin Rivers Expansion	Service Expansion	W/S, Parks, Dev	2024	2025	2026	\$1,830,000	\$2,390,000	\$1,172,400	\$363,300	\$854,300
SA-38 1st Ave Pond	Service Expansion	W/S, Dev	2024	2025	2026	\$2,760,000	\$3,590,000	\$2,881,600	-	\$708,400
SA-25 Westgate Regional Pump Station	Service Expansion	W/S, Parks	2025	2026	2027	\$2,130,000	\$2,670,000	\$2,038,415	\$631,585	-
SA-25 Westgate Regional Phase 1	Service Expansion	Dev	2025	2026	2027	\$900,000	\$1,160,000	-	-	\$1,160,000
SA-60 Lake Bluffs	Service Expansion	W/S, Dev	2025	2026	2027	\$4,650,000	\$6,050,000	\$57,000	-	\$5,993,000
5-Year Subtotal						\$55,170,000	\$70,440,000	\$41,979,015	\$3,383,885	\$25,077,100
20-Year Planning Horizon										
SA-34 30th St/17th Ave	Service Expansion	W/S, Parks, Dev	2027	2028	2029	\$2,300,000	\$2,880,000	\$1,932,500	\$281,200	\$666,300
Boomerang Regional Phase 3	Service Expansion	W/S, Parks, Dev	2028	2029	2030	\$6,150,000	\$8,000,000	\$255,900	\$802,300	\$6,941,800
SA-4 35th Ave/O St	Service Expansion	W/S, Dev	2028	2029	2030	\$1,000,000	\$1,170,000	\$262,400	-	\$907,600
SA-3 35th Ave/AA St	Service Expansion	Development	2029	2030	2031	\$1,750,000	\$2,190,000	-	-	\$2,190,000
Bittersweet Park Expansion	Service Expansion	W/S, Parks, Dev	2029	2030	2031	\$2,520,000	\$3,160,000	\$2,475,181	\$684,819	-
SA-35 44th Ave/F St	Service Expansion	W/S, Parks, Dev	2030	2031	2032	\$2,060,000	\$2,580,000	\$166,000	\$658,300	\$1,755,700
SA-36 59th Ave/10th St	Service Expansion	W/S, Parks, Dev	2031	2032	2033	\$6,550,000	\$8,190,000	\$3,810,800	\$2,569,500	\$1,809,700
SA-16 95th Ave/16th St	Service Expansion	W/S, Parks, Dev	2034	2035	2036	\$4,040,000	\$5,260,000	\$205,300	\$610,300	\$4,444,400
SA-14 Tech Center Expansion	Service Expansion	W/S, Dev	2035	2036	2037	\$2,660,000	\$3,460,000	\$10,000	-	\$3,450,000
SA-15 37th St/SH-257 Pump Station	Service Expansion	Development	2036	2037	2038	\$3,100,000	\$3,880,000	-	-	\$3,880,000
SA-12 Cobblestone Regional	Service Expansion	W/S, Dev	2037	2038	2039	\$3,270,000	\$4,260,000	\$48,500	-	\$4,211,500
Glenmere Park Expansion	Service Expansion	W/S, Parks, Dev	2037	2038	2039	\$1,690,000	\$2,200,000	\$1,427,916	\$603,228	\$168,856
SA-25 Westgate Regional Phase 2	Service Expansion	W/S, Dev	2038	2039	2040	\$950,000	\$1,220,000	\$857,400	-	\$362,600
SA-42 23rd Ave/NW C St	Service Expansion	W/S, Parks, Dev	2039	2040	2041	\$4,630,000	\$6,030,000	\$2,513,300	\$1,421,100	\$2,095,600
20-Year Subtotal						\$42,670,000	\$54,480,000	\$13,965,198	\$7,630,746	\$32,884,056
Total						\$97,840,000	\$124,920,000	\$55,944,212	\$11,014,631	\$57,961,156

August 2020 dollars as adjusted by ENR-CCI were used for project OPCCs, total costs, and project fund allocations – City of Greeley Water and Sewer Department, City of Greeley Parks Department, and Development.

¹ W/S: City of Greeley water and sewer department, Parks: City of Greeley parks department, Dev: Development

² Project planning, design, and construction years are subject to change pending future project updates, development of projects, and/or schedule changes.

³ OPCC and total costs per project are subject to change pending future project updates, development of projects, and/or schedule changes.

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6.4 CIP Implementation Schedule

Projects identified in the 5-year and 20-year planning horizons were given projected planning, design, and construction start years to help the City schedule project implementation. Annual fiscal requirements from 2021 through 2042 are shown in **Figure 6-3**.

For scheduling purposes, 5-year improvements were identified from 2022 through 2027, based on design start year, while 20-year improvements were identified from 2028 through 2042. NP projects are usually considered lower priority than water, sewer, or transportation projects so they were generally moved in time to match other nearby projects. It was assumed that each stage (planning, design, and construction) will take at least one year with the construction phase taking two, three, or four years if the total CIP cost for a project was greater than \$1 million, \$5 million, or \$10 million, respectively.

Estimated start years for each planning horizon were adjusted based on the following factors:

- Water and Sanitary Sewer Improvements. When applicable, start years of NP projects were adjusted to align with major water and sanitary sewer improvements.
- Transportation Improvements. When applicable, start years were adjusted to coincide with major transportation improvements identified as part of the City's Keep Greeley Moving Phase 2 initiative (City of Greeley, 2021).
- Scheduling. When applicable, start years were adjusted based on needed prioritization of projects.
- Funding. Projects were staggered as needed to balance funding requirements.

If a project start year was shifted, the project is left within its original 2025 or 2040 planning horizon for modeling and analysis purposes but will appear in the correct 5- or 20-year CIP total. Note that the Upper Equalizer Project has major outlays between 2024 and 2028 resulting in higher CIP budgets over that timeframe.

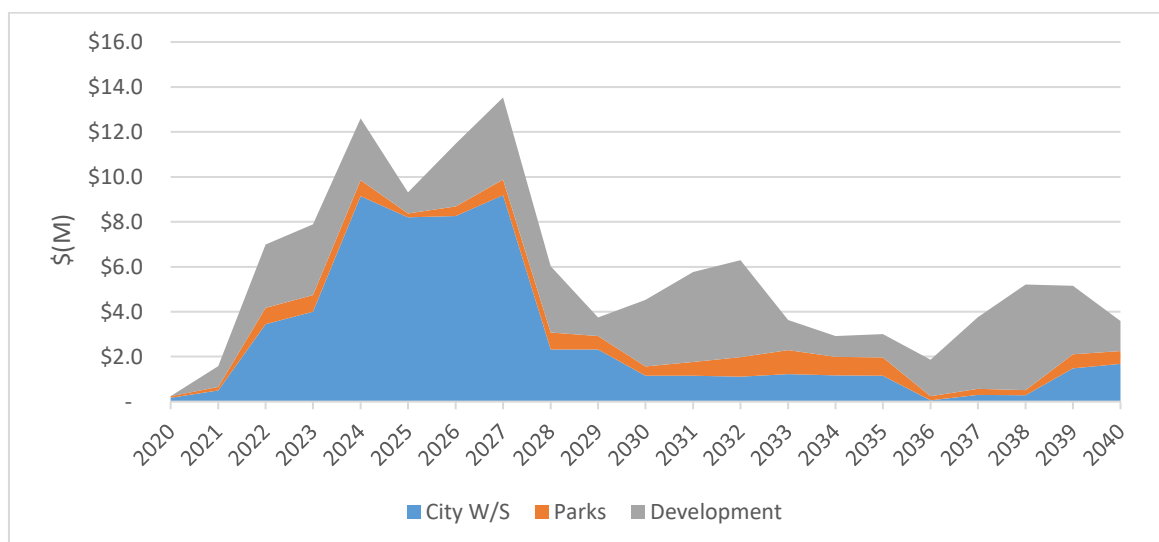


Figure 6-3 Annual NP Funding Projections by Fund

CIP costs are August 2020 dollars from ENR-CCI.

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Section 7

Findings and Recommendations

The findings and recommendations summarized in this section have been drawn from the planning and evaluation sections of this NPMP. The recommendations identify system needs, actions, and capital improvements through the buildout planning horizon. However, the actual implementation time frame will depend on actual growth rates, order of development, and the level of available capital funding. Additionally, the actual scope and implementation of these recommendations may vary with detailed planning and design.

7.1 Key Findings

Key findings identified as part of the NPMP include the following:

- Discussions with other Front Range stakeholders revealed that the City has a unique and advanced NP irrigation system, particularly for raw water suppliers. For more information, see **Section 2.1**.
- Historically, comprehensive data collection has often been difficult for the NP system. Additional studies or data collection, along with more standardized record keeping practices, can help the City keep track of the overall system. Record keeping practices could include recording ditch laterals in GIS, updating and enforcing construction drawing standards, creating a system for regularly updating the NP GIS database, and/or installing SCADA systems. For more information, see **Section 2.4** and **Section 2.5**.
- Review of historical demands showed that NP usage varies annually by significant amounts. In particular, demand dropped significantly as parks transitioned to improved control systems. Future NP demands are expected to come from two sources: 1) undeveloped lands that will use NP irrigation when they develop, and 2) existing areas that will convert to NP irrigation, referred to as conversion areas. NP peak season demands are expected to increase by 1.1 MGD by 2025, 2.8 MGD by 2040, and 11.5 MGD by buildout. NP adoption is strongly influenced by policy, which is a key conservation measure. For more information, see **Section 3**.
- Some of the existing systems were identified as needing improvement, but no critical deficiencies were identified. These include areas that are expected to have undersized inlet lines, pipes, or pumps by buildout. For more information, see **Section 5.2**.
- New recommended CIP projects were identified. These primarily consist of new pump stations or expansions of existing pipe systems to serve new areas and customers. New pump stations will be constructed primarily by development. It is estimated that the system will need 4 new pump stations by 2025, 12 new pump stations between 2025 and 2040, and 19 new pump stations between 2040 and buildout. For more information, see **Section 5.3**.

7.2 Recommendations

The recommendations for the NPMP include the following:

- Implement and enforce an NP policy to promote and expand NP irrigation practices. It is recommended for this policy to mandate that new developments and redevelopments use NP irrigation and for the policy to generally encourage the growth of the NP system.
- Consider implementing improved operational practices at existing pump stations either when it becomes necessary, or during other construction, such as rehabilitating a park irrigation system. This can include increasing the watering window to reduce peak hour demands by decreasing the size of irrigation zones and implementing SCADA where not currently installed. It is recommended for customers to use a watering window of 10 hours a day, where possible, and to use the best landscaping practices included in **Appendix F**.
- Create new standards for data collection and record keeping. This can include enforcing standards related to construction record drawings, developing and maintaining an internal record-keeping system, creating a plan for regularly updating the GIS database, and/or implementing a CMMS for NP infrastructure. It is also recommended for the City to conduct a study of ditches and laterals throughout the LREGA, and/or require developers to include this data in their plans.
- Implement and enforce requirements for the installation of SCADA systems at new or rebuilt pump stations. The City may consider including SCADA requirements in the City's Specifications.
- Continue monitoring and recording demands and pump station flows to identify major changes in operations that may impact system performance.
- Continue maintenance of the InfoWater model. This can include adding new pipes, deleting abandoned pipes, tracking open and closed valves, and reflecting operational changes as the system continues to expand.
- Evaluate the St. Michaels pump station to determine whether additional construction is needed at this site to meet higher demands. This evaluation should determine whether demand management could be an effective solution, and whether the pumps can be upsized without replacing the entire pump station.
- Coordinate this NPMP with other relevant planning documents, such as the WTDMP, SSMP, *Imagine Greeley Comprehensive Plan*, and BBC report. It is recommended to use this NPMP as a guide for infrastructure planning and to use the BBC report as a guide for water resources planning.
- Continue building the NP system through a hub-and-spoke approach. Consider looping or connecting systems where systems are on similar hydraulic grade lines and looping would improve operational flexibility.

- In areas with limited or interim development, require the construction of NP infrastructure, such as piped irrigation system, even if a pump station will not be constructed until later.
- New pipe and pump station layouts are conceptual in nature and are primarily intended to show hydraulic feasibility for master planning purposes. Conduct a detailed evaluation of pipe alignment and size, and pump station location and sizing as projects move into design and implementation stages when there is more certainty of development and design criteria. The InfoWater model can be used as a tool to support future planning decisions, if regularly maintained.
- Complete the capital improvements recommended in **Section 6**, prioritizing the 5-year CIP recommended projects. Coordinate closely with the City's parks department, other utilities, and developers to regularly update the scheduling of these projects. The City should consider using the InfoWater model as a tool to inform developer plans while coordinating with them.
- Update the NPMP every 5 years, including reevaluating demand and population projections every 5 to 10 years. Planning assumptions made for the NP system in the next 20 years and beyond is subject to change with time.

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Section 8

References

- AECOM. 2016. *City of Greeley Non-Potable Water Supply Upper Equalizer Infrastructure Feasibility Study*.
- AECOM. 2021. *Poudre Ponds Reclamation and Restoration Improvements Project Mini Master Plan*.
- Applegate Group, Inc. 2004. *Non-Potable Water Master Plan*.
- Aqua Engineering, Inc. 2002. *Non-Potable Master Plan*.
- BBC Research and Consulting. 2018. *City of Greeley Population and Water Demand Projections*.
- BBC Research and Consulting. 2017. *Technical Memorandum – Updated Water Demand Projections and Future Water Needs*.
- Boyle Engineering Corporation. 1993. *Greeley-Loveland Reservoir Storage and Canal Delivery System Study*.
- City of Greeley. 2019. *Annual Growth & Development Projections Report*.
- CDM Smith. 2021. *CIP Planning Tool: WTDMP, NPMP, and SSMP City of Greeley Excel Spreadsheet*.
- City of Greeley. 2020. *City of Greeley Project Initiation Form Excel Spreadsheet*.
- City of Greeley. 2018. *Comprehensive Plan – Imagine Greeley (including supplemental information)*.
- City of Greeley. 2008. *Design and Criteria and Construction Standards: Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*. Vol. III
- City of Greeley, Intergovernmental Agreements (various dates and sources).
- City of Greeley. 2021. *Keep Greeley Moving Phase 2 by Neighborhood 2023 – 2029*.
- City Greeley. Meetings with Westminster (January 30, 2020), Denver Water (February 25, 2020), Evans (November 4, 2020), Windsor (November 5, 2020).
- City of Greeley. 2021. *Operation Rehab Project 2021 – 2025 Excel Spreadsheet*.
- City of Greeley. 2019. *Pipe Rehabilitation Cost Estimating Template – V4.0 Excel Spreadsheet*.
- City of Greeley. 2021. *Water and Sewer Department 10 Year CIP 2021 – 2030*.
- Design Workshop, Inc. 2016. *Greeley Parks, Trails and Open Lands Master Plan*.
- Design Workshop, Inc. 2016. *Island Grove Regional Park Master Plan*.

ECL. 1999. *Non-Potable Water Program Master Plan*.

EDAW. 2002. *Greeley Parks and Trails Master Plan*.

U.S. Department of Transportation: Federal Highway Administration. 2014. *Mitigation Strategies for Design Exceptions*

Appendix A

Field Inventory Summaries

The following table summarizes the infrastructure identified and recorded as part of the field inventory conducted for the NPMP.

Asset Type	Number of Items Surveyed
Air release valve	19
Augmentation water discharge	1
Backflow preventer	1
Blow off	57
Control panel building	1
Curb stop valve	13
Ditch-point	14
Drain valve	7
Flume level sensor	1
Flush pit	3
Head gate	24
Manhole	4
Meter	131
Pond	20
Pressure release valve	1
Pump	71
Settling vault	1
Tracer wire	38
Truck fill	2
Valve	263
Weir	6
Well	9

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Appendix B

Naming System

The following table captures the naming system used to record infrastructure identified as part of the field inventory for the NPMP.

System	Location	Asset Type
NP-Non-Potable Water	BG-Boomerang Golf	WEL-Well
	BP-Bittersweet Park	MET-Meter
	BS-Balsam Sports	PMP-Pump
	CW-Cottonwood Park	VAL-Valve
	DP-Delta Park	FPT-Flush Pit
	EM- East Memorial	HGT-Head gate
	GM-Glenmere Park	MNH-Man Hole
	GW-Greeley West Park	FLF-Filter Flush
	HH-Highland Hills Golf	PND-Pond
	IG- Island Grove Park	PPL-Pump Panel
	JF-Jackson Field Sports	TKF-Truck Fill
	JJ-Josephine Jones Park	TRW-Tracer Wire
	LG-Linn Grove	SVT-Settling Vault
	LP-Luther Park	ARV-Air Relief Valve
	ME-Madison Elementary	CSV-Curb Stop Valve
	MF-Monfort Elementary	BOF-Blow Off
	NR-North Ridge School	PRV-Pressure reducing valve
	PM-Promontory Park	WER- Weir
	PP-Poudre Ponds	BFP-Backflow Preventor
	PV-Peak View Park	BDT-Boyd Ditch
	RE- Romero Elementary	ADS-Augmentation Discharge
	RP-Ramseier Park	
	SM-Saint Michaels	
	SP-Sanborn Park	
	TC-Tech Center	
	WP-Waggin Tail Dog Park	
	YS-Youth Sports Complex	
	TR-Twin Rivers Park	

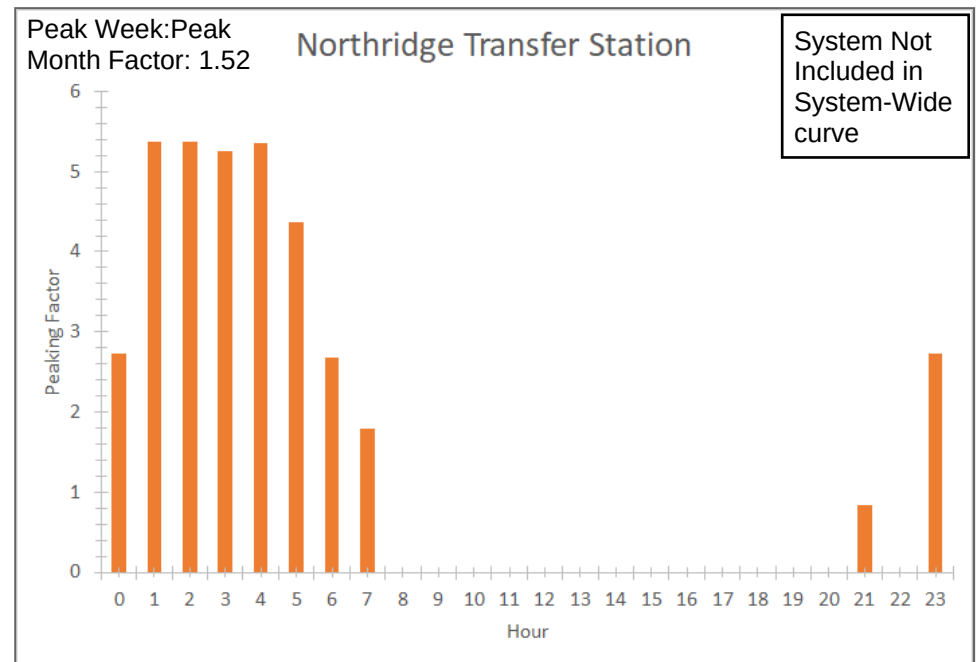
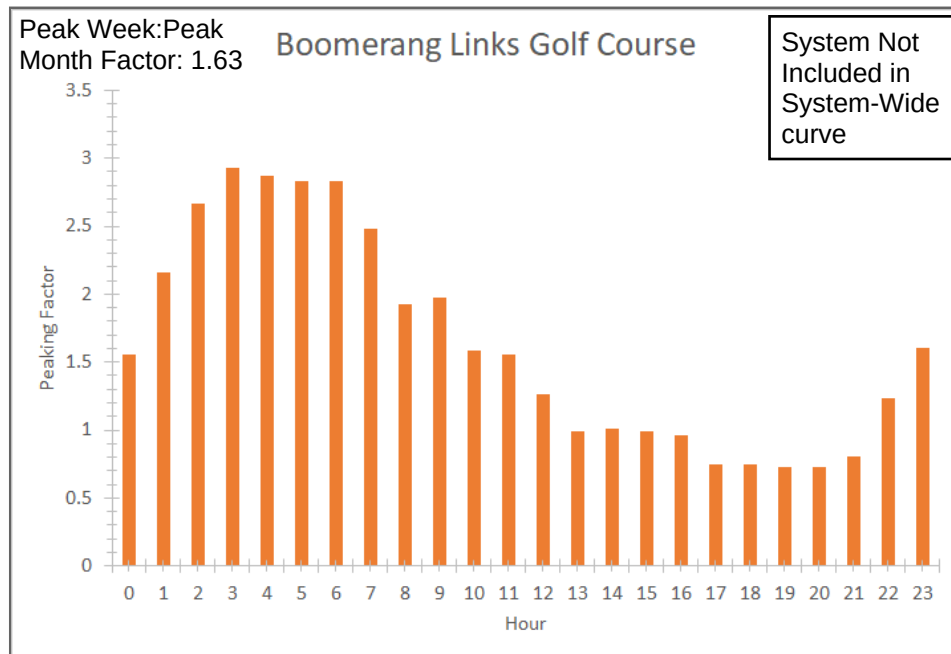
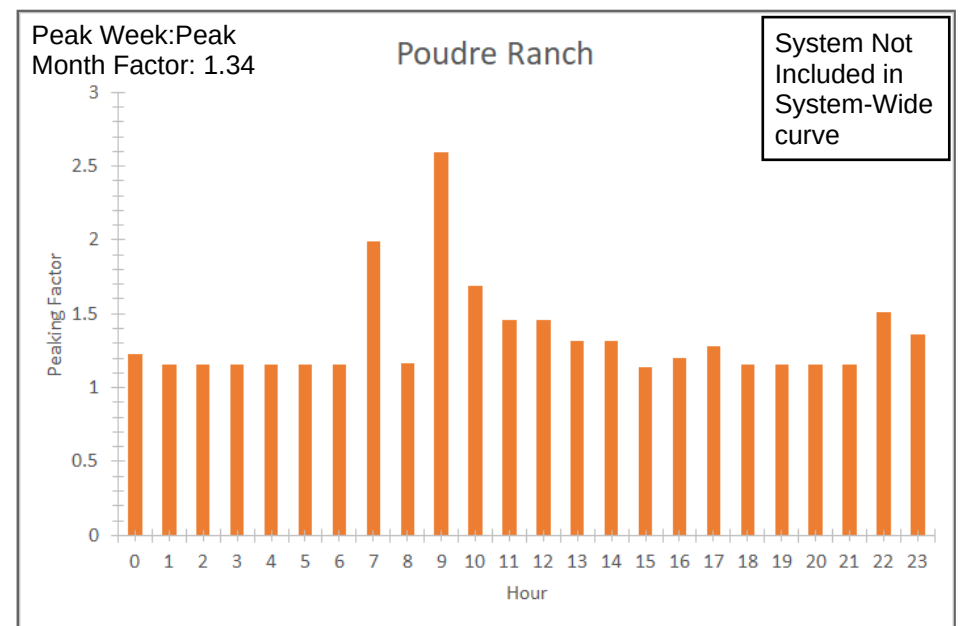
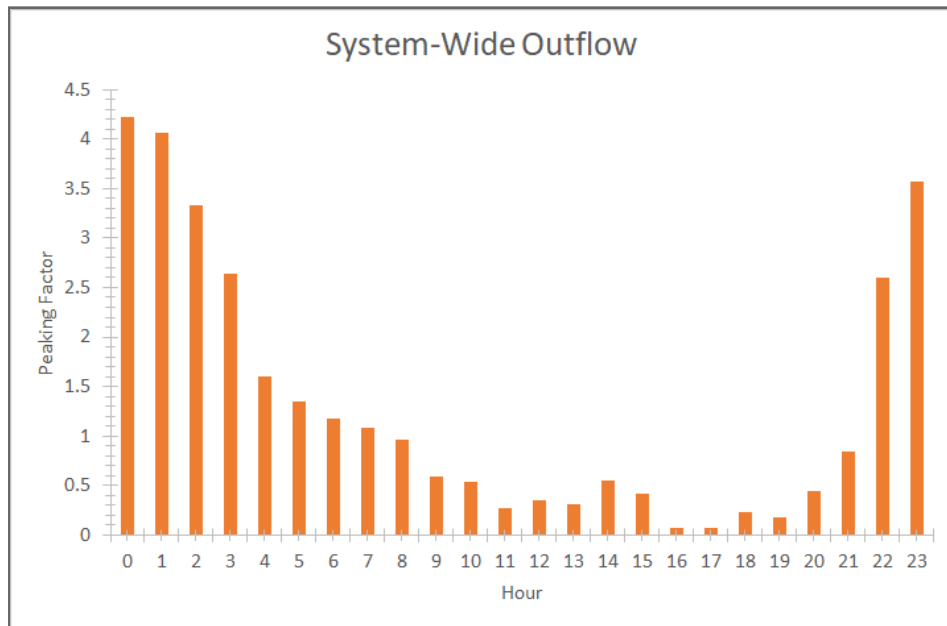
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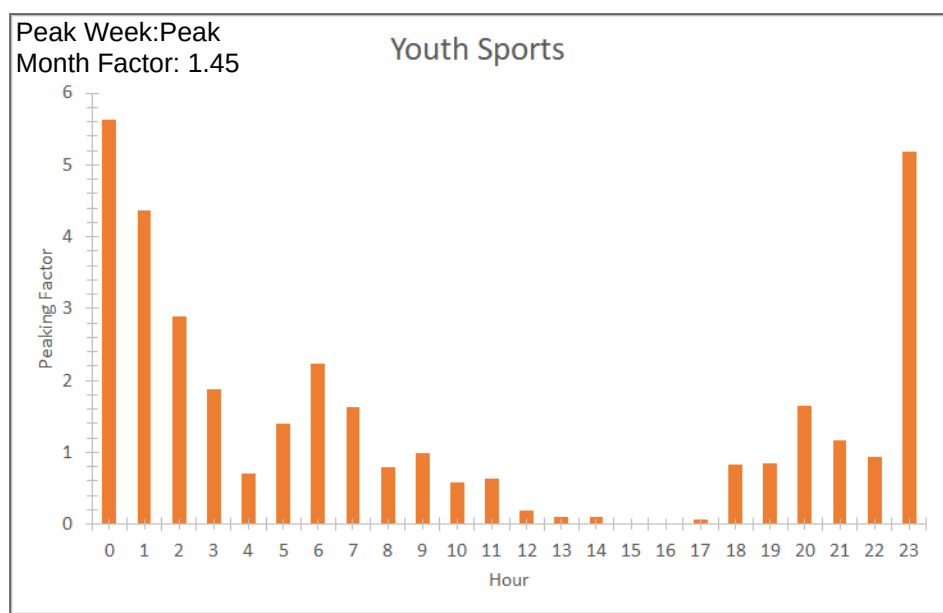
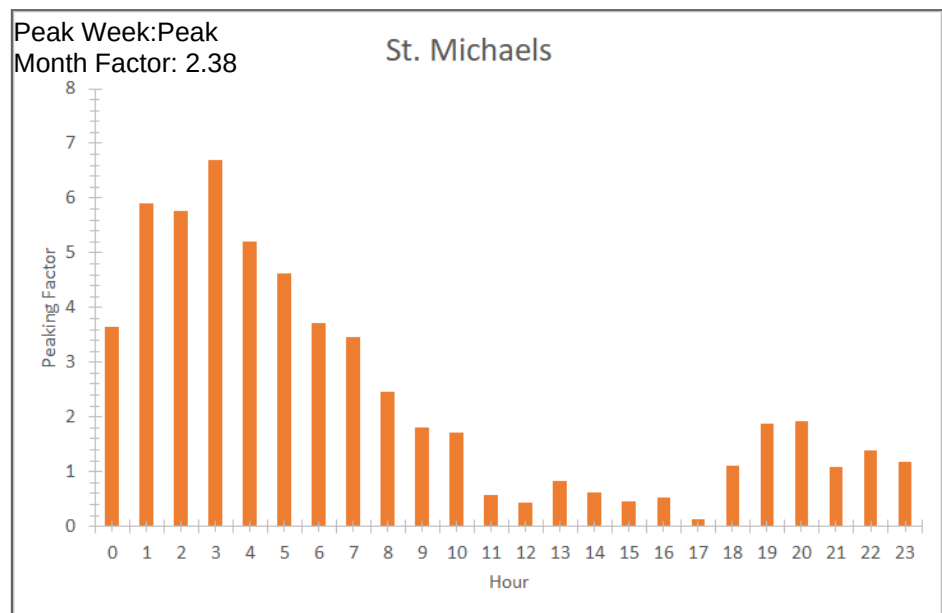
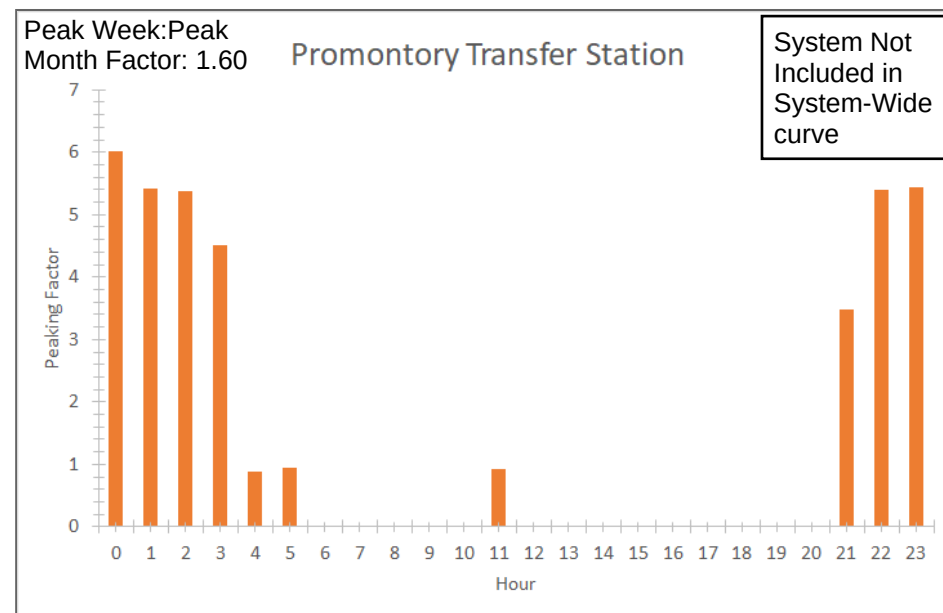
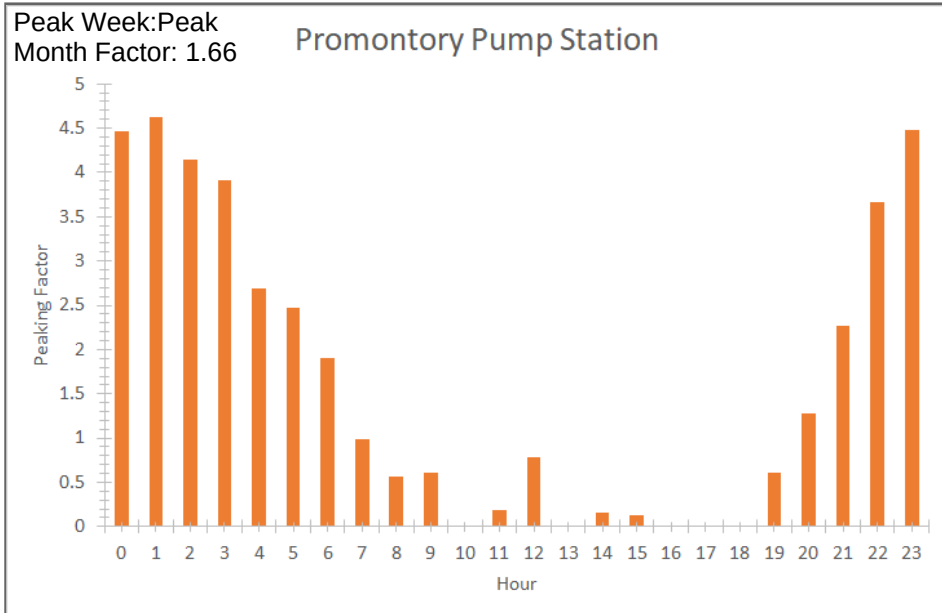
Appendix C

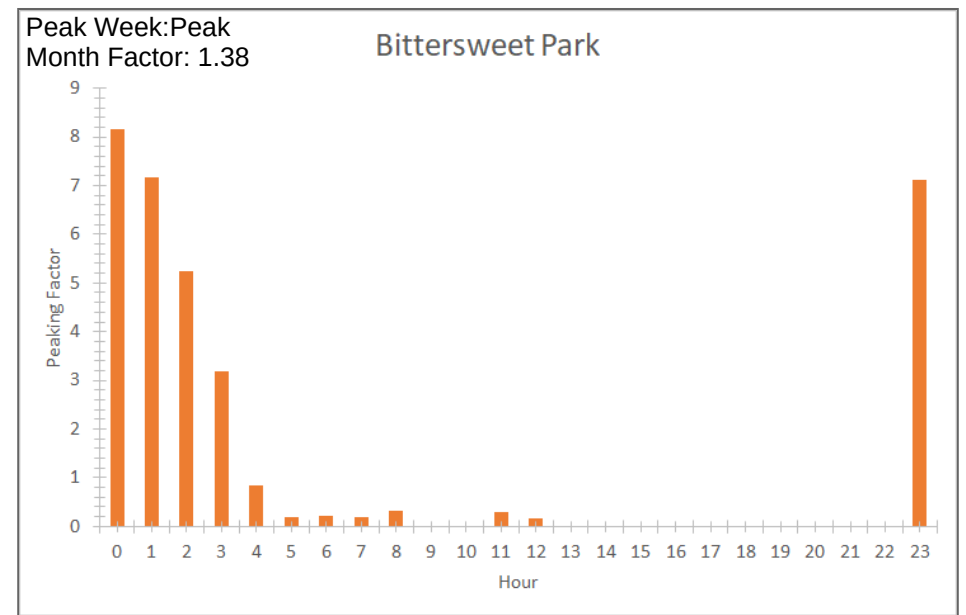
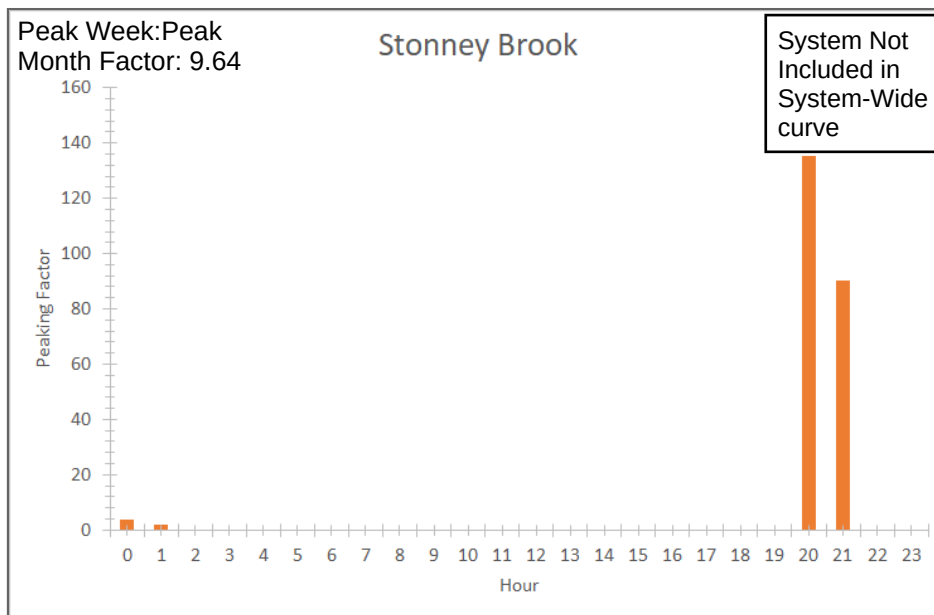
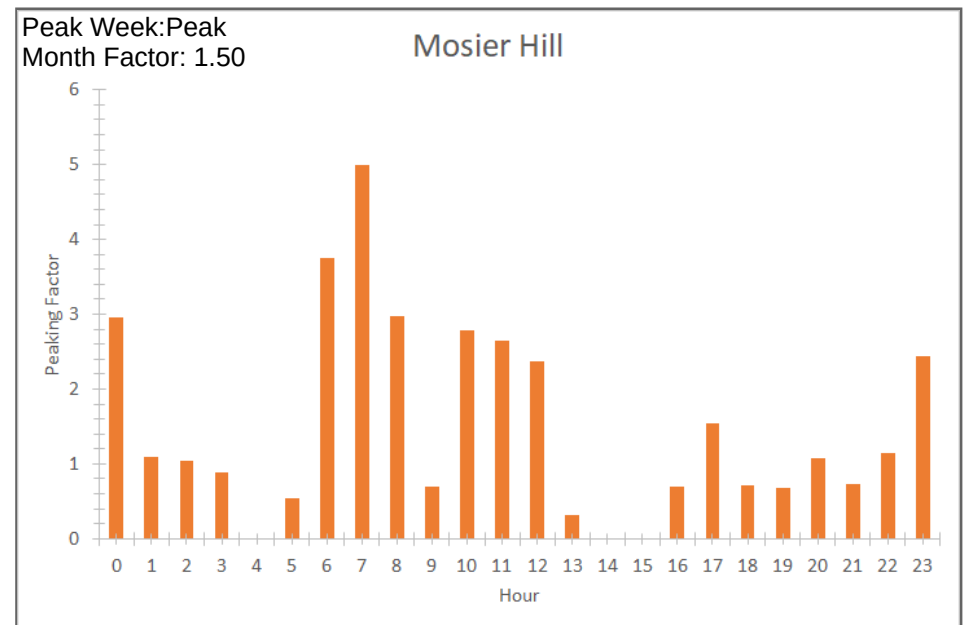
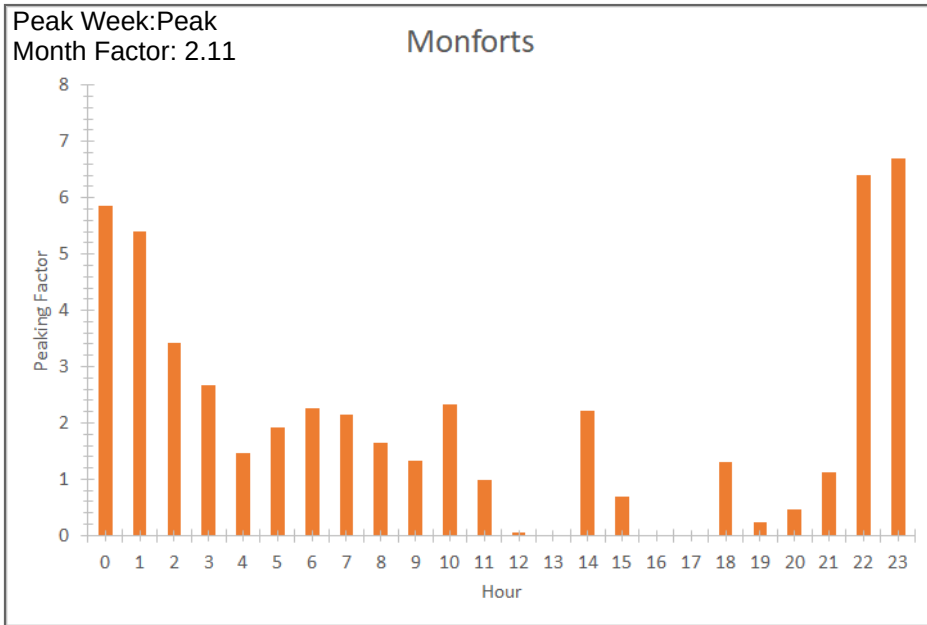
Individual Diurnal Curves

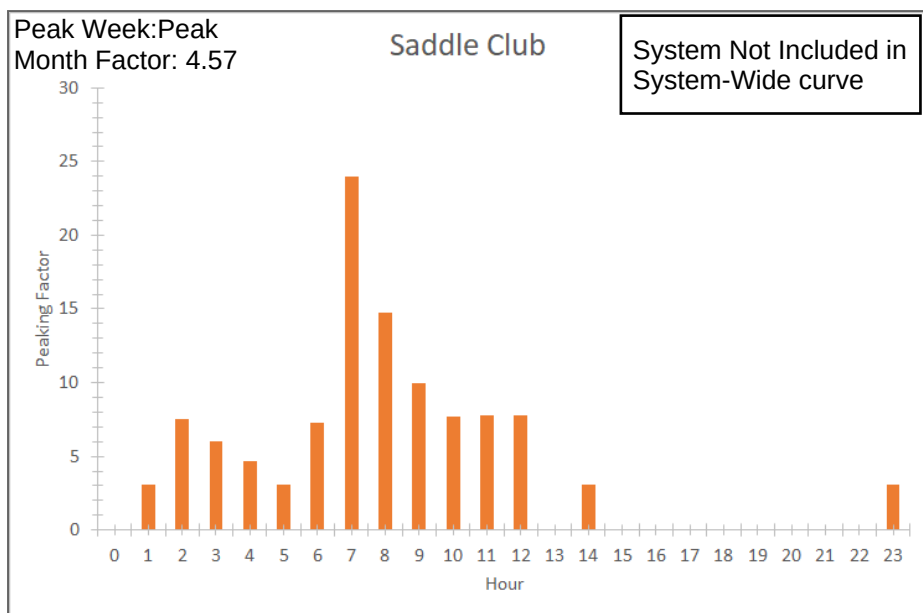
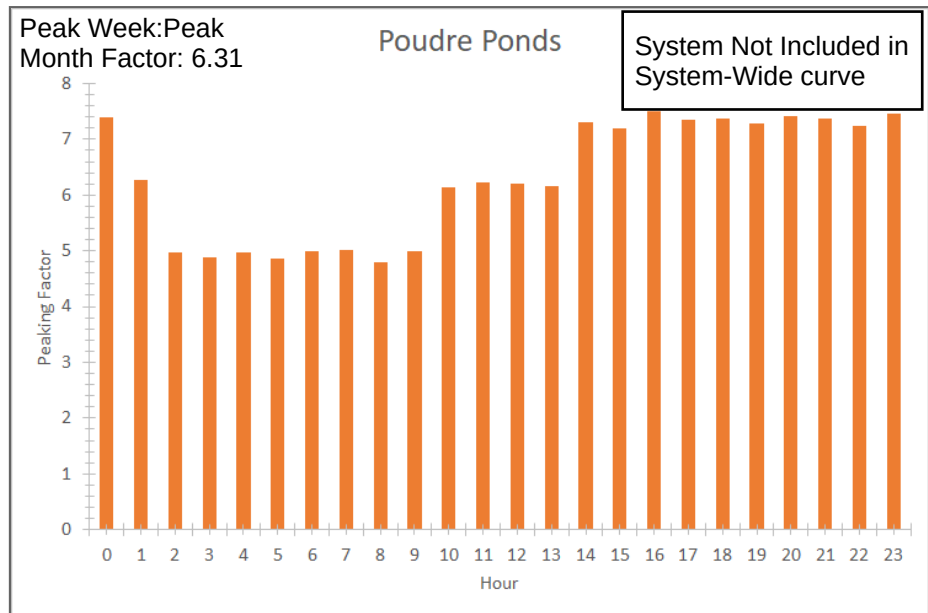
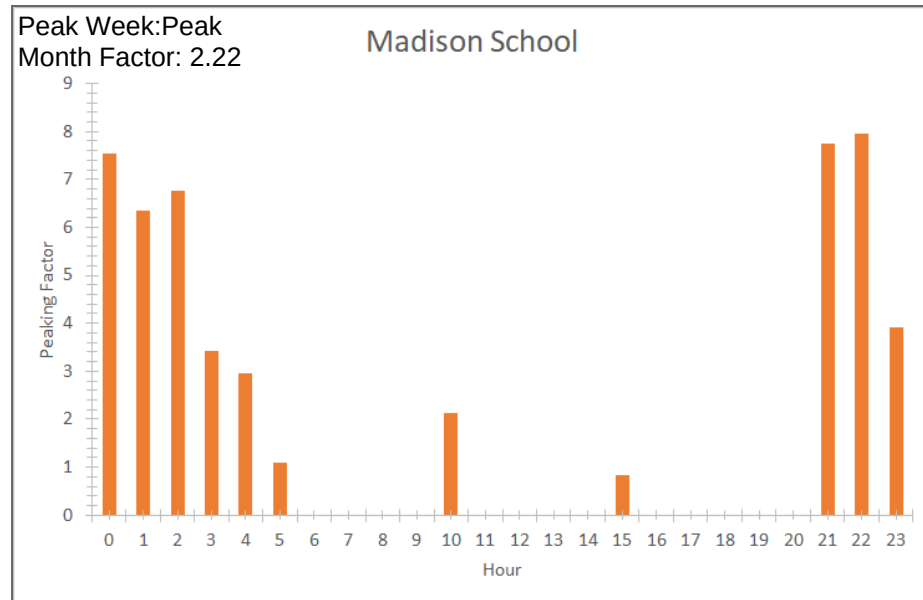
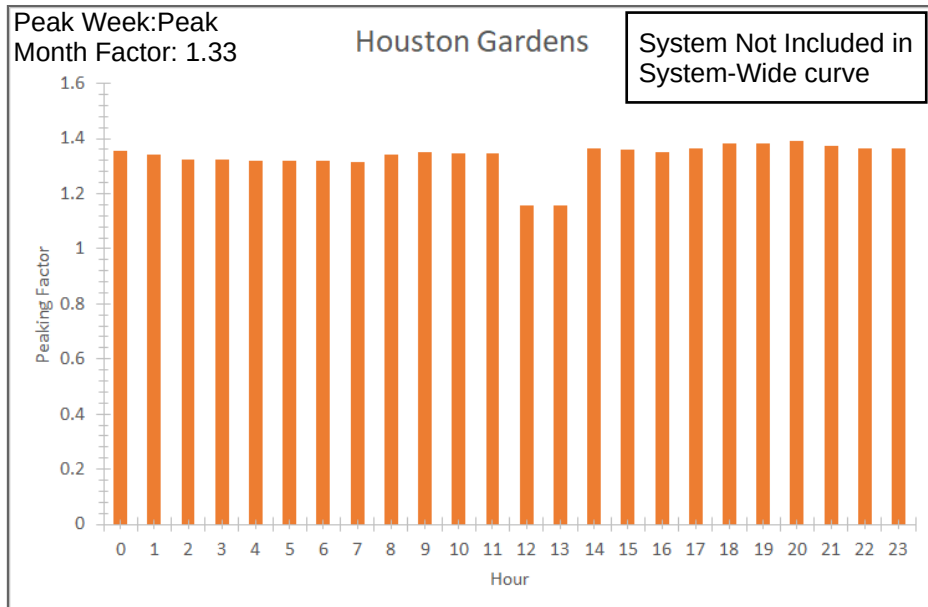
The graphs shown below are diurnal curves for each of the individual existing systems, where SCADA data was available. Each curve has a unique peak week : peak month factor and was based on the system's peak week (during July and August 2018 and 2019). Operational changes may improve individual system performance by flattening demand during periods of use while reducing peak demand factors. Such changes could result in downsizing future pipelines and pumps and potentially reducing future operating costs without changing future maximum month demands. It should be noted that current demand patterns are largely driven by end user choices, such as vegetation, watering schedule and duration, irrigation system configuration, and irrigation controls, as well as future weather conditions. Any or all of these factors could change in the future.

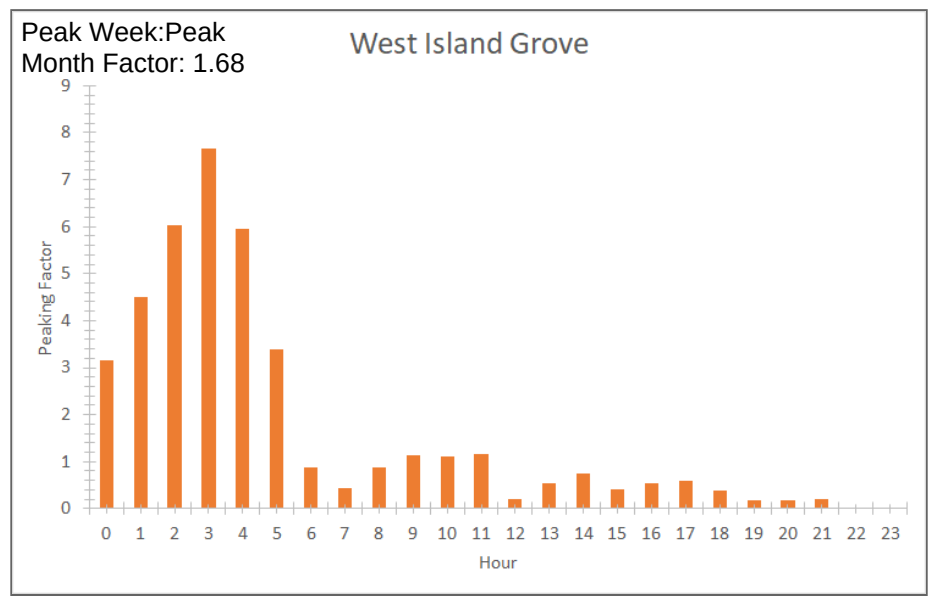
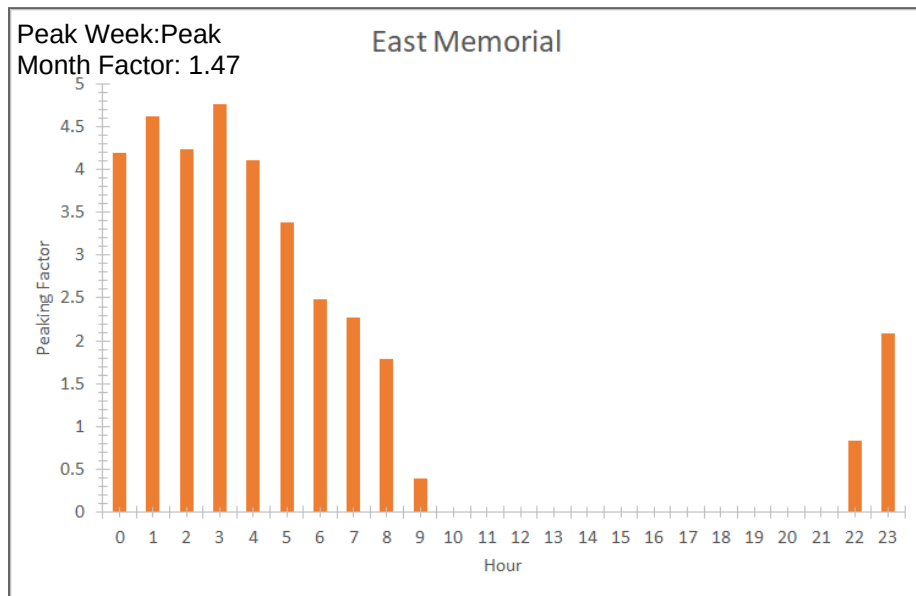
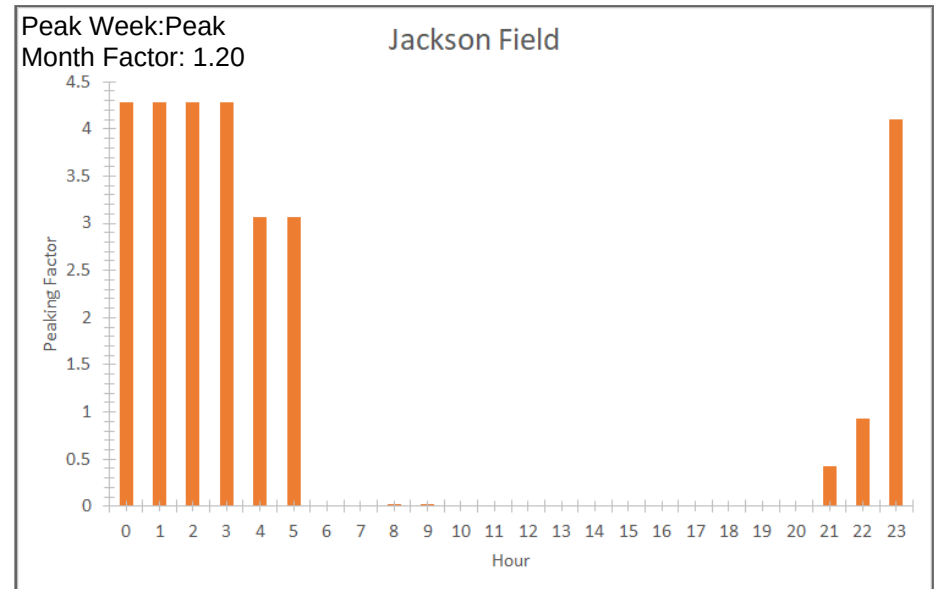
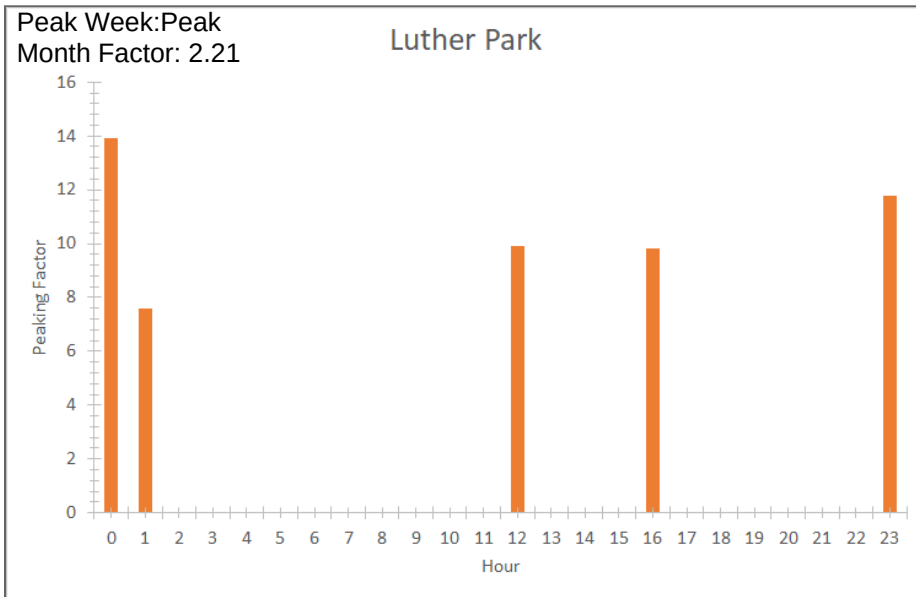
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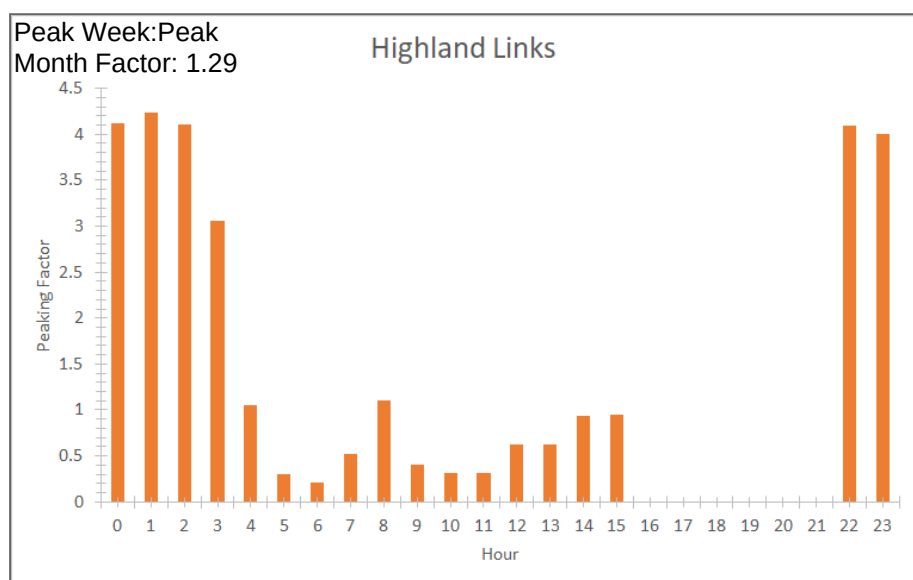
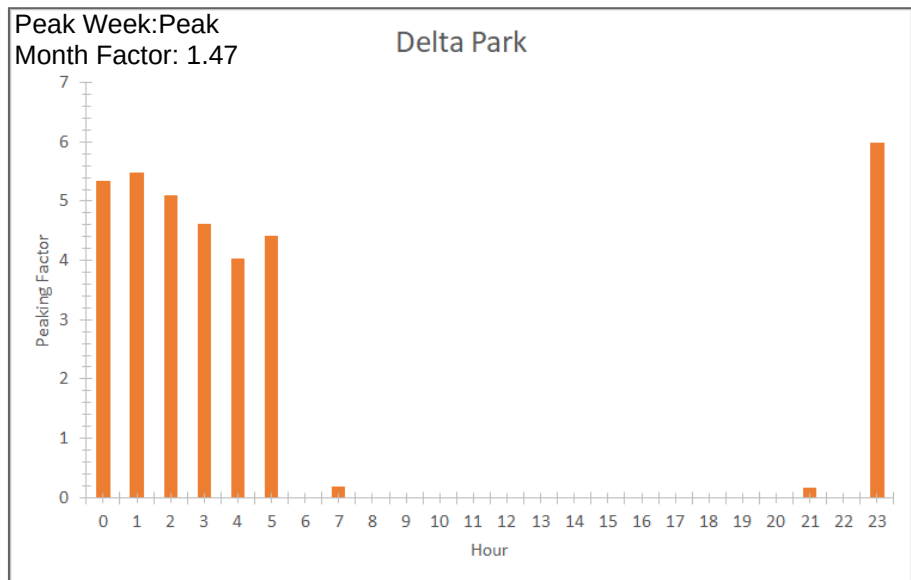
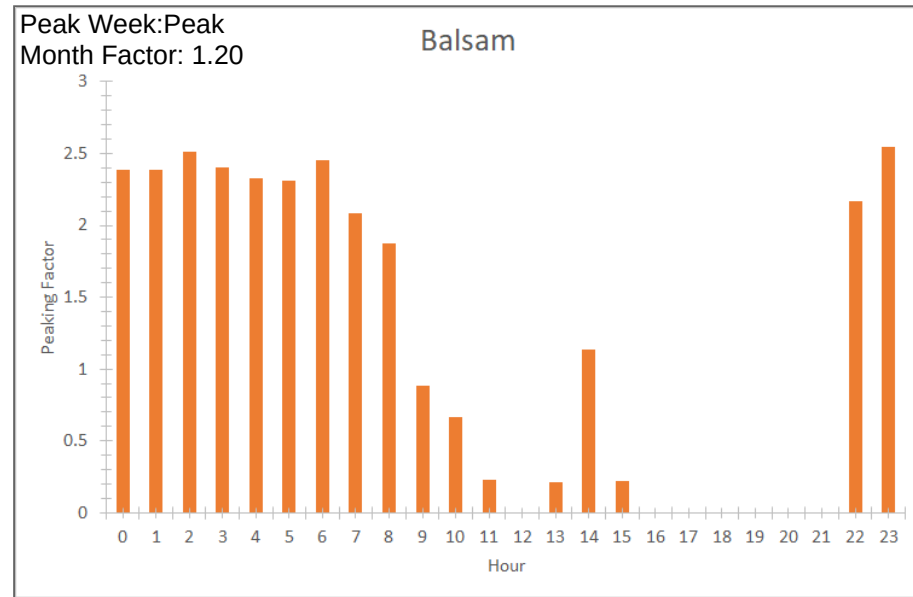
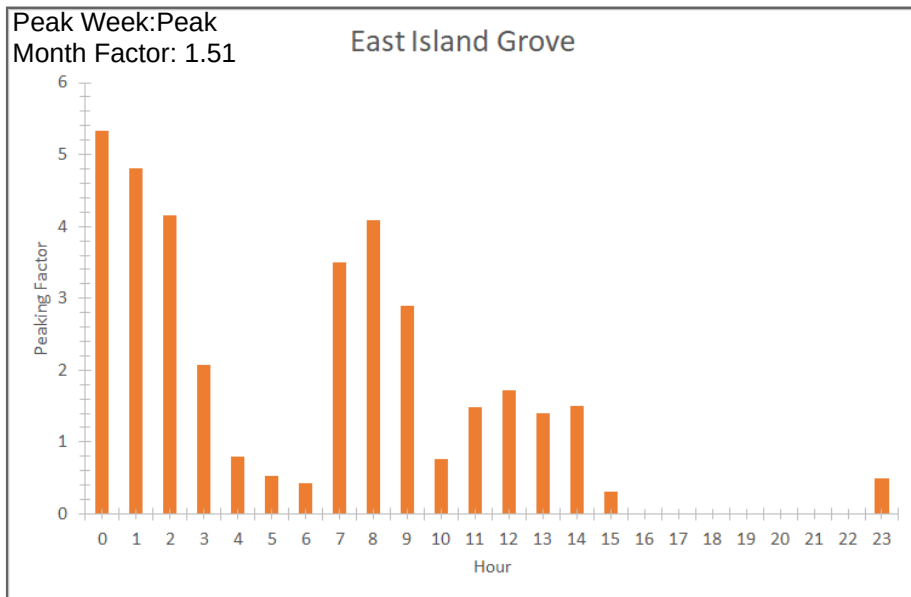






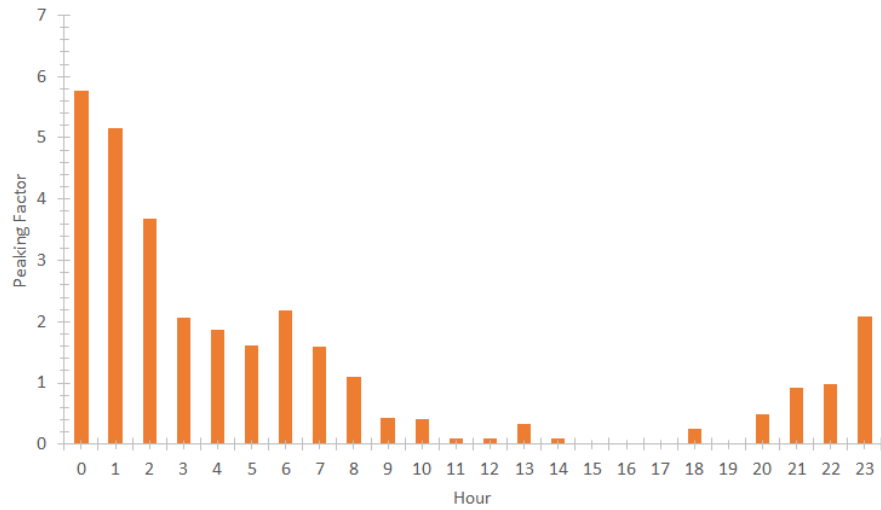






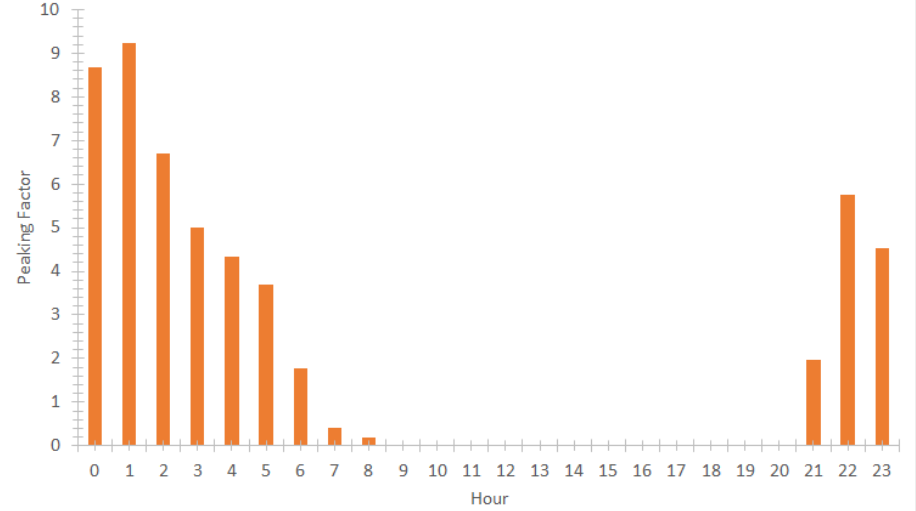
Peak Week:Peak
Month Factor: 1.30

Twin River



Peak Week:Peak
Month Factor: 2.33

North Ridge



Appendix D

Existing Station Details

The following table contains the results of the modeling and desktop analyses for the existing system. For more information on recommended improvements to the existing system, please see **Section 5.2**.

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Pump Station Name	Pump Name	Pump Design Capacity (gpm) Existing	Station Design Capacity (gpm) Existing	Pumping Head (ft) Existing	Inlet Diameter (Smallest) (in) Existing	Max Hour Demand (gpm) Existing	Max Hour Demand (gpm) Buildout	Max Day Demand (gpm) Buildout	Max Day Demand (gpd) Buildout	Max Hour % of Pumping Capacity Buildout	Max Day % of Pumping Capacity Buildout, 10hrs	Recommended Pond Capacity (AF) Buildout	Inlet Max Headloss at Buildout (ft/1000 ft)	Max Day Demand without Adoption (gpd) Buildout	Notes
Twin Rivers	NP-TR-PMP-01	1,000	4,200	259	10	1,314	2,004	544	782,942	48%	31%	10.6	21	783,205	
	NP-TR-PMP-02	200													
	NP-TR-PMP-03	1,000													
	NP-TR-PMP-04	1,000													
	NP-TR-PMP-05	1,000													
Youth Sports	NP-YS-PMP-06	600	1,200	250	6	941	941	257	370,109	78%	51%	5.0	19	370,109	
	NP-YS-PMP-07	600													
Highland Hills Golf	NP-HH-PMP-01	667	2,001	289	10	1,792	1,792	571	822,053	90%	68%	11.1	18	822,053	
	NP-HH-PMP-02	667													
	NP-HH-PMP-03	667													
Monfort	NP-MF-PMP-01	800	2,400	234	10	1,423	1,745	589	848,074	73%	59%	11.5	21	848,337	
	NP-MF-PMP-02	800													
	NP-MF-PMP-03	800													
Josephine Jones Park	NP-JJ-PMP-01	115	115	223	4	106	161	52	75,413	140%	109%	1.0	30	75,472	
St. Michaels	NP-SM-PMP-01	560	1,120	288	20	1,121	1,167	426	613,800	104%	91%	8.3	0	613,800	
	NP-SM-PMP-02	560													
Peakview Park	NP-PV-PMP-01	400	800	240	8	681	681	148	213,048	85%	44%	2.9	9	213,048	
	NP-PV-PMP-02	400													
Boomerang South	NP-BG-PMP-01	500	1,500	307	N/A	694	0	0	0	0%	0%	0.0	N/A	0	Being replaced by Boomerang Regional Pump Station
	NP-BG-PMP-02	500													
	NP-BG-PMP-03	500													
North Ridge High School	NP-NR-PMP-01	900	2,700	272	18	1,205	1,752	486	699,811	65%	43%	9.4	1	699,811	
	NP-NR-PMP-02	900													
	NP-NR-PMP-03	900													
Boomerang North	NP-BG-PMP-04	500	1,500	307	8	769	769	250	359,309	51%	40%	4.9	11	359,309	
	NP-BG-PMP-05	500													
	NP-BG-PMP-06	500													
Poudre River Ranch	NP-BG-PMP-09	175	175	226	24	205	205	84	120,830	117%	115%	1.6	0	120,830	Single inlet for all 71st Avenue Transfer pumps
Boomerang Transfer	NP-BG-PMP-07	900	1,800	272		951	621	346	498,010	35%	46%	6.7		498,010	
	NP-BG-PMP-08	900				936	936	269	387,346	52%	36%	5.2		387,346	
North Ridge Transfer	NP-BG-PMP-10	900	1,800	272		936	936	269	387,346	52%	36%	5.2		387,346	
	NP-BG-PMP-11	900													
Promontory Park - Transfer	NP-PM-PMP-01	800	1,600	157	12	1,651	1,651	464	668,765	103%	70%	9.0	7	668,765	
	NP-PM-PMP-02	800													
Promontory Park - Main	NP-PM-PMP-03	700	2,100	261	14	1,270	1,866	674	970,200	89%	77%	13.1	3	970,200	
	NP-PM-PMP-04	700													
	NP-PM-PMP-05	700													
Greeley West Park	NP-GW-PMP-01	1,000	2,000	236	4	72	861	280	402,610	43%	34%	5.4	1,150	402,946	Pump station being replaced, proposed inlet size unknown
	NP-GW-PMP-02	1,000													
Sanborn Park	NP-SP-PMP-01	250	500	256	4	268	289	94	135,158	58%	45%	1.8	60	135,168	
	NP-SP-PMP-02	250													
Cottonwood Park	NP-CW-PMP-01	115	115	212	4	69	69	23	32,414	60%	47%	0.4	4	32,414	
Glenmere Park	NP-GM-PMP-01	180	180	226	4	135	304	99	142,214	169%	132%	1.9	127	142,215	
Bittersweet Park	NP-BP-PMP-01	500	1,000	250	6	854	1,160	258	371,563	116%	62%	5.0	150	371,626	
	NP-BP-PMP-02	500													
Luther Park	NP-LP-PMP-01	265	530	224	10	492	498	89	127,469	94%	40%	1.7	2	127,474	
	NP-LP-PMP-02	265													
Madison Elementary and Houston Gardens	NP-ME-PMP-01	125	125	200	8	310	310	298	428,616	248%	571%	5.8	3	428,618	Single inlet for two pumps
	NP-ME-PMP-02	500	500	231		90	93	27	38,203	19%	13%	0.5		38,203	

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Pump Station Name	Pump Name	Pump Design Capacity (gpm) Existing	Station Design Capacity (gpm) Existing	Pumping Head (ft) Existing	Inlet Diameter (Smallest) (in) Existing	Max Hour Demand (gpm) Existing	Max Hour Demand (gpm) Buildout	Max Day Demand (gpm) Buildout	Max Day Demand (gpd) Buildout	Max Hour % of Pumping Capacity Buildout	Max Day % of Pumping Capacity Buildout, 10hrs	Recommended Pond Capacity (AF) Buildout	Inlet Max Headloss at Buildout (ft/1000 ft)	Max Day Demand without Adoption (gpd) Buildout	Notes
Ramseier	NP-RP-PMP-01	225	450	235	8	734	739	240	345,485	164%	128%	4.7	11	345,490	
	NP-RP-PMP-02	225													
Island Grove and Saddle Club	NP-IG-PMP-01	600	600	290	N/A	605	605	135	194,242	101%	54%	2.6	N/A	194,242	
	NP-IG-PMP-02	700	700	300	N/A	401	401	120	172,267	57%	41%	2.3	N/A	172,267	
	NP-IG-PMP-03	300	300	259	N/A	72	138	48	69,595	46%	39%	0.9	N/A	69,677	
Jackson Field Sports	NP-JF-PMP-01	200	400	236	14	258	317	95	137,074	79%	57%	1.9	0	137,132	
	NP-JF-PMP-02	200													
Linn Grove Cemetery	NP-LG-PMP-03	350	350	305	4	95	122	40	57,168	35%	27%	0.8	11	57,168	
Bella Romero Elementary	NP-RE-PMP-01	330	330	263	N/A	109	109	35	50,803	33%	26%	0.7	N/A	50,803	
East Memorial	NP-EM-PMP-01	34	319	189	10	314	440	146	210,600	138%	110%	2.8	2	210,651	
	NP-EM-PMP-02	285		213											
Delta Park	NP-DP-PMP-01	95	95	231	4	52	52	6	8,928	55%	16%	0.1	2	8,928	
Balsam Park	NP-BS-PMP-01	290	290	120	4	51	51	19	27,749	18%	16%	0.4	0	27,749	

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Appendix E

Future Pump Station Details

The following table contains the preliminary design points used to design all future pump stations through buildout. This information is for planning purposes only and does not constitute a full hydraulic design. Additional engineering work, as well as coordination between developers and the City, will be necessary to design all future NP infrastructure.

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Pump Station Name	Planning Horizon	Pump Station Elevation (ft)	HGL (ft) ³	Pump Station Demand (gpm) ²			% of Buildout			Max Day Demand, Unadopted (gpd) Buildout	# Pumps	Pump Design		PS Outlet Size (in)	Pond Size (acre-ft) ¹	Notes
				2025	2040	Buildout	2025	2040	Buildout			Flow (gpm)	Head (ft)			
SA-0	2075	4741	4930	0	0	641	0%	0%	100%		2	390	170	8	3.0	
SA-1	2075	4742	4929	0	0	646	0%	0%	100%		2	390	170	8	3.0	
SA-2	2075	4714	4915	0	0	534	0%	0%	100%		2	330	180	8	2.5	
SA-3	2040	4709	4887	0	118	505	0%	23%	100%		2	310	160	8	2.3	
SA-4	2040	4692	4895	0	110	187	0%	59%	100%		2	120	180	8	0.9	
SA-5	2075	4697	4885	0	0	516	0%	0%	100%		2	310	170	8	2.4	
SA-6	2075	4732	4933	0	0	300	0%	0%	100%		2	180	180	8	1.4	
SA-10	2075	4643	4831	0	0	833	0%	0%	100%		2	500	170	10	3.8	
SA-12	2040	4919	5150	0	284	963	0%	29%	100%		2	580	210	10	4.4	
SA-13	2075	4896	5091	0	0	1006	0%	0%	100%		2	610	170	10	4.6	
SA-14	2025	4898	5150	217	353	2915	7%	12%	100%		2	1750	230	16	13.4	Tech Center
SA-15	2040	4996	5184	0	1	1158	0%	0%	100%		2	700	170	10	5.3	
SA-16	2040	4906	5104	0	265	866	0%	31%	100%		2	520	180	10	4.0	
SA-25	2025	4921	5098	186	374	521	36%	72%	100%		2	320	160	8	2.4	
SA-30	2075	4880	5053	0	0	360	0%	0%	100%		2	220	155	8	1.7	
SA-34	2040	4752	4939	0	190	464	0%	41%	100%		2	280	170	8	2.1	
SA-35	2040	4681	4859	0	381	508	0%	75%	100%		2	310	160	8	2.3	
SA-36	2040	4790	4976	0	284	737	0%	38%	100%		2	450	170	8	3.4	
SA-38	2040	4636	4843	0	46	118	0%	39%	100%		2	80	180	8	0.5	
SA-41	2075	4663	4840	0	0	928	0%	0%	100%		2	560	160	10	4.3	
SA-42	2040	4663	4861	0	278	596	0%	47%	100%		2	360	180	8	2.7	
SA-44	2025	4835	5011	48	147	549	9%	27%	100%		2	330	160	8	2.5	
SA-46	2075	4749	4927	0	0	921	0%	0%	100%		2	560	160	10	4.2	
SA-47	2075	4761	4949	0	0	799	0%	0%	100%		2	480	170	10	3.7	
SA-48	2075	4757	4945	0	0	862	0%	0%	100%		2	520	170	10	4.0	
SA-49	2075	4712	4901	0	0	920	0%	0%	100%		2	560	170	10	4.2	
SA-50	2075	4741	4929	0	0	1275	0%	0%	100%		2	770	170	12	5.9	
SA-51	2075	4730	4928	0	0	2083	0%	0%	100%		2	1250	180	16	9.6	
SA-52	2075	4724	4912	0	0	1078	0%	0%	100%		2	650	170	10	5.0	
SA-53	2075	4686	4874	0	0	1500	0%	0%	100%		2	910	170	12	6.9	
SA-57	2075	4894	5114	0	0	1232	0%	0%	100%		2	740	200	16	5.7	
SA-60	2025	4894	5081	342	733	922	37%	80%	100%		2	560	200	10	4.2	
Boomerang Regional PS	2025	4791	4978	829	1650	2716	31%	61%	100%		2	1630	170	16	12.5	

Notes and Equations:

¹Pond size = ((peak hour demands, gpm) / (4.22 peak hour / peak month) * (1440 min / day) * (1 AF / 325851 gal)) * 1.1 (for ET losses)

²Peak hour demands

³Average head at downstream junction = (Elevation, ft) + (Downstream pressure @ max hour, psi)*(2.31 ft/1 psi)

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Appendix F

WaterWise Landscaping Best Practices Manual Criteria

The following manual was developed by the City of Greeley as a guide for implementing best practices for landscaping and irrigation to promote water conservation.

City of Greeley



WaterWise Landscaping Best Practices Manual Criteria

Draft

November 2019

*Water Conservation
Water Resources*

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WaterWise Landscaping Best Practices Manual

Section 1 – Introduction

Prevalent landscaping practices used in development today have disregarded the long-term effects on the region's water supply. Nearly 75% of summer water use is consumed by outdoor vegetation. The drought in Colorado has highlighted the necessity of using WaterWise design practices in order to best use our limited water resources. Significant reductions can be gained through minor changes in the arrangement of plantings, alternative plant selection and soil preparation.

The City of Greeley has drafted criteria that includes WaterWise landscape practices that will be used to guide development in the design of landscaping. This criteria can also be used as a reference for existing landscapes and irrigation design. The purpose of the project is to:

1. move closer to use of landscaping that matches our semi-arid environment
2. include specific direction in choice of plant material
3. include illustrations
4. to the extent possible, make language easy to understand and apply
5. include both xeriscape requirements and aspirational practices

Besides requirements for new development, the process also includes this “Best Practices Manual” that all citizens can use in making choices about their home landscaping. These Best Practices for landscape design are derived from the seven principles of Xeriscaping, as well as GreenCo's Best Management Practices.

The intention for these Best Practices is to inform home and property owners about landscape and irrigation needs unique to Colorado, and to assist in creating responsible landscape and irrigation design decisions.

WaterWise Landscaping

Best Practices

Section 2 – WaterWise Principles and Guidelines

DSW, Sources: GreenCo BMPs, Xeriscape Principles

This section focuses on eight “principles” that act as goals for smart planting and irrigating in the Colorado region. Each principle offers a series of design recommendations and techniques in the form of “guidelines”. The guidelines function as steps to achieve the goals. Each guideline is not imperative but still important to ensure healthy plant growth, reduced water waste and increased cost savings over time. The following principles, if used properly, will help to create a useful, efficient and enjoyable WaterWise landscape.

Principle #1 – Plan and design landscaping comprehensively.

Guidelines

- A. Start with an inventory and analysis plan of the site that identifies “existing conditions.” Conditions such as drainage areas, sun exposure, soil types, good views, existing plants, etc. will affect how the site is used (Figure 1). Next develop a list of activities and areas, also called a “program,” expected to occur on the site. For example a backyard program might include a lawn play area, dog run, dining patio, barbecue grill, shade trees and shrub beds. Continue by diagramming possible locations for the program activities, while also providing access and traffic patterns or screening as needed. Finally, use this information to develop a plan that integrates plants into the overall scheme (Figure 2).
- B. Now with your overall plan, consider options on how you would like to conserve water. Several recommendations for water conservation are addressed throughout this document.
- C. Calculate the water requirements for your landscape using the Water Budget Worksheet provided in Section Seven of this manual. Try not to exceed an average total of 15 gallons per square foot annually.
- D. Incorporate trees into the landscape to provide shade, reduce stormwater runoff, stabilize soil and protect against wind. If considering the gross site area, a minimum goal of 20 percent tree canopy coverage (at trees’ maturity) for Front Range communities is recommended.
- E. When designing plant placement on slopes, place lower-water demand plants at the tops of slopes and higher-demand plants at the bottom.
- F. Artificial flowers and grass are discouraged. Exceptions may be granted for special use areas such as synthetic turf athletic fields.

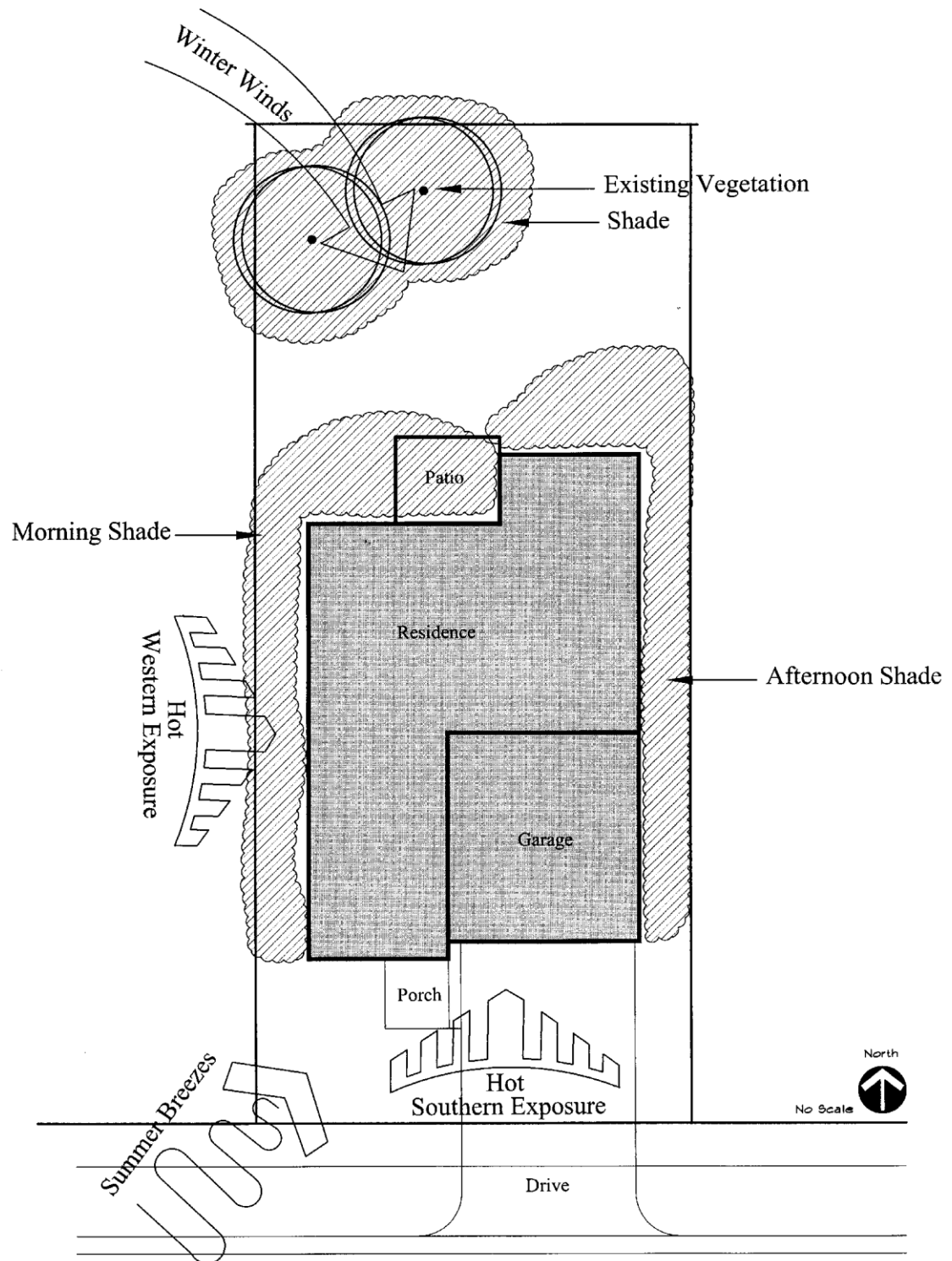


Figure 1. Inventory and Analysis Plan

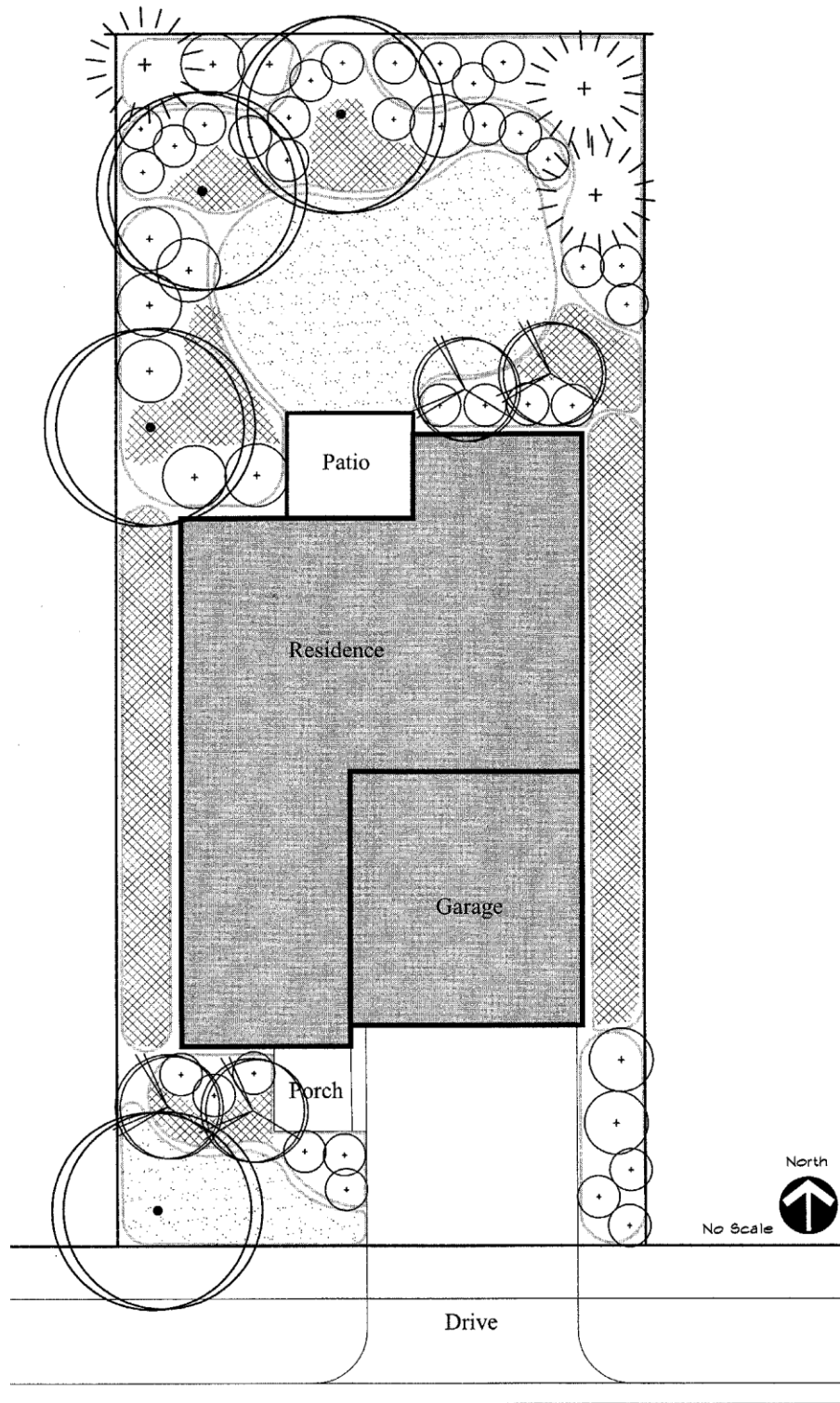


Figure 2. Overall Planting Plan

Principle #2 - Evaluate soil and improve, if necessary.

Guidelines

- A. Soil suitability for planting should be evaluated to identify potential soil amendments that may improve plant health and survival (see Section Five).
- B. Strip and stockpile existing topsoil prior to major site re-grading. Following completion of grading, replace topsoil and improve soil for planting with suitable soil amendments.
- C. Improve soil as suitable (see Section Five) before planting and installing the irrigation system. Soil improvement promotes better absorption of water, improved water-holding capacity and drainage of the soils. It also allows for better oxygen transfer within the root zone.
- D. Add organic material to the plant hydrozones, but only as needed. This typically means adding organic material for High and Moderate water zones, but not for Low and Very Low water zones. pH-balanced examples of organic materials are compost (from plants), sphagnum peat and animal manure (other than cow or horse).
- E. Soil preparation should include the breaking up and loosening, or scarification, of soil to 6 inches, with incorporation of organic amendments, fertilizer, etc. as specified by a landscape designer, landscape architect or soil analysis (Figure 3).

For more information please refer to Section 5, Understanding Soils and Soil Preparation.

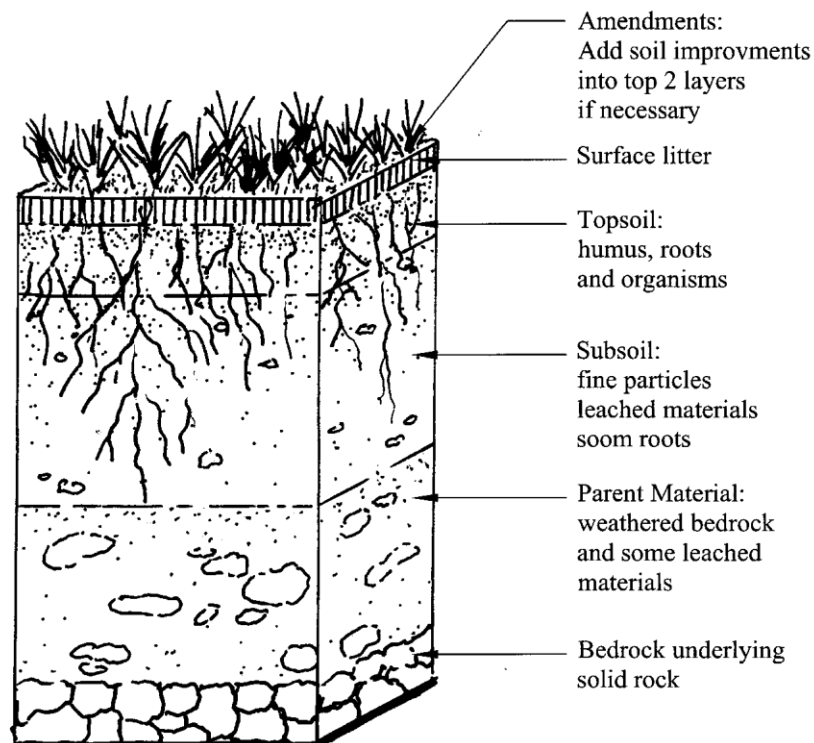


Figure 3. Soil Profile

Principle #3 - Create efficient turf areas.

Guidelines

- A. Include turf areas where they provide defined functions (i.e., recreation, traffic areas, etc.). Plantings of trees, shrubs, ground covers and flowers are best separated from grass so they can be watered separately. Often, portions of turf areas can be replaced with more water-efficient ground covers and mulches (Figure 4).
- B. When selecting turfgrass, consider the use, aesthetic and design goals of the site, estimated water use and maintenance budget. Alternative grass types, such as tall fescue, buffalograss, blue grama and wheat grass, may provide lower water and maintenance needs than bluegrass. In areas where irrigation is not planned for instance, a mix of mainly native bunch and sod-forming grasses might be used. (See Section Four for native seed mix options.)
- C. Avoid using turf in areas less than 8 feet wide and on slopes steeper than 3:1. These areas require inefficient irrigation sprays. Consider using drip-irrigated shrubs or groundcovers with Low or Very Low water requirements as alternatives. A special exception may be streetscape tree lawns, where turfgrass may be most appropriate with careful consideration and monitoring of potential irrigation inefficiencies.
- D. Some sites and turf areas with difficult irrigation or maintenance concerns may perform better with low water grass types or groundcovers. Consider street rights-of-way, industrial sites, drainageways and natural areas for such alternative grasses. (See Principle #8 below.)



Figure 4. Efficient Turf Area in Front Yard

Principle #4 - Use appropriate plants and group according to their water need, i.e. “hydrozoning”.

Guidelines

- A. Plants with lower water requirements, such as native species adapted to Colorado’s climate, should be considered. However, other plants can have a place in xeriscape designs, even if they require larger amounts of water. The key is to use those plants in appropriate locations and not to interplant them with others that have very different, lower water requirements. In effect, the grouping of plants into “hydrozones” based on their water requirements allows them to be irrigated efficiently. A detailed list of Colorado landscape plants and their respective water requirements by “hydrozone category” is included in Section Three.
- B. Group plants with like water needs together (Figure 5). Plants located within the drip line for large, mature trees and shrubs should have similar water requirements as the trees and shrubs. (A drip line is considered the outermost circle on the ground where water drips from the leaves of a tree or shrub canopy above.)
- C. Plants of any water need may be used in the landscape, providing the total annual water use does not exceed Water Allowance for the ET (Evapo-Transpiration) Reference Location. For example, this allowance is 15 gallons/square foot/season in the Denver metro area. (See Section Six below for Water Budget calculations.)
- D. High water zones should be separated from Low and Very Low water zones by Moderate water zones whenever possible.
- E. Select plants that are well adapted to the climate, topographic and geologic conditions of the site.
- F. Select plants with lower water requirements for areas with southern and western exposures.
- G. Strips less than 8 feet wide should be landscaped with Low or Very Low water plants. (See Principle #3 above.)

Principle #5 - Water efficiently with a properly designed irrigation system

Guidelines

- A. Irrigate according to the water need of each hydrozone, not solely on a fixed schedule (Figure 6). Well-planned sprinkler systems can save water when properly installed and operated. Turf areas should be watered separately from beds. Shrubs, flowers and ground covers can be watered more efficiently, by less frequent irrigation that is allowed to penetrate the root zone more deeply. (See Principle #4 above.)
- B. Consider plant water requirements in irrigation design schemes.
- C. Take into account the hydraulic principles when designing the irrigation system. Generally these principles deal with water volume, pressure and patterns of movement.

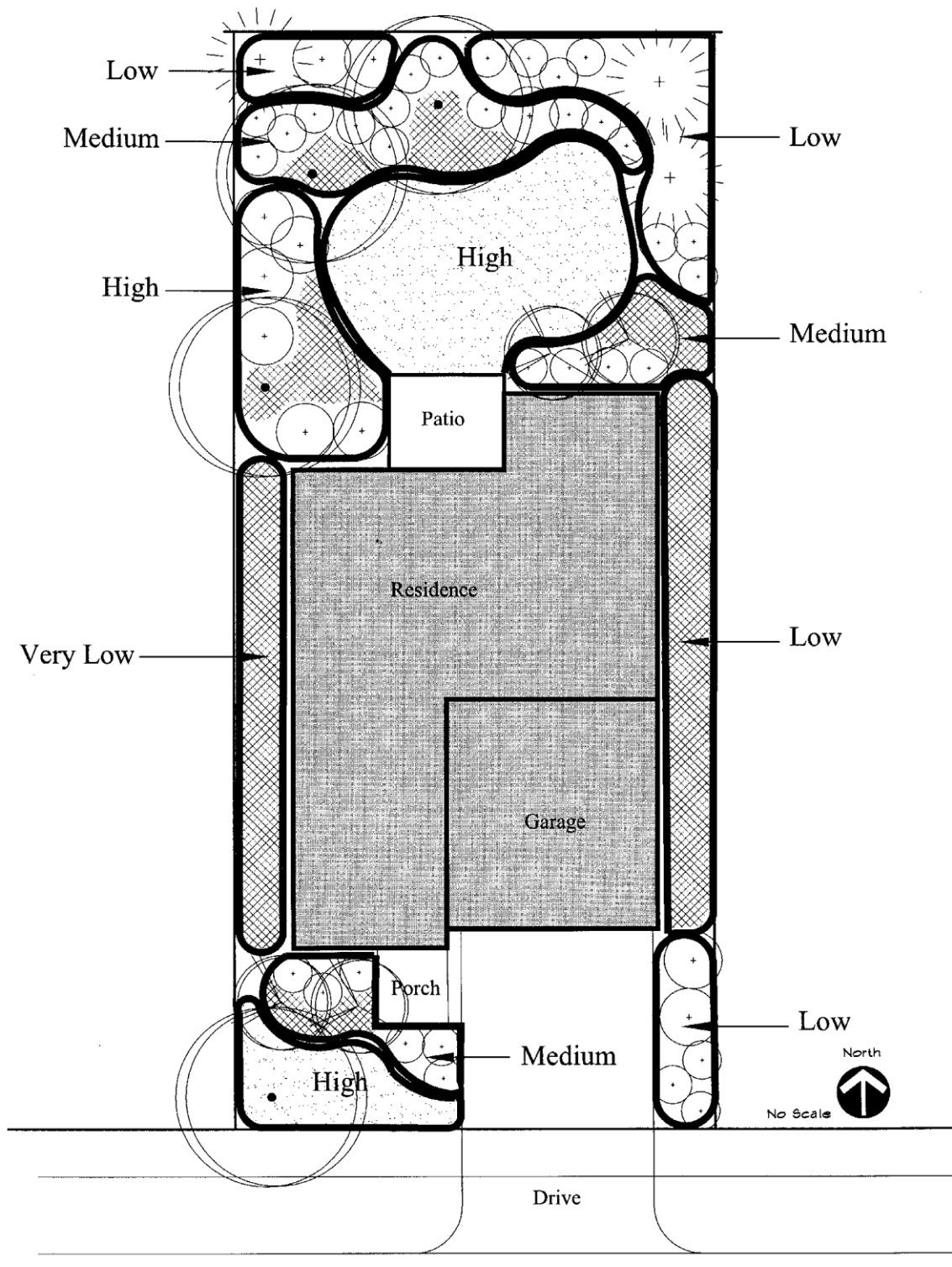


Figure 5. Hydrozone Outline Diagram with 4 water need types

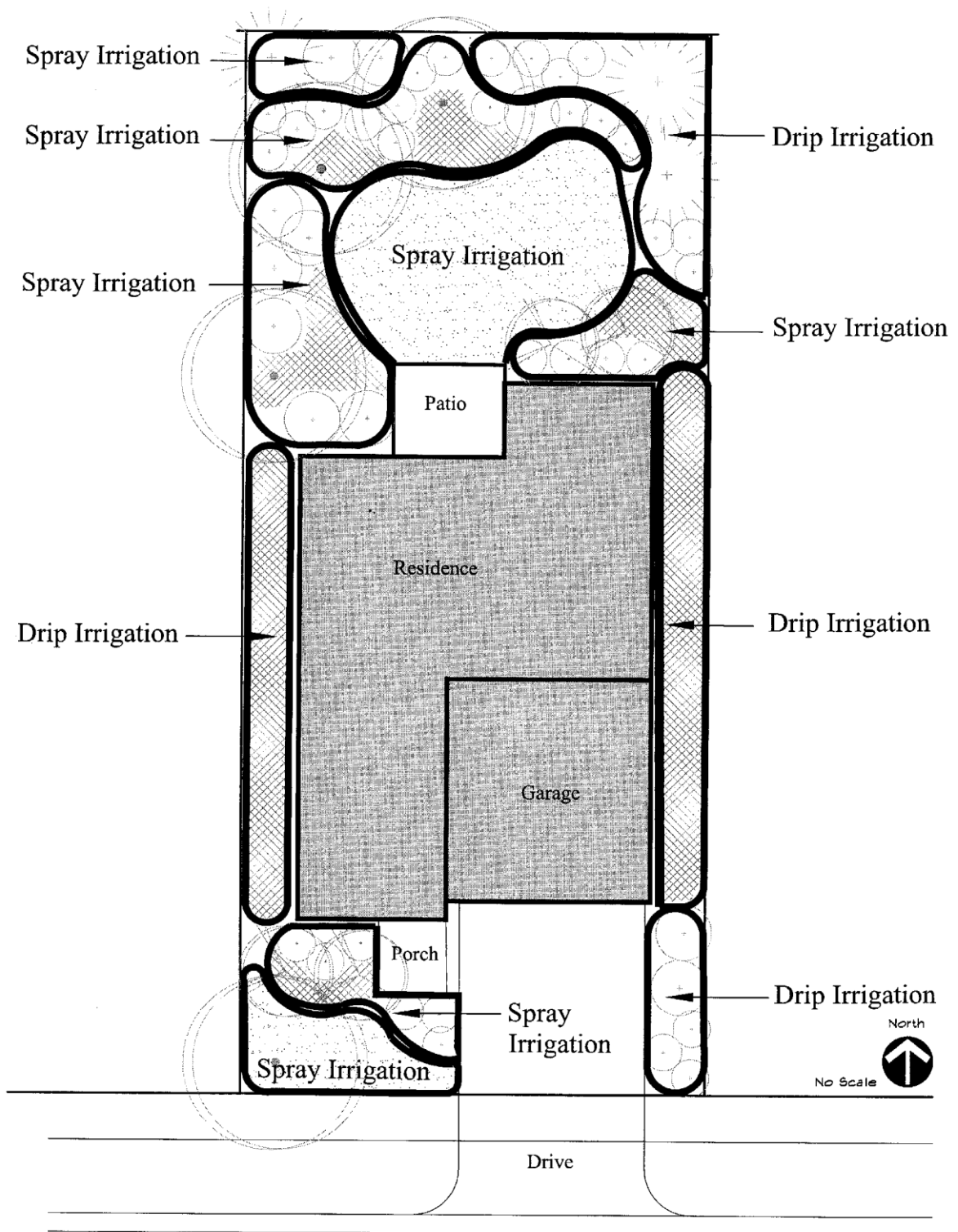


Figure 6. Irrigation Type Diagram

- D. Install an irrigation controller that offers flexible programming. Landscapes should not need as much supplemental watering during a rainy period. Rain or moisture sensors are available to coordinate with controllers, and some controllers are self-adjusting based on weather conditions.
- E. Ensure that the irrigation system is installed per plan and is accurate.
- F. Provide “as-built” drawings of irrigation system after installation with dimensions shown for irrigation components. Such drawings will help to find and correct problems in the future.
- G. Operate irrigation systems to maximize irrigation water efficiency.

For more information please refer to Section 6, Irrigation Design Techniques and Equipment.

Principle #6 - Use mulches to reduce surface evaporation of water and weeds.

Guidelines

- A. Mulched planting beds are an ideal replacement for expansive turf areas. Mulches protect and reduce temperature extremes in the soil, minimize evaporation, reduce weed growth and slow erosion. Mulches also provide landscape interest. Organic mulches are typically bark chips, wood grindings, chopped leaves or pole peelings. Inorganic mulches include rock and various gravel products.
- B. Organic mulches are generally recommended for the most benefit of the plants, but the roots of some plants perform better with inorganic mulch. Landscape professionals can help determine suitable mulches for selected plants. Inorganic mulches may also be preferred as more stable in especially windy locations, areas requiring high maintenance or those apt to erosion.
- C. Place mulch directly on the soil or on breathable fabric (Figure 7). Do not use solid sheet plastic beneath mulched areas, as these keep out water and air – both of which are vital to plant health.
- D. All plantable areas not covered with turf should be covered with a minimum of four inches (4”) of a suitable mulch to retain water, and inhibit weeds.
- E. Mulching exceptions for Low and Very Low hydrozones should be considered.

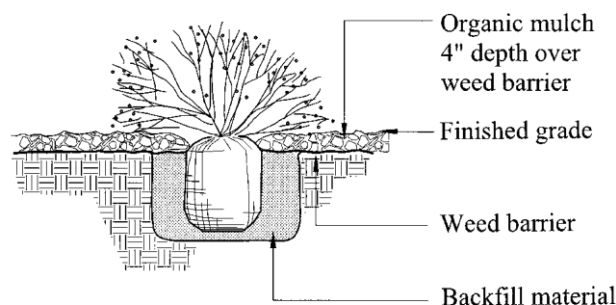


Figure 7. Shrub Planting in Mulch Bed

Principle #7 - Practice appropriate landscape maintenance.

Guidelines

- A. Proper pruning, weeding, mowing and fertilization, plus attention to the irrigation system, are needed to maximize water savings. Regular maintenance of planting and irrigation system preserves the intended beauty of the landscape, and saves water and maintenance costs through efficient operations. Always water according to hydrozone need and current soil moisture conditions, rather than according to a rigid schedule.
- B. Landscapes should be maintained to ensure water efficiency. A regular maintenance schedule should include but not be limited to checking, adjusting, and repairing irrigation equipment; resetting the automatic controller; aerating turf areas; replenishing mulch; fertilizing; pruning, and weeding in all landscaped areas.
- C. Whenever possible, repair of irrigation equipment should be done with the originally specified materials or their equivalents so that original performance and efficiency can be maintained for longer periods. (See Section Six for more Irrigation information.)



Garden Maintenance

Principle #8 – Preserve existing landscape and natural areas.

Guidelines

- A. Where possible preserve existing native remnant plant communities and site conditions that support them.
- B. Where possible preserve healthy trees – established plants have often developed a root system that is adapted to lower water conditions.
- C. Local native plants and plants with documented lower water requirements should be given priority in landscape design. A native plant is a species that “occurs naturally in a particular region, state, ecosystem, and habitat without direct or indirect human action” (Federal Native Plant Conservation Committee, 1994). A local native plant is derived from “a population or ecotype of the native plant species that was grown from genetically local plant materials” (Colorado Native Plant Society).
- D. Use of native plants in the landscape supports local biodiversity, helps sustain local wildlife, enhances recreation experience, supports remnant native plant communities and reduces water consumption.



Natural Area

- E. All landscapes have the potential to impact native communities through transport of and plant propagules by and storm drainage.



have
plant
seeds
wind

- Landscapes adjacent to native sites are particularly critical due to the potential of direct spread, but all projects (public or private) should not harbor or install exotic horticultural plant species that are known to be invasive and therefore threaten natural areas. A complete list of threatening plants to avoid is provided by the Colorado Native Plant Society web site: <http://carbon.cudenver.edu/~shill/species_avoid.pdf>.
- F. Landscapes adjacent to native areas should emphasize the use of species with low fuel volume of low flammability. Mowing management can be used to limit build up of flammable plant materials. Information on the fire-resistance of some native plants can be found at <www.ext.colostate.edu/PUBS/NATRES/06307.html>.
 - G. Remove species that are designated state noxious weeds, especially ornamental species such as purple loosestrife, oxeye daisy, tamarisk, myrtle spurge and yellow toadflax. See Section Four below for the 2003 list of noxious weeds for Colorado, or for more information see the “Noxious Weed List (Rules and Regulations)” at <www.ag.state.co.us/DPI/weeds/weed.html>.

For more information please refer to Section 4, Natural Areas and Native Plants.

WaterWise Landscaping Best Practices

Section 3 – WaterWise Plant Lists

A. The Four Hydrozones – WaterWise Plant Groupings

The key to WaterWise landscaping is to arrange plants in appropriate locations and not to interplant them with others that have very different, lower water requirements. This grouping of plants into “hydrozones” is based on their water requirements, and allows them to be irrigated efficiently. The following list shows how to group plants based their water needs.

Due to variability in plant water requirements due to location of the plant on a site, a range of hydrozone categories has been shown for many plants. For purposes of calculating the water budget for each hydrozone, the lowest hydrozone category for each plant shall be used.

High Water need

example: Bluegrass turf – always wet at the surface

uses 18-20 gals./ S.F./season = 3 waterings per week totaling 5 inches (in July)

Moderate Water need

example: turf-type Tall Fescue – ½ the water of Bluegrass turf

uses 10 gals./S.F./ season = ¾ inches of water, once per week

Low Water need

example: Buffalograss turf – needs rain and occasional watering

uses 0-3 gals./S.F./season = ½ inch of water per 2 weeks, optional

Very Low Water need

example: too dry for any turf grass (drier than Denver)

no irrigation required

B. Colorado WaterWise Plant List Summary

1. Shrubs (Deciduous, Rocky Mountain Natives)
2. Shrubs (Deciduous, Introduced to the region)
3. Trees (Deciduous, Rocky Mountain Natives)
4. Trees (Deciduous, Introduced to the region)
5. Evergreens (Coniferous Trees)
6. Evergreens (Coniferous Shrubs)
7. Evergreens (Non-coniferous)
8. Vines
9. Groundcovers (Including turf & meadow grasses)
10. Selected Perennials

The complete Plant Lists are provided on the following pages.

Copying and use of this list is encouraged, only if the following note, & the water needs of plants are included.

For more information see...**WaterWise Landscaping with Trees, Shrubs, and Vines**

Jim Knopf, Chamisa Books

SHRUBS

(Deciduous Rocky Mountain Natives)
[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Acer•glabrum	Rocky Mountain Maple	(M-H)
Acer•grandidentatum	Bigtooth Maple, Wasatch Maple	(M)
Alnus•tenuifolia	Rocky Mountain Alder	(H)
Amelanchier•alnifolia	Rocky Mtn. Serviceberry	(M+/-)
Amelanchier•utahensis *	Utah Serviceberry	(VL- M)
Amorpha•canescens	Lead Plant	(L- M)
Amorpha•fruticosa	False Indigo	(M +/-)
Amorpha•nana	Dwarf Lead Plant	(L- M)
Atriplex•canescens	Four-wing Saltbush	(VL-L)
Atriplex•confertifolia	Shadscale	(VL-L)
Betula•fontinalis	Rocky Mtn. River Birch	(H)
Betula•glandulosa	Bog Birch	(H)
Ceratoides•lanata *	Winterfat	(L)
Cercocarpus•montanus	Deciduous Mountain Mahogany	(L- M)
Chamaebatiaria•millefolium	Fernbush	(VL-L)
Chrysothamnus•spp.	Rabbitbrush species	(VL-L)
Cornus•sericea (now C. stolonifera)		
Cornus•stolonifera	Redtwig Dogwood	(H)
Corylus•cornuta	Beaked Hazelnut	(H- M)
Crataegus•var.occidentalis *	Native Hawthorn	(M+/-)
Crataegus•erythropoda *	(syn.? C. s. var. occidentalis)	(M+/-)
Crataegus•succulenta•var. macrantha *	Native Hawthorn	(M+/-)
Fallugia•paradoxa	Apache Plume	(VL-L)
Fendlera•rupicola	Cliff Fendlerbush	(L- M)
Forestiera•neomexicana	New Mexico Privet	(M+/-)
Fraxinus•anomala	Singleleaf Ash	(L)
Holodiscus•dumosus	Rock Spray	(L- M)
Jamesia•americana	Jamesia	(M - H)
Lonicera•involucrata	Twinberry	(H)
Lycium•pallidum *	Pale Wolfberry	(L)
Ostrya•knowltonii *	Western Hop Hornbeam	(M+/-)

Parryella•filifolia *	Dunebloom	(M+/-)
Pentaphylloides•floribunda	= Potentilla•fruticosa	
Peraphyllum•ramosissimum *	Squaw Apple	(L - M)
Philadelphus•lewisii	Lewis's Mockorange	(M+/-)
Philadelphus•microphyllus	Littleleaf Mockorange	(M+/-)
Physocarpus•monogynus	Mountain Ninebark	(M+/-)
Poliomintha•incana *	Purple Sage	(VL-L)
Potentilla•fruticosa	Shrubby Potentilla	(M - H)
Prunus•americana	Wild Plum	(M+/-)
Prunus•besseyi	Sand Cherry	(L-M)
Prunus•pensylvanica *	Pin Cherry	(M+/-)
Prunus•pensylvanica•saximontana *	Dwarf Pin Cherry	(M+/-)
Prunus•virginiana	Chokecherry	(M - H)
Ptelea•trifoliata	Hoptree	(M+/-)
Purshia•tridentata	Bitterbrush	(L - H)
Quercus•gambelii	Gambel's Oak	(M+/-)
Quercus•turbinella *	Turbinella Oak	(L - M)
Quercus•undulata *	Wavyleaf Oak	(L - M)
Rhamnus•smithii *	-----	(M+/-)
Rhus•glabra	Smooth Sumac	(L - M)
Rhus•glabra•var. cismontana	Rocky Mountain Smooth Sumac	(L-M)
Rhus•glabra•'Laciniata'	Cutleaf Smooth Sumac	(L-M)
Rhus•microphylla *	Littleleaf Sumac	(L-M)
Rhus•trilobata	Three-leaf Sumac	(L - M)
Ribes•aureum	Golden Currant	(M+/-)
Ribes•cereum *	Squaw Currant	(M+/-)
Ribes•inerme	Whitestem Gooseberry	(M+/-)
Rosa•woodsii	Wood's Rose	(M+/-)
Rubus•deliciosus	Boulder Raspberry	(M+/-)
Rubus•idaeus•var. strigosus	Wild Raspberry	(M - H)
Rubus•parviflorus *	Thimbleberry	(M - H)
Salix•irrorata	Bluestem Willow	(H)
Sambucus•caerulea *	Blue Elderberry	(H)
Sambucus•melanocarpa *	Blackbead Elderberry	(H)
Sambucus•racemosa *	Red Elderberry	(H)
Sarcobatus•vermiculatus *	Greasewood	(VL-L)
Shepherdia•argentea	Silver Buffaloberry	(M+/-)
Shepherdia•canadensis *	Buffaloberry	(M+/-)
Sorbus•scopulina *	Rocky Mtn. Mountain Ash	(M - H)
Symphoricarpos•albus	Snowberry	(M+/-)
Symphoricarpos•orbiculatus *	Coralberry	(M+/-)
Tetradymia•canescens *	Gray Horsebrush	(L)

SHRUBS

(Deciduous, Introduced)
[Revised April '03]

WATER NEEDS OF PLANTS

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18-20 gals./ S.F./season July: 5" -- 3 times per week	10 gals./S.F./ season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation
Abelia•chinensis *	Chinese Abelia (China)	(M-H)	
Abelia•x•grandiflora *	Abelia (origin unknown)	(M-H)	
Abeliophyllum•distichum *	----- (Korea)	(M+/-)	
Acanthopanax•senticosus *	Syn. Elentherococcus s.		
Acanthopanax•sieboldianus *	= Elentherococcus•sieboldianus		
Acer•azimovii * (= A.•ovczimmikovii?)	Azimov Maple	(M+/-)	
Acer•campestre *	Hedge Maple (e. Europe & w. Asia)	(M-H)	
Acer•ginnala	= Acer•tataricum•ssp.•ginnala		
Acer•maximowiczianum *	----- (China-Mongolia-Korea)	(M-H)	
Acer•semenovii *	= Acer•tataricum•ssp.•semenovii		
Acer•tataricum	Tatarian Maple (A. Minor, se. Asia)	(L-M)	
Acer•tataricum•ssp.•ginnala	Ginnala Maple (c. Asia)	(L-M)	
Acer•tataricum•ssp.•semenovii *	Turkestan Maple (c. Asia)	(L-M)	
Aesculus•parviflora *	Bottlebrush Buckeye (Ga., Ala.)	(H)	
Aesculus•sylvatica *	----- (se. USA)	(H)	
Alnus•cordata *	Italian Alder (Corsica, s. Italy)	(H)	
Alnus•glutinosa *	European Alder (Eur., n. Africa, Turkey)	(H)	
Alnus•rubra (was A.•oregona) *	Oregon Alder (w. N. Am.)	(H)	
Amelanchier•stolonifera *	Running Serviceberry (ne. N. Am.)	(H)	
Aralia•elata *	Angelica Tree (Jap., Kor., Manch.)	(M-H)	
Aralia•spinosa *	Devil's Walkingstick (e. USA)	(M-H)	
Aronia•melanocarpa	Chokeberry (e. N. America)	(M+/-)	
Artemisia•abrotanum	Southernwood (s. Europe)	(M+/-)	
Atraphaxis•caucasica *	----- (Transcaucasica)	(M+/-)	
Atraphaxis•pyrifolia *	----- (c. Asia)	(L)	
Berberis•koreana *	Korean Barberry (Korea)	(M+/-)	
Berberis•oblonga *	----- (Turkestan)	(M-L)	
Berberis•thunbergii	Japanese Barberry (Jap.)	(M-H)	
Buddleja•alternifolia *	Butterflybush (nw. China)	(M+/-)	
Buddleja•davidii	Butterflybush (China)	(M+/-)	
Buddleja•globosa *	----- (Chile, Argentina, Peru)	(M+/-)	
Buddleja•x•Lochinch' *	----- (hort. hybrid)	(M+/-)	
Callicarpa•bodineri *	Beauty Berry (c. & w. China)	(M+/-)	
Callicarpa•dichotoma *	Korean Beautyberry (e. USA)	(H)	

<i>Calycanthus occidentalis</i> *	California Allspice (sw. USA)	(H)
<i>Calycanthus chinensis</i> *	----- (e. China)	(H)
<i>Calycanthus floridus</i> *	Carolina Allspice (se. USA)	(H)
<i>Caragana arborescens</i>	Siberian Peashrub (c. Asia - Mongolia)	(L-M)
<i>Caragana aurantiaca</i> *	Dwarf Peashrub (Sib., Afghan., Turkestan)	(L-M)
<i>Caragana frutex</i> *	Russian Peashrub (c. Asia, Siberia)	(L-M)
<i>Caragana maximowicziana</i> *	----- (Tibet, n. China)	(L-M)
<i>Caragana microphylla</i>	----- (nw. China, Sib.)	(L-M)
<i>Caragana pygmaea</i> *	----- (nw. China)	(L-M)
<i>Caragana sinica</i> *	Chinese Peashrub (n. China)	(L-M)
<i>Caryopteris incana</i> *	----- (China, Jap.)	(L-M)
<i>Caryopteris mongolica</i> *	----- (n. China, Mong.)	(L-M)
<i>Caryopteris x clandonensis</i>	Bluemist Spirea (hort. hybrid)	(L-M)
<i>Ceanothus sanguineus</i> *	Oregon Tea (Cal. to BC)	(H)
<i>Cerasus verrucosa</i> *	----- (Tajikistan)	(L-M)
<i>Cercis griffithii</i> *	Griffith's Redbud (c. Asia)	(L-M)
<i>Chaenomeles japonica</i> *	Dwarf Quince (Japan)	(M+/-)
<i>Chaenomeles lagenaria</i>	= <i>C. speciosa</i>	
<i>Chaenomeles speciosa</i> *	Flowering Quince (China, Japan)	(M+/-)
<i>Chamaecytisus hirsutus</i> *	----- (Sib.-n. China)	(M+/-)
<i>Chilopsis linearis</i> *	Desert Willow (desert southwest)	(L-M)
<i>Chimonanthus praecox</i> *	Fragrant Wintersweet (China)	(H)
<i>Chionanthus retusus</i>	Chinese Fringe Tree (China, Kor. Taiwan)	(H)
<i>Chionanthus virginicus</i>	Fringe Tree (e. N. America)	(M-H)
<i>Clematis heracleifolia</i> var. <i> davidiana</i> *	----- (e. China)	(M-H)
<i>Clerodendrum trichotomum</i> *	Glory Bower (Japan)	(H)
<i>Clethra alnifolia</i> *	Summer-sweet (e. N. America)	(H)
<i>Clethra delavayi</i> *	Summer-sweet (w. China)	(M+/-)
<i>Cornus alba</i> 'Elegantissima'	Variegated R'twig Dog'd (Sib., n. Chi., Kor.)	(H)
<i>Cornus alternifolia</i>	Pagoda Dogwood (e. N. America)	(H)
<i>Cornus amomum</i> *	Silky Dogwood (e. N. America)	(M-H)
<i>Cornus controversa</i> *	Giant Dogwood (Japan, China, Him.)	(H)
<i>Cornus kousa</i> *	----- (Japan, Korea, China)	(M-H)
<i>Cornus kousa</i> var. <i> chinensis</i> *	----- (China)	(H)
<i>Cornus mas</i> *	Cornelian Cherry (c. Europe-w. Asia)	(M-H)
<i>Cornus racemosa</i> *	Gray Dogwood (ne. N Am)	(M-H)
<i>Cornus sericea</i> (now <i>C. stolonifera</i>)	(See: Native Rocky Mtn. deciduous shrubs)	
<i>Cornus stolonifera</i> 'Flaviramea'	Yellowtwig Dogwood (N. Am.)	(H)
<i>Coronilla emerus</i> *	Scorpion Senna (s. Norway, Spain, Greece)	(M-H)
<i>Corylopsis pauciflora</i> *	Winter Hazel (Japan, Taiwan)	(H)
<i>Corylopsis sinensis</i> *	Chinese Winter Hazel (c. China)	(M+/-)
<i>Corylopsis spicata</i> *	Japanese Winter Hazel (Japan)	(H)
<i>Corylus avellana</i> *	European Hazel (Europe)	(M-H)
<i>Corylus chinensis</i> *	Chinese Hazel (sw. China)	(H)
<i>Corylus maxima</i> *	Filbert (se. Eur., A. Minor)	(H)
<i>Cotinus coggygia</i>	Smoke Tree (s. Europe-Asia)	(M+/-)
<i>Cotinus obovatus</i> *	American Smoketree (s. USA)	(M-H)
<i>Cotoneaster actinifolius</i>	Peking Cotoneaster (n. China)	(M+/-)
<i>Cotoneaster apiculatus</i>	Cranberry Cotoneaster (China)	(M+/-)
<i>Cotoneaster bullatus</i> *	----- (w. China)	(M+/-)
<i>Cotoneaster divaricatus</i>	Spreading Cotoneaster (China)	(M+/-)
<i>Cotoneaster franchetii</i> *	----- (sw. China, Tibet)	(M-H)
<i>Cotoneaster horizontalis</i>	Rock Cotoneaster (w. China)	(M+/-)
<i>Cotoneaster ignavus</i> *	----- (e. Turkestan)	(M+/-)
<i>Cotoneaster multiflorus</i> *	Many-flowered Cotoneaster (nw. China)	(M+/-)
<i>Cotoneaster racemiflorus</i> * <i> songaricus</i> *	----- (c. Asia)	(M+/-)
<i>Cotoneaster simonsii</i> *	----- (Himal., Sikkim, Nepal)	(M-H)
<i>Crataegus x mordanensis</i> 'Toba'	Toba Hawthorn (hort. hybrid)	(M+/-)
<i>Cudrania tricuspidata</i> *	Chinese Silkworm Thorn (China)	(H)
<i>Cydonia oblonga</i> *	Quince (n. Persia)	(M+/-)
<i>Cydonia sinensis</i> *	= <i>Pseudocydonia sinensis</i>	

Cyrilla•racemiflora *	Leatherwood (e. N. America)	(H)
Cytisus•albus *	= Cytisus•multiflorus	
Cytisus•decumbens *	Prostrate Broom (s. Europe)	(L-M)
Cytisus•hirsutus	= Chamaecytisus•hirsutus	
Cytisus•multiflorus *	Portuguese Broom (se. Europe)	(L-M)
Cytisus•purgans *	----- (s. Eur. - n. Afr.)	(L-M)
Cytisus•scoparius *	Scotch Broom (c. & s. Europe)	(L-M)
Cytisus•x•praecox *	Warminster Broom (hort. hybrid)	(L-M)
Dalea•formosa *	Feather Plume (w. Tex., Okl., Colo.)(L	
Dalea•frutescens *	Black Dalea (w. Tex., Okla.)	(L)
Dalea•scoparia *	Broom Dalea (w. Tex., N. Mex., Az.)	(L)
Daphne•caucasica *	Caucasian Daphne (Caucasus)	(M+/-)
Daphne•genkwa *	----- (China)	(M+/-)
Daphne•giraldii *	Daphne (nw. China)	(M+/-)
Daphne•mezereum *	February Daphne (Europe, w. Asia)	(M+/-)
Decaisnea•fargesii *	----- Bluebean Shrub (w. China)	(M-H)
Deutzia•gracilis *	Slender Deutzia (Japan)	(M-H)
Deutzia•scabra *	Fuzzy Deutzia	(M-H)
Deutzia•x•lemoinei *	Lemoine Deutzia (Hort. hybrid)	(M-H)
Diervilla•lonicera *	----- (e. N. America)	(H)
Diervilla•sessilifolia *	Southern Bush-honeysuckle (se. USA)	(H)
Dipelta•floribunda *	----- (c. & w. China)	(M+/-)
Dipteronia•sinensis *	----- (China)	(M+/-)
Disanthus•cercidifolius *	----- (China, Jap.)	(H)
Elaeagnus•multiflora *	Cherry Elaeagnus (Jap., China)	(M-H)
Elentherococcus•sieboldianus *	----- (Jap., China)	(M+/-)
Eleutherococcus•senticosus *	Siberian Ginseng (ne. Asia)	(M-H)
Elsholtzia•stauntonii *	Mint Shrub (n. China)	(M+/-)
Euonymus•atropurpureus *	Wahoo (NY to Fla, Minn. to Tex.)	(M-H)
Euonymus•alatus	Burning Bush Euonymus (China, Jap., Kor.)	(M+/-)
Euonymus•bungeanus *	Winterberry (China, Korea, Manch., Jap.)	(M+/-)
Euonymus•europaeus *	Spindletree (Europe)	(M-H)
Euonymus•nanus•v.•turkestanicus *	Turkestan Euonymus (Caucasus - w. China)	(M+/-)
Euonymus•phellomanus *	----- (n. & w. China)	(M+/-)
Euonymus•sachalinensis *	Sakhalin Euonymus (ne. Asia)	(M+/-)
Exochorda•albertii (now E. korolkowii)		
Exochorda•giraldii *	Pearlbush (c. China)	(M+/-)
Exochorda•korolkowii *	Pearlbush (Uzbekistan, Tajikistan)	(M+/-)
Exochorda•racemosa *	Common Pearlbush (n. China)	(M-H)
Exochorda•serratifolia *	Pearlbush (Korea, Manchuria)	(M+/-)
Exochorda•x•macrantha *	Pearlbush (hort. hybrid)	(M+/-)
Fontanesia•phillyreoides•ssp.•fortunei *	----- (China)	(M+/-)
Forsythia•mandschurica *	Manchurian Forsythia (Manch.)	(M+/-)
Forsythia•ovata *	Early Forsythia (Korea)	(M+/-)
Forsythia•suspensa *	Forsythia (China)	(M+/-)
Forsythia•x•intermedia	Forsythia (hort. hybrid)	(M+/-)
Fothergilla•gardenii *	Fothergilla (Va. - Ga.)	(H)
Fothergilla•major *	----- (Allegheny Mts.)	(H)
Genista•tinctoria *	----- (Europe, w. Asia)	(L-M)
Halimodendron•halodendron *	Salt Tree (se. Russia-c. & w. Asia)	(VL-L)
Hamamelis•japonica *	Japanese Witch Hazel (Japan)	(H)

Hamamelis•mollis *	Chinese Witch Hazel (w. China)	(H)
Hamamelis•vernalis *	Witch Hazel (s.e. N. America)	(H)
Hamamelis•virginiana *	Common Witch Hazel (Canada to Georgia)	(H)
Heptacodium•miconioides *	----- (China)	(M+/-)
Hibiscus•syriacus	Rose-of-Sharon Hibiscus (China, India)	(M+/-)
Hippophaë•rhamnoides	Sea Buckthorn (Eurasia)	(M-H)
Holodiscus•discolor *	Rock Spirea (s. Ore.-s. Calif.)	(M+/-)
Hydrangea•arborescens	Hills-of-snow Hydrangea (e. USA)	(H)
Hydrangea•involucrata *	----- (Japan)	(H)
Hydrangea•paniculata	Peegee Hydrangea (China, Japan)	(H)
Hydrangea•quercifolia *	Oakleaf Hydrangea (se. USA)	(H)
Hydrangea•serrata *	----- (Jap., Korea)	(M-H)
Indigofera•amblyantha *	Pink Indigo (China)	(M+/-)
Indigofera•decora *	White Chinese Indigo (China)	(M+/-)
Indigofera•gerardiana *	= Indigofera•heterantha	
Indigofera•heterantha *	----- (Afghan.-w. China)	(M+/-)
Indigofera•incarnata *	= Indigofera•decora	
Indigofera•kirilowii *	----- (n. China, Korea)	(M+/-)
Indigofera•potaninii *	Potanin Indigo (nw. China)	(M+/-)
Itea•virginica *	Sweetspire (e. USA)	(H)
Jasminum•nudiflorum *	Winter Jasmine (China)	(M+/-)
Kerria•japonica	Kerria (Japan)	(M-H)
Kolkwitzia•amabilis	Beautybush (China)	(M+/-)
Leptodermis•oblonga *	----- (n. China)	(M+/-)
Lespedeza•bicolor *	----- (Japan)	(M+/-)
Lespedeza•thunbergii *	----- (Japan, China)	(M+/-)
Ligustrum•vulgare	Common Privet (Medit. region)	(M+/-)
Lindera•benzoin *	Spicebush (e. USA)	(M)
Lindera•obtusiloba *	----- (KOR., Jap., China)	(M-H)
Lonicera•spinosa *	----- (nw Him., Tibet, e. Turkestan)	(M+/-)
Lonicera•alberti *	----- (Turkestan, Tibet)	(M+/-)
Lonicera•caerulea *	----- (Tibet, e. Siberia)	(M+/-)
Lonicera•chrysantha *	----- (ne. Asia, c. Japan)	(M-H)
Lonicera•etrusca *	----- (Medit. to s. Switzerland)	(M+/-)
Lonicera•fragrantissima *	Winter Honeysuckle (China)	(M-H)
Lonicera•hispidula *	----- (Turkestan)	(M+/-)
Lonicera•korolkowii	----- (Mts. c. Asia, Afghan. Pak.)	(M+/-)
Lonicera•maackia *	Amur Honeysuckle (e. Asia)	(M-H)
Lonicera•maximowiczii•v. sachalinensis *	Sakhalin Honeysuckle (Manch, China, Kor.)	(M-H)
Lonicera•microphylla *	----- (nw. Him., Tibet, Sib.)	(M+/-)
Lonicera•morrowii *	Morrow Honeysuckle (Jap.)	(M-H)
Lonicera•pileata *	----- (China)	(M+/-)
Lonicera•quinquelocularis *	----- (Afghan. to Yunnan)	(M+/-)
Lonicera•spinosa•var. alberti *	Fragrant Turkestan Honeysuckle (c. Asia)	(M+/-)
Lonicera•standishii *	Fragrant Winter Honeysuckle (China)	(M+/-)
Lonicera•syringantha	Lilac-scented Honeysuckle (China, Tibet)	(M-H)
Lonicera•tatarica•'Zabelii'	Zabel's Honeysuckle (c. Asia, Afghan.)	(M+/-)
Lonicera•thibetica *	Tibetan Honeysuckle (Tibet., w. China)	(M+/-)
Lonicera•xylostium *	European Fly Honeysuckle (Eurasia)	(M+/-)
Lonicera•x•Xylostoides *	----- (garden origin)	(M+/-)
Lycium•chinense *	Chinese Wolfberry (e. Asia)	(M-H)

Magnolia•sieboldii *	Oyama Magnolia (Jap., Korea, w. China)	(H)
Magnolia•stellata	Star Magnolia (c. Japan)	(H)
Myrica•pensylvanica *	Bayberry (e. N. America)	(H)
Neillia•thibetica *	----- (Himalaya Mts.)	(M+/-)
Neviusii•alambamensis *	----- (se. USA)	(H)
Orixa•japonica *	----- (Japan, China, Korea)	(M+/-)
Paeonia•lutea *	Tree Peony (China, Tibet)	(M+/-)
Paeonia•suffruticosa *	Tree Peony (China, Tibet)	(M+/-)
Parrotia•persica *	----- (Persia)	(M+/-)
Parrotiopsis•jacquemontiana *	----- (Himalaya)	(M-H)
Philadelphus•coronarius +	Sweet Mockorange (Europe, sw. Asia)	(M+/-)
Philadelphus•x•virginialis +	----- (Hort. Hybrid)	(M+/-)
Photinia•villosa *	Oriental Photinia (China, Korea, Jap.)	(M-H)
Physocarpus•opulifolius	Dwarf Ninebark (e. N. America)	(M+/-)
Poncirus•trifoliata *	Trifoliate Orange (c. & n. China)	(M-H)
Prinsepia•sinensis *	----- (Manchuria)	(M+/-)
Prinsepia•uniflora *	----- (nw. China)	(M+/-)
Prunus•andersonii *	Desert Peach (sw. U.S.A.)	(L-M)
Prunus•cerasifera	Cherry Plum (A. Minor, Cauc.)	(M+/-)
Prunus•cerasifera•'Newport'	Newport Plum (garden origin)	(M+/-)
Prunus•fruticosa *	European Dwarf Cherry (Eur., Siberia)	(M+/-)
Prunus•nigra *	Canada Plum (ne. N. Am.)	(M-H)
Prunus•padus *	Bird Cherry (Eurasia)	(M+/-)
Prunus•tomentosa	Nanking Cherry (n. w. China, Tib. Kashmir)	(M-H)
Prunus•x•cistena	Cistena Plum (hort. hybrid)	(M+/-)
Pseudocdonia•sinensis *	Quince (China)	(M+/-)
Purnus•fasciculata *	Desert Almond (sw. USA)	(VL-L)
x•Pyracomeles•vilmorinii *	(Pyracanthus•crenatoserrataXOsteomeles•subrotunda)	(M+/-)
Rhamnus•dahuricus *	Common Buckthorn (e. Russia to Japan)	(M+/-)
Rhamnus•frangula	Glossy Buckthorn (Eur., Turk., n. Afr.)	(M+/-)
Rhamnus•frangula•'Asplenifolia' *	----- (Hort. Cultivar)	(M+/-)
Rhodotypos•scandens *	Jetbead (Japan, China)	(H)
Rhus•punjabensis *	----- (c., w. China)	(M+/-)
Rhus•typhina	Staghorn Sumac (e. N. America)	(M+/-)
Rhus•typhina•'Laciniata'	Cutleaf Staghorn Sumac (?)	(M+/-)
Ribes•alpinum	Alpine Currant (w. Europe)	(M-H)
Ribes•nevadense *	Sierra Currant (Ore., Cal., Nev.)	(M+/-)
Rosa•banksiae *	Banksia Rose (w. & c. China)	(M+/-)
Rosa•davidii *	David's Rose (w. & c. China)	(M+/-)
Rosa•ecae *	----- (c. Asia)	(M+/-)
Rosa•filipes *	----- (w. China)	(M+/-)
Rosa•foetida•'Bicolor'	Austrian Copper Rose (c. Asia)	(M-L)
Rosa•foetida•'Persiana'	Persian Yellow Rose (s.w. Asia)	(M-L)
Rosa•glauca	Redleaf Rose (c. & s. Europe)	(M+/-)
Rosa•helenae *	Helen Wilson's Rose (c. China)	(M+/-)
Rosa•hugonis	= R. xanthira•f. hugonis	
Rosa•kokanica *	----- (c. Asia, China)	(M+/-)
Rosa•laxa *	----- (c. Asia, nw. China)	(M+/-)
Rosa•moyesii *	Moyes Rose (w. China)	(M+/-)
Rosa•moyesii *	Moyes Rose (w. China)	(M+/-)
Rosa•persica *	Persian Rose (Persia, Afghan., c. Asia)	(M+/-)
Rosa•pulverulenta *	----- (s. Eur. to Afghanistan)	(M+/-)
Rosa•rubrifolia (now R. glauca)		

Rosa•rugosa	Rugosa Rose (e. Russia)	(M+/-)
Rosa•sericea *	----- (c. Asia, w. China)	(M+/-)
Rosa•setigera *	Prairie Rose (e. & c. USA)	(M+/-)
Rosa•webbiana	----- (c. Asia, Afghan, Kashmir.)	(M+/-)
Rosa•wichuriana *	----- (e. Asia)	(M+/-)
Rosa•xanthina•f. hugonis	Father's Rose (c. China)	(M+/-)
Rosa•x•harisonii *	Harison's Yellow Rose (Hort. hybrid)	(M+/-)
Salix•discolor	Pussy Willow (e. N. America)	(H)
Salix•matsudana•'Tortuosa'	Corkscrew Willow (China, Japan)	(H)
Sambucus•canadensis	Elderberry (e. N. America)	(H)
Sibiraea•altaiensis *	----- (w. China to Balkans)	(L-M)
Sibiraea•laevigata	= Sibiraea•altaiensis	
Sophora•davidii *	Father David's Sophora (China)	(L-M)
Sorbaria•sorbifolia	Ural False Spirea (Sib., Manch., Korea, Jap.)	(M+/-)
Sorbaria•tomentosa•v. angustifolia *	----- (Afghan., Pak., Kashmir)	(L-M)
Spiraea•betulifolia•var. lucida *	----- (B.C., Ore., Wyo., Mon.)	(M+/-)
Spiraea•cantoniensis *	----- (China)	(M+/-)
Spiraea•douglasii *	----- (B.C. to n. Cal.)	(M+/-)
Spiraea•japonica *	----- (Japan, China)	(M+/-)
Spiraea•japonica•'Albiflora' *	----- (Japan)	(M+/-)
Spiraea•japonica•'Anthony•Waterer'	Anthony Waterer Spirea (garden origin)	(M+/-)
Spiraea•japonica•'Bumalda'	----- (Hort. cultivar)	(M+/-)
Spiraea•japonica•'Froebelii'	Froebel's Spirea (garden origin)	(M+/-)
Spiraea•nipponica *	----- (Japan)	(M+/-)
Spiraea•trilobata	----- (n. Sib., Turkestan, n. China)	(L-M)
Spiraea•wilsonii *	----- (c. & w. China)	(M+/-)
Spiraea•x•vanhouttei	Vanhoutte Spirea (hort. hybrid)	(M+/-)
Spiraea•x•arguta*	Garland Spirea (garden origin)	(M+/-)
Staphylea•trifolia*	Bladdernut (e. USA)	(M-H)
Staphylea•holocarpa *	Oriental Bladdernut (China)	(H)
Staphylea•pinnata *	European Bladdernut (c., se. Eur. A. Minor)	(H)
Stephanandra•incisa *	Lace Shrub (Jap., Korea, Taiwan)	(H)
Stephanandra•tanakae *	Lace Shrub (Japan)	(M-H)
Stephylea•bumalda *	Japanese Bladdernut (Japan)	(M-H)
Symphoricarpos•x•chenaultii•'Hancock' +	Hancock Coralberry (garden origin)	(M+/-)
Symplocos•paniculata *	Sapphireberry (Pakistan to Korea)	(M +/-)
Syringa•amurensis *	= Syringa•reticulata•v. mandschurica	
Syringa•joskiae *	Hungarian Lilac (Hungary)	(M+/-)
Syringa•meyerii *	----- (n. China)	(M+/-)
Syringa•microphylla *	Littleleaf Lilac (n. China)	(M+/-)
Syringa•oblata *	Early Lilac (n. China)	(M+/-)
Syringa•patula *	----- (Korea, China)	(M+/-)
Syringa•persica	Persian Lilac (Persia)	(M+/-)
Syringa•persica•'Laciniata' *	Cutleaf Persian Lilac (Persia ?)	(M+/-)
Syringa•reflexa *	Nodding Lilac (c. China)	(M+/-)
Syringa•reticulata•'Miss•Kim'	Miss Kim Lilac (hort. hybrid)	(M+/-)
Syringa•sweginzowii *	Chengtu Lilac (nw. China)	(M+/-)
Syringa•velutina *	Korean Lilac (Korea)	(M+/-)
Syringa•villosa	----- (China)	(M+/-)
Syringa•vulgaris	Common Lilac (s.e. Europe)	(M+/-)
Syringa•wolfii *	Wolf's Lilac (Korea, Manchuria)	(M+/-)
Syringa•x•chinensis	----- (hort. hybrid)	(M+/-)
Syringa•x•laciniata	Cutleaf Lilac (sw. Asia)	(M+/-)
Syringa•x•prestoniae *	----- (Canadian hort. origin)	(M+/-)
Viburnum•burejaeticum *	----- (n. China, Korea, Russia)	(M-H)
Viburnum•carlesii	Korean Spice Viburnum (Korea, Jap.)	(M-H)
Viburnum•cassinoides *	Witherod Viburnum (e. N. Am.)	(H)

Viburnum•dentatum	Arrowwood Viburnum (e. N. America)	(H-M)
Viburnum•dilatatum *	Linden Viburnum (China, Jap.)	(H)
Viburnum•farreri *	Fragrant Viburnum (n. China)	(H)
Viburnum•lantana	Wayfaring Vib. (Eur., n. Afr., Cauc. A. Minor)	(M+/-)
Viburnum•lentago	Nannyberry (e. N. America)	(M-H)
Viburnum•opulus	European Highbush Cranberry (Eurasia)	(H)
Viburnum•opulus•'Compactum'	----- (cultivar)	(H)
Viburnum•opulus•'Roseum'	European Snowball Viburnum	(H)
Viburnum•plicatum *	----- (Jap., China)	(H-M)
Viburnum•plicatum•'Sterile' *	Japanese Snowball Viburnum (Jap. China)	(H)
Viburnum•plicatum•form•'tomentosum' *	Doublefile Viburnum (Jap., China)	(H)
Viburnum•prunifolium	Black Haw (e. N. Am.)	(M-H)
Viburnum•sargentii *	Sargent's Vib. (e. Sib., n. & w. China, Jap.)	(M-H)
Viburnum•setigerum *	Tea Viburnum (c. & w. China)	(M+/-)
Viburnum•sieboldii *	----- (Japan)	(H)
Viburnum•trilobum	American Highbush Cranberry (N. America)	(H)
Viburnum•trilobum•'Compactum'	----- (cultivar)	(H)
Viburnum•x•bodnantense•'Pink•Dawn' *	----- (hort. hybrid)	(M-H)
Viburnum•x•carlcephalum	----- (hort. hybrid)	(M-H)
Vitex•agnus-castus•f. •latifolia *	Hardy Chaste Tree (s. Europe to c. Asia)	(L-M)
Vitex•negundo•var. •heterophylla *	Cutleaf Chaste Tree(n. China, Mongolia)	(M+/-)
Vitex•rotundifolia *	----- (Asia to Australia)	(M+/-)
Weigela•florida	Weigela (n. China, Korea, Jap.)	(H)
Weigela•middendorffiana *	Middendorff Weigela (n. China, Jap.)	(H)
Xanthocerus•sorbifolium	Yellowhorn (n. China)	(M+/-)
Zanthoxylum•piperitum *	Pepper Tree (China, Korea, Jap.)	(M+/-)
Zanthoxylum•schinifolium *	Pepper Tree (China, Korea, Jap.)	(M+/-)
Zanthoxylum•simulan *	----- (China, Taiwan)	(M-H)
Zenobia•pulverulenta *	Dusty Zenobia (N. Carolina-Florida)	

Trees

(Deciduous Rocky Mountain Natives)
[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation
Celtis•occidentalis Celtis•reticulata	Hackberry Netleaf Hackberry		(M-H) (M-H)
Fraxinus•cuspidata * Fraxinus•pennsylvanica	Fragrant Ash Green Ash		(M+/-) (M-H)
Populus•angustifolia Populus•deltoides Populus•fremontii Populus•tremuloides Populus•x•acuminata	Narrowleaf Cottonwood Plains Cottonwood Fremont's Cottonwood Aspen Lanceleaf Cottonwood		(H) (H) (H) (H) (H)
Sapindus•drummondii *	Soapberry		(L-M)

Trees

(Deciduous, Introduced)
[Revised April '03]

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Acer•capillipes *	Snake-bark Maple (Japan)	(H)
Acer•cappadocicum *	Caucasian Maple (Cauc., A. Minor, n. India)	(M-H)
Acer•cissifolium *	Ivy-leaved Maple (c. China)	(M-H)
Acer•davidii *	Snake-bark Maple (n. China)	(M-H)
Acer•griseum *	Paperbark Maple (China)	(M-H)
Acer•heldreichii *	Greek Maple (Cauc., Balk., n. Turkey)	(M-H)
Acer•macrophyllum *	Oregon Maple (w. N. Am.)	(H)
Acer•mandschuricum *	Manchurian Maple (Korea, Manch.)	(M-H)
Acer•monspessulanum *	Montpelier Maple (Medit.- c. Asia)	(M+/-)
Acer•palmatum	Japanese Maple (Kor., Jap.)	(H)
Acer•pectinatum	----- (Tibet, w. & c. China)	(M-H)
Acer•platanoides	Norway Maple (Eur. to n. Persia)	(M-H)
Acer•platanoides•ssp. turkestanicum *	Turkestan Maple (c. Asia)	(M+/-)
Acer•pseudoplatanus *	Sycamore Maple (nw. c. Eur. to w. Asia)	(M-H)
Acer•pseudosieboldianum *	Korean Maple (Korea-Manch.)	(H)
Acer•rubrum	Red Maple (e. N. America)	(M-H)
Acer•saccharinum	Silver Maple (e. N. Am.)	(M-H)
Acer•saccharinum•'Laciniatum' +	Cutleaf Silver Maple (Hort. cultivar)	(M-H)
Acer•saccharum	Sugar Maple (e. N. America)	(H)
Acer•triflorum *	Three-flowered Maple (Manch., Korea)	(M+/-)
Acer•truncatum *	Shantung Maple (n. China, Manch., Korea)	(H)
Acer•turkestanicum *	= A. platanoides ssp. turkestanicum	
Aesculus•flava	Sweet Buckeye (e. N. America)	(M-H)
Aesculus•glabra	Ohio Buckeye (e. N. America)	(M-H)
Aesculus•hippocastanum	Horse Chestnut (Eurasia)	(M-H)
Aesculus•octandra	= Aesculus•flava	
Aesculus•pavia *	Red Buckeye (se. USA)	(H)
Aesculus•turninata *	Japanese Horsechestnut (Japan)	(M-H)
Aesculus•x•carnea *	Red-flowered Horsechestnut (hort. hybrid)	(M+/-)
Ailanthus•altissima	Tree of Heaven (n. China)	(L-M-H)
Albizia•julibrissin*	Silk Tree (Iran-Japan)	(M+/-)
Amelanchier•asiatica *	Asiatic Serviceberry (China)	(M+/-)
Asimia•triloba *	Paw Paw (ec. USA)	(H?)
Betula•albosinensis *	Chinese Red Birch (c., w., nw. China)	(M-H)
Betula•ermanii *	Russian Rock Birch (ne. Asia)	(H)
Betula•mandshurica•var. japonica *	Japanese White Birch (Jap., Sakhalin Is.)	(H)
Betula•maximowicziana *	Monarch Birch (Jap.)	(H)
Betula•nigra	River Birch (e. USA)	(H)

Betula•papyrifera	Paper Birch (e. N. America)	(H)
Betula•pendula'•Lacinata'	Cutleaf Weeping Eur.. Birch (hort. hybrid)	(H)
Betula•pendula	European Birch (Eur.-w. Asia)	(H)
Betula•utilis•var. •jacquemantii *	Whitebarked Himal. Birch (Kash., c. Nepal)	(M-H)
Carpinus•betulus *	European Hornbeam (Eur.-w. Asia)	(H)
Carpinus•carolinana *	American Hornbeam (e. N. America)	(H)
Carpinus•cordata *	Heartleaf Hornbeam (China)	(M-H)
Carpinus•henryana *	----- (c. China)	(M-H)
Carpinus•japonica *	Japanese Hornbeam (Japan)	(H)
Carpinus•laxiflora *	----- (Jap., Kor., n. & w. China)	(M-H)
Carpinus•orientalis *	Oriental Hornbeam (se. Eur., A. Minor)	(M-H)
Carpinus•tschonoskii *	Yeddo Hornbeam (ne. & sw. China)	(M-H)
Carpinus•turczaninowii *	----- (w. China)	(M+/-)
Carya•illinoensis *	Pecan (Iowa s. to Mexico)	(M+/-)
Carya•laciniosa *	Shellbark Hickory (e. N. America)	(M-H)
Carya•ovata *	Shagbark Hickory (e. N. America)	(H)
Castanea•crenata *	Japanese Chestnut (Jap.)	(H)
Castanea•dentata	American Chestnut (e. N. America)	(H)
Castanea•mollissima *	Chinese Chestnut (China, Korea)	(M-H)
Catalpa•bignonioides *	Southern Catalpa (se. USA)	(H)
Catalpa•bungei *	----- (n. China)	(M+/-)
Catalpa•fargesii *	----- (w. China)	(M+/-)
Catalpa•ovata *	Chinese Catalpa (China)	(H)
Catalpa•speciosa	Catalpa (e. N. America)	(M-H)
Celtis•australis *	Mediterranean Hackberry (Medit., Mid East)	(M+/-)
Celtis•caucasica *	Caucasian Hackberry (Asia Minor-Afghan.)	(M+/-)
Celtis•laevigata	Sugarberry (se. USA)	(M-H)
Cercidiphyllum•japonicum *	Katsura Tree (Japan, w. China)	(H-M)
Cercis•canadensis	Eastern Redbud (e. N. America)	(M-H)
Cercis•reniformis *	Texas Redbud (N. Mex., Tex., Okla.)	(M+/-)
Chitalpa	= x•Chitalpa•tashkentensis	
Cladrastis•lutea *	Yellowwood (se. USA)	(H)
Cladrastis•platycarpa *	Japanese Yellowwood (Jap., China)(H)	
Cladrastis•sinensis *	Chinese Yellowwood (China)	(H)
Corlyus•columna	Turkish Hazel (se. Europe, w. Asia)	(M+/-)
Cornus•walteri *	Walter Dogwood (c. China)	(M-H)
Corylus•americana *	American Hazel (e. N. America)	(H)
Crataegus•altaica'•Hissarica' *	Hissar Hawthorn (Tajikistan)	(M+/-)
Crataegus•ambigua +	Russian Hawthorn (se. Russia)	(M+/-)
Crataegus•arnoldiana *	----- (New England)	(M+/-)
Crataegus•azarolus *	Red Azarole (s. Eur., n. Afr., w. Asia)	(M+/-)
Crataegus•crus-galli	Cockspur Hawthorn (se. N. America)	(M+/-)
Crataegus•laevigata *	English Hawthorn (Eur., n. Afr., India)	(M-H)
Crataegus•maximowiczii *	----- (ne. Asia)	(M±)
Crataegus•mollis	Downy Hawthorn (e. N. America)	(M+/-)
Crataegus•monogyna *	Singleseed Hawthorn (Eur., n. Afr., w. Asia)	(M+/-)
Crataegus•pedicellata *	----- (ne. USA)	(M+/-)
Crataegus•phaenopyrum	Washington Hawthorn (se. N. America)	(M+/-)
Crataegus•pinnatifida *	Chinese Hawberry (c. Asia, Korea)	(M+/-)
Crataegus•rivularis *	----- (Rocky Mtn. States)	(M+/-)
Crataegus•tianshanica *	Tien Shan Hawthorn (c. Asia)	(M+/-)
Crataegus•turkestanica *	Turkestan Hawthorn (Turkestan)	(M+/-)
Crataegus•viridis•'Winter•King' *	Winter King Hawthorn (e. USA)	(M+/-)
Crataegus•x•nitida *	Shining Hawthorn (s. USA)	(M+/-)
Cyrilla•racemiflora *	Leatherwood (e. N. Am. & e. S. Am.)	(H)
x•Chitalpa•tashkentensis *	Chitalpa (Catalpa•bignonioides X Chilopsis•linearis)	(M+/-)
Diospyros•virginiana *	American Persimmon (e. USA)	(M-H)

Eucommia•ulmoides *	Hardy Rubber Tree (c. China)	(M+/-)
Evodia•daniellii *	= Tetradium•daniellii *	
Evodia•hupehensis *	= Tetradium•hupehensis *	
Fagus•grandifolia *	American Beech (e. N. America)	(H)
Fagus•orientalis *	Oriental Beech (se. Eur.-Iran)	(M+/-)
Fagus•sylvatica	European Beech (Europe)	(H)
Fraxinus•americana	White Ash (e. N. America)	(M-H)
Fraxinus•americana•'Autumn•Purple'	Autumn Purple Ash (hort. cultivar)	(M-H)
Fraxinus•angustifolia•'Raywood' *	Raywood Ash (s. Europe-c. Asia, n. Afr.)	(M+/-)
Fraxinus•angustifolia•ssp. syriaca *	Turkestan Ash (c. Asia, A. Minor)	(M+/-)
Fraxinus•chinensis *	Chinese Ash (China)	(M+/-)
Fraxinus•cuspidata *	Flowering Ash (N. Mex. to Mex.)	(L-M)
Fraxinus•excelsior *	European Ash (Europe, w. Asia)	(M+/-)
Fraxinus•latifolia *	Oregon Ash (w. US)	(M+/-)
Fraxinus•mandshurica *	Manchurian Ash (n. Asia)	(M+/-)
Fraxinus•nigra *	Black Ash (N. Am.)	(M+/-)
Fraxinus•ornus *	Flowering Ash (s. Europe-w. Asia)	(M+/-)
Fraxinus•oxycarpa•'Raywood' *	= F. angustifolia 'Raywood'	
Fraxinus•quadrangulata *	Blue Ash (Mich., to Ark.)	(M-H)
Fraxinus•sieboldiana *	----- (Japan, China)	(M-H)
Fraxinus•sogdiana *	= Fraxinus•angustifolia•ssp. syriaca	
Fraxinus•velutina *	Velvet Ash (Ariz., N. Mex.)	(M+/-)
Ginkgo•biloba *	Ginkgo, Maidenhair Tree (se. China)	(M-H)
Gleditsia•caspica *	Caspian Honeylocust (Azerbaijan-n. Iran)	(M+/-)
Gleditsia•triacanthos•var.	Honeylocust varieties (c. & e. N. America)	(M-H)
Gymnocladus•dioica	Kentucky Coffeetree (c. & e. N. America)	(M-H)
Halesia•diptera *	Two-winged Silverbell (s. USA)	(H)
Halesia•tetraptera *	Silverbell Tree (se. USA)	(H)
Hemiptelea•davidii *	David Hemiptelea (n. China to Korea)	(M-H)
Hovenia•dulcis *		
Idesia•polycarpa *	----- (Sichuan)	(M-H)
Juglans•ailanthifolia *	Japanese Walnut (Jap.)	(M+/-)
Juglans•ailantifolia *	Heartnut (Japan)	(H)
Juglans•cinerea *	White Butternut (N. America)	(M+/-)
Juglans•mandshurica *	Manchurian Walnut (Manchuria, ne. China)	(M+/-)
Juglans•microcarpa *	Little Walnut (OK., N. Mex., Tex., Kan., Mex.)	(M+/-)
Juglans•nigra	Black Walnut (e. USA)	(M-H)
Juglans•regia•varieties *	Carpathian Walnut varieties (se. Eur. - China)	(M+/-)
Kalopanax•pictus *	= Kalopanax•septemlobus	
Kalopanax•septemlobus *	Castor-aralia (China, Korea, Japan)	(M-H)
Koelreuteria•paniculata	Golden Raintree (n.China, Korea)	(M+/-)
Laburnum•alpinum *	Alpine Golden Chaintree (sc. Europe)	(M-H)
Laburnum•anagyroides *	Common Laburnum (c. & s. Eur.)	(M+/-)
Laburnum•X•'Waterer' *	Waterer Laburnum (hort. hybrid)	(H)
Larix•decidua	European Larch (Alps, Carpathian Mts.)	(H)
Larix•gmelinii *	Dahurian Larch (e. Asia)	(H)

Larix•kaempferi *	Japanese Larch (Japan)	(H)
Larix•laricina	Tamarack (n. N. America)	(H)
Larix•leptolepis *	= Larix•kaempferi	
Larix•occidentalis *	Rocky Mtn. Larch (B.C. to Montana)	(M-H)
Liquidambar•styraciflua *	Sweetgum (e. N. America to c. America)	(H)
Liriodendron•tulipifera *	Tulip Tree (e. N. America)	(H)
Maackia•amurensis *	Amur Maackia (Manchuria, Korea)	(M+/-)
Maackia•chinensis *	----- (c. China)	(M+/-)
Maclura•pomifera *	Osage Orange (Ark., Tex.)	(M+/-)
Magnolia•acuminata *	Cucumber Tree (e. N. AM)	(H)
Magnolia•kobus *	Tree Star Magnolia (Japan)	(M-H)
Magnolia•x•soulangiana	Saucer Magnolia (hort. hybrid)	(H)
Malus•'Hopa'	Hopa Crabapple (hort. cultivar)	(M+/-)
Malus•'Radiant'	Radiant Crabapple (hort. cultivar)	(M+/-)
Malus•'Snowdrift'	Snowdrift Crabapple (hort. cultivar)	(M+/-)
Malus•baccata	Siberian Crabapple (Manchuria, China)	(M+/-)
Malus•dolgo	Dolgo Crabapple (Siberia ?)	(M+/-)
Malus•ioensis	Prairie Crabapple (c. USA)	(M+/-)
Malus•ioensis•'Plena'	Bechtel Crabapple (hort. cultivar)	(M+/-)
Malus•sp. •'Golden•Delicious'	Golden Delicious Apple (hort. cultivar)	(M+/-)
Malus•sp. •'Red•Delicious'	Red Delicious Apple (hort. cultivar)	(M+/-)
Malus•sp. •'Winesap'	Winesap Apple (hort. cultivar)	(M+/-)
Malus•spp.	Common Apple (se. Europe, c. Asia)	(M+/-)
Mespilus•germanica *	Medlar (Europe-Asia Minor)	(M+/-)
Metasequoia•glyptostroboides *	Dawn Redwood (w. China)	(M-H)
Morus•alba	White Mulberry (Asia)	(M+/-)
Morus•australis *	----- (e. Asia)	(M+/-)
Morus•nigra *	Black Mulberry (sw. Asia)	(M+/-)
Morus•rubra *	Red Mulberry (e. N. America)	(M+/-)
Nothofagus•antarctica *	Southern Beech (Chile, Argentina)	(H)
Nyssa•sylvatica *	Blackgum (Ontario, Texas)	(H)
Ostrya•carpinifolia *	European Hop Hornbeam (s. Eur., se. Asia)	(M)
Ostrya•virginiana *	American Hop Hornbeam (e. N. America)	(H)
Paulownia•fortunei*	----- (China, Japan)	(H)
Paulownia•kawakamii*	----- (s. China, Taiwan)	(H)
Paulownia•tomentosa *	Empress Tree (c. & w. China)	(M-H)
Phellodendron•amurense *	Amur Cork Tree (n. China, Jap., Manch.)	(M-H)
Phellodendron•chinese *	Chinese Cork Tree (c. China)	(M-H)
Phellodendron•Japonicum *	Japanese Cork Tree (c. Japan)	(H)
Phellodendron•sachalinense *	Sakhalin Cork Tree (w. China, n. Jap., Kor.)	(H)
Pistacia•chinensis *	Chinese Pistachio (China, Taiwan)	(L-M)
Pistacia•vera *	Edible Pistachio (Persia, c. Asia)	(L-M)
Platanus•occidentalis *	Eastern Plane Tree (la., to Tex. to Mex.)	(H)
Platanus•orientalis *	Oriental Plane Tree (se. Eur., sw. Asia)	(M+/-)
Platanus•x•acerifolia *	London Plane Tree (hort. hybrid)	(H)
Prunus•armeniaca	Apricot (c. & e. Asia)	(M+/-)
Prunus•armeniaca•var. •mandshurica *	= Prunus•mandshurica	
Prunus•avium *	Bird Cherry (Eur.-A. Minor-e. Sib.)	(H-M)
Prunus•cerasus *	Pie Cherry (se. Eur., Iran, n. India)	(M+/-)
Prunus•cerasus•'Meteor'	Meteor Pie Cherry (hort. cultivar)	(M+/-)
Prunus•cerasus•'Morello'	Morello Pie Cherry (hort. cult.)	(M+/-)
Prunus•cerasus•x•'Montmorency'	Montmorency Pie Cherry (hort. cultivar)	(M+/-)
Prunus•cerasus•x•'North•Star'	North Star Pie Cherry (hort. cultivar)	(M+/-)
Prunus•maackii	Manchurian Cherry (Kor. Manch.)	(M-H)

Prunus•mahleb *	St. Lucie Cherry (Eur.-Asia Minor)	(M+/-)
Prunus•mandshurica *	Manchurian Apricot (Manchuria, Korea)	(M+/-)
Prunus•persica	Peach (c. & e. Asia)	(M+/-)
Prunus•salicina *	Japanese Plum (China, Jap.)	(H-M)
Prunus•sp. •'Green•Gage'	Green Gage Plum (hort. cultivar)	(M+/-)
Prunus•sp. •'Stanely'	Stanley Plum (hort. cultivar)	(M+/-)
Prunus•spp.	Domestic Plums	(M+/-)
Prunus•x•dasycarpa * (P. •armenica x P. •cerasifera)	Black Apricot (c. Asia-Asia Minor)	(M-L)
Pseudolarix•kaempferi *	Golden Larch (e. China)	(H?)
Ptelea•polyadenia*	----- (sw. USA)	(M+/-)
Pterocarya•fraxinifolia *	Caucasian Walnut (Caucasus, Persia)	(M+/-)
Pteroceltis•tartarianovii *	Tartar Wingceltis (n., c. China)	(M+/-)
Pterostyrax•hispidia *	Fragrant Epaulette Tree (Japan, China)	(H?)
Pyrus•bucharica *	= Pyrus•korshinsky	
Pyrus•calleryana•'Bradford'	Bradford Pear (China)	(M+/-)
Pyrus•communis +	Common Garden Pear (Europe, w. Asia)	(M+/-)
Pyrus•communis•'Maxine'	Maxine Pear (hort. cultivar)	(M+/-)
Pyrus•communis•'Moonglow'	Moonglow Pear (hort. cultivar)	(M+/-)
Pyrus•korshinsky *	Buchara Pear (Turkestan)	(L-M)
Pyrus•salicifolia *	Willow-leaved Pear (se. Europe, w. Asia)	(M+/-)

Quercus•acutissima *	Sawtooth Oak (Japan, China, Korea)	(M-H)
Quercus•alba	White Oak (e. USA)	(M+/-)
Quercus•bicolor	Swamp White Oak (ne. N. Am.)	(M+/-)
Quercus•douglasii *	California Blue Oak (w. US)	(M+/-)
Quercus•frainetto *	Hungarian Oak (s. Italy, Balk., Turkey)	(M+/-)
Quercus•glandulifera *	----- (Jap., Korea, China)	(M+/-)
Quercus•imbricaria *	Shingle Oak (e. & c. USA)	(M-H)
Quercus•kelloggii *	California Black Oak (w. US)	(M+/-)
Quercus•macrocarpa	Bur Oak (c., ne. N. America)	(M+/-)
Quercus•mongolica *	Mongolian Oak (ne. Asia)	(M+/-)
Quercus•muehlenbergii *	Chinquapin Oak (e. USA)	(M-H)
Quercus•palustris	Pin Oak (ne. N. America)	(M-H)
Quercus•phellos *	Willow Oak (se. USA)	(M-H)
Quercus•prinus *	Chestnut Oak (e. USA)	(M-H)
Quercus•robur	English Oak (Europe, n. Afr., w. Asia)	(M-H)
Quercus•rubra	Northern Red Oak (ne. USA)	(M-H)
Quercus•sadleriana *	Deer Oak (w. USA)	(M+/-)
Quercus•shumardii *	Shumard's Oak (c. USA)	(M-H)
Quercus•vacciniifolia *	Huckleberry Oak (w. US)	(M+/-)

Salix•pentandra *	Laurel-leaf Willow (Eur.)	(H)
Sassafras•albidum *	Sassafras (e. N. Am.)	(H)
Sophora•davidii *	David's Sophora (China)	(L-M)
Sophora•japonica (aka Styphnolobium•japonicum)	Japanese Pagoda Tree (China, Korea)	(M+/-)
Sorbus•tortinialis *	Chequer Tree (A. Minor, n. Africa, Eur. Asia)	(H)
Sorbus•alnifolia *	----- (Jap., Korea)	(H)
Sorbus•americana	American Mtn. Ash (ne. N. America)	(M-H)
Sorbus•aria*	Whitebeam Mtn. Ash (Eur.)	(H)
Sorbus•aucuparia	European Mtn. Ash (Eurasia)	(M-H)
Sorbus•cashmeriana *	Kashmir Mountain Ash (Himalaya)	(H)
Sorbus•commixta *	----- (Korea, Japan)	(M-H)
Sorbus•decora	Showy Mountain Ash (ne. N. America)	(M-H)
Sorbus•forrestii *	Forest's Mountain Ash (China)	(M-H)
Sorbus•hupehensis *	Hupei Mtn. Ash (c., w. China)	(M-H)
Sorbus•intermedia *	Scandinavian Mtn. Ash (Scand.)	(H)
Sorbus•latifolia *	----- (Europe)	(M-H)
Sorbus•pohuashanensis *	----- (n. China)	(H)
Sorbus•prattii *	Pratt's Mountain Ash (w. China)	(M+/-)
Sorbus•tianschanica *	Tien Shan Mtn. Ash (c. Asian mtns.)	(H)

<i>Sorbus</i> • <i>x</i> • <i>hybrida</i> *	Oakleaf Mtn. Ash (hort. hybrid)	(H)
<i>Stranvaesia</i> • <i>davidiana</i> *	Chinese <i>Stranvaesia</i> (w. China)	(H)
<i>Styphnolobium</i> • <i>japonicum</i>	see <i>Sophora</i> • <i>japonica</i>	
<i>Styrax</i> • <i>japonicum</i> *	Japanese Snowball (Japan, China)	(H)
<i>Styrax</i> • <i>obassia</i> *	Fragrant Snowbell (Japan)	(H)
<i>Syringa</i> • <i>pekinensis</i>	Peking Tree Lilac (n. China)	(M+/-)
<i>Syringa</i> • <i>reticulata</i>	Japanese Tree Lilac (n. Japan)	(M-H)
<i>Syringa</i> • <i>reticulata</i> •var.• <i>mandschurica</i>	Manchurian Tree Lilac (Japan)	(M+/-)
<i>Taxodium</i> • <i>ascendens</i> *	Pond Cypress (se. USA)	(H)
<i>Taxodium</i> • <i>distichum</i>	Bald Cypress (se. N. America)	(H)
<i>Tetradium</i> • <i>danielii</i> *	Korean <i>Evodia</i> (China, Korea)	(H)
<i>Tetradium</i> • <i>hupehensis</i> *	Hupei Bee Bee Tree (sw. China, Korea)	(M+/-)
<i>Tilia</i> • <i>americana</i>	Basswood (c., e. N. America)	(H)
<i>Tilia</i> • <i>amurensis</i> *	Amur Linden (Manch., Korea)	(M-H)
<i>Tilia</i> • <i>cordata</i>	Littleleaf Linden (Eur. to Caucasus)	(H)
<i>Tilia</i> • <i>mongolica</i> *	Mongolian Linden (Mon., e. Russia, n. China)	(M-H)
<i>Tilia</i> • <i>platyphyllos</i> *	Bigleaf Linden (se., Europe)	(M-H)
<i>Tilia</i> • <i>tomentosa</i> *	Silver Linden (se. Europe, w. Asia)	(M+/-)
<i>Tilia</i> • <i>x</i> • <i>euchlora</i> *	Crimean Linden (hort. hybrid)	(M-H)
<i>Toona</i> • <i>sinensis</i>	----- (China)	(M-H)
<i>Ulmus</i> • <i>parvifolia</i> *	Chinese Elm (China, Japan, Korea)	(M-H)
<i>Ulmus</i> • <i>americana</i> •cvs.	American Elm (DED resistant cultivars)	(L-M-H)
<i>Zelkova</i> • <i>carpinifolia</i> *	Caucasian <i>Zelkova</i> (Cauc.)	(M-H)
<i>Zelkova</i> • <i>serrata</i> *	Japanese <i>Zelkova</i> (Jap., Taiwan, e. China)	(H)
<i>Zelkova</i> • <i>sinica</i> *	Chinese <i>Zelkova</i> (e. China)	(H)
<i>Ziziphus</i> • <i>jujuba</i> *	Chinese Jujuba (temp. Asia)	(H-M)

EVERGREENS

(Coniferous Trees)

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation
Abies•cilicica *		Cilician Fir (s. Turkey, nw. Syria, Lebanon)	(M-H)
Abies•concolor		White Fir (Colo. to Mex.)	(M-H)
Abies•holophylla *		Manchurian Fir (Manch., Korea)	(M-H)
Abies•homolepis *		Nikko Fir (Japan)	(H)
Abies•koreana *		Korean Fir (s. Korea)	(H)
Abies•lasiocarpa		Subalpine Fir (Rocky Mtns.)	(H)
Abies•nordmanniana *		Caucasian Fir (Greece, Cauc., Turkey)	(M)
Calocedrus•decurrens *		Incense Cedar (w. Ore.-Baja Calif.)	(M-H)
Cedrus•atlantica *		= Cedrus•libani•ssp. atlantica	
Cedrus•deodara *		Deodara Cedar (Himalaya Mts. Afghan.-w. Nepal)	(M-H)
Cedrus•libani *		Lebanon Cedar (nw. Syria, se Turkey)	(M-H)
Cedrus•libani•ssp. atlantica *		Atlas Cedar (Atlas Mts.)	(M-H)
Cedrus•libani•ssp. stenocoma *		Hardy Turkish Cedar (s. Turkey)	(M-H)
Cupressus•arizonica *		Arizona cypress (Ariz., N. Mex., Tex., Mex.)	(L-M)
Cupressus•bakeri *		Modoc Cypress (Calif., Oregon)	(M+/-)
Picea•abies		Norway Spruce (n. & c. Europe)	(H)
Picea•engelmannii		Engelmann Spruce (B.C. to N. Mex.)	(H)
Picea•glauca		White Spruce (n. N. Am.)	(M-H)
Picea•glauca•'Black•Hills'		Black Hills Spruce (Black Hills S.Dak.)	(M-/-)
Picea•glauca•'Conica'		Dwarf Alberta Spruce (hort. cultivar)	(H)
Picea•omorika *		Serbian Spruce (Balk.)	(M-H)
Picea•pungens		Colorado Spruce (Wyo., Colo., N. Mex., Utah)	(M-H)
Picea•schrenkiana•ssp. tianshanica *		----- (c. Asia)	(M+/-)
Pinus•heldreichii (was P. leucodermis) *		Bosnian Pine (w. Balkans - se. Italy - Greece)	(M+/-)
Pinus•aristata		Bristlecone Pine (Mts. Cal. to Colo.)	(M, H)
Pinus•bungeana *		Lacebark Pine (nw. China)	(M+/-)
Pinus•cembra *		Swiss Stone Pine (c. Eur. mtns.)	(M-H)
Pinus•contorta•ssp. latifolia		Lodgepole Pine (Alaska, Cal., to Colo.)	(M-H)
Pinus•densiflora *		Japanese Red Pine (Jap., Korea)	(M-H)
Pinus•flexilis		Limber Pine (Albt. to Cal. to Tex.)	(M-H)
Pinus•nigra		Austrian Pine (se. Eur., w. Asia, n. Afr.)	(M-H)
Pinus•peuce *		Macedonian Pine (Balk.)	(M-H)
Pinus•ponderosa		Ponderosa Pine (w. North America)	(M+/-)
Pinus•pumila *		Dwarf Siberian Pine (ne. Asia)	(H)
Pinus•strobbiformis		Southwestern White Pine (Colo., Ariz., n. Mex.)	(M-H)

Pinus•strobus	Eastern White Pine (e. N. America)	(H)
Pinus•sylvestris	Scotch Pine (n. Eurasia)	(M-H)
Pinus•wallichiana *	Himalayan White Pine (Himalaya Mtns.)	(M-H)
Pseudotsuga•menziesii	Douglas Fir (B.C. to Mex. to Tex.)	(M-H)
Sequoiadendron•giganteum *	Giant Sequoia (Sierra Nevada Mts.)	(H)
Tsuga•canadensis	Canada Hemlock (ne. N. America)	(H)

EVERGREENS

(Coniferous Shrubs)

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Chamaecyparis•pisifera *	----- (Japan)	(H)
Juniperus•chinensis	Chinese Juniper (e. Asia)	(L-M)
Juniperus•chinensis•'Hetzi'•Glaucal	Hetzi Juniper (hort. cultivar)	(L-M)
Juniperus•chinensis•'Pfitzeriana'	Pfitzer Juniper (hort. cultivar)	(L-M)
Juniperus•chinensis•'Pfitzeriana'•Compacta'	Compact Pfitzer Juniper (hort. cultivar)	(L-M)
Juniperus•chinensis•'Tortulosa' *	Hollywood Juniper (hort. cultivar)	(L-M)
Juniperus•chinensis•var. •sargentii	Sargent's Juniper (e. Asia)	(L-M)
Juniperus•communis•saxatilis	Mountain Common Juniper (circumboreal)	(L-M)
Juniperus•horizontalis	Horizontal Juniper (Nov. Sc. to Alaska, N J., to Mon.)	(L-M)
Juniperus•horizontalis•'Bar'•Harbor'	Bar Harbor Juniper (hort. cultivar)	(L-M)
Juniperus•horizontalis•'Blue'•Chip'	Blue Chip Juniper (e. Asia)	(L-M)
Juniperus•horizontalis•'Plumosa'	Andorra Juniper (hort. cultivar)	(L-M)
Juniperus•horizontalis•'Prince'•of'•Wales'	Prince of Wales Juniper (hort. cultivar)	(L-M)
Juniperus•horizontalis•'Wiltonii'	Wilton Carpet Juniper (hort. cultivar)	(L-M)
Juniperus•monosperma	Oneseed Juniper (Colo., Utah, Tex., Mex.)	(VL-L)
Juniperus•osteosperma	Utah Juniper (sw. USA)	(VL-L)
Juniperus•procumbens var. & cv.	Japargarden Juniper varieties and cultivars	(M-H)
Juniperus•sabina	Savin Juniper (w. Asia)	(L-M)
Juniperus•sabina•'Buffalo'	Buffalo Juniper (hort. cultivar)	(L-M)
Juniperus•sabina•'Skandia'	Skandia Juniper (hort. cultivar)	(L-M)
Juniperus•sabina•var. •tamariscifolia	Tam Juniper (hort. cultivar)	(L-M)
Juniperus•scopulorum	Rocky Mtn. Juniper (B.C. to s. Ariz., to Tex.)	(L)
Juniperus•squamata	----- (India, Tibet, Taiwan)	(M+/-)
Juniperus•squamata•'Meyeri'	----- (hort. cultivar)	(M+/-)
Juniperus•virginiana	Eastern Redcedar (e. N. Am.)	(M-H)
Microbiota•decussata *	Siberian Cypress (Siberia)	(M+/-)
Pinus•edulis	Piñon Pine (Wyo., Cal., Mex.)	(VL-M)
Pinus•mugo	Mugo Pine (c. Eur. Balk.)	(M-H)
Platycladus•orientalis *	Oriental Arborvitae (China, Korea)	(M+/-)
Taxus•baccata *	English Yew (Eur., n. Afr., w. Asia)	(H)

<i>Taxus•brevifolia *</i>	Anticancer Yew (pnw. USA)	(H)
<i>Taxus•cuspidata *</i>	Japanese Yew (Jap., Kor., Manchuria)	(H)
<i>Taxus•x•media *</i>	----- (hort. hybrid)	(H)
<i>Thuja•occidentalis•var.</i>	Western Arborvitae varieties (e. N. Am.)	(H)
<i>Thuja•orientalis (now Platycladus•orientalis)</i>		
<i>Thuyopsis•dolabrata *</i>	False Arborvitae (Japan)	(H)

7. EVERGREENS

(Non-coniferous)

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Agave•parryi *	Parry's Agave (Cal., N.Mex., Mex.)	(VL-L)
Agave•utahensis *	Utah Agave (Cal., Nev. Utah, Ariz.)	(VL-L)
Allenrolfea•occidentalis *	Iodine Bush (sw. USA, deserts)	(L-VL)
Arctostaphylos•patula *	Greenleaf Manzanita (sw. USA)	(M+/-)
Artemisia•cana •(a.k.a. Seriphidium•canum)	Black Sage (w. USA)	(VL-M)
Artemisia•tridentata (a.k.a. S. tridentata)	Big Western Sage (intermtn. w. N. America)	(VL-M)
Aucuba•japonica *	Spotted Laurel (China, Taiwan, s. Japan)	(H)

Berberis•candidula *	Paleleaf Barberry (China)	(M+/-)
Berberis•julianae	Wintergreen Barberry (w. China)	(M+/-)
Berberis•triacanthophora *	= Berberis•X•wisleyensis	
Berberis•verruculosa *	Warty Barberry (w. China)	(M+/-)
Berberis•X•wisleyensis *	Threespike Barberry (hort. hybrid)	(M+/-)
Bruckenthalia•spiculifolia *	Spike Heath (se. Europe, Asia Minor)	(M+/-)
Buxus•microphylla•v.•koreana *	Korean Boxwood (Jap., Korea)	(M-H)
Buxus•sempervirens *	Common Boxwood (s. Eur., w. Asia, n. Afr.)	(M-H)

Ceanothus•fendleri	Fendler Ceanothus (Rocky Mtn. West)	(M+/-)
Ceanothus•integerrimus *	Deerbrush (sw. N. America)	(M+/-)
Ceanothus•sanguineus *	Oregon Tea (B.C. to Mont. to Calif.)	(M+/-)
Ceanothus•velutinus *	Snowbrush Ceanothus (Western Mtns., USA)	(M-H)
Cercocarpus•breviflorus	= Cercocarpus•ledifolius•v.•paucidentatus	
Cercocarpus•intricatus	= Cercocarpus•ledifolius•v.•intracatus	
Cercocarpus•ledifolius	Curleaf Mtn. Mahogany (Intermtn. USA)	(VL-L)
Cercocarpus•ledifolius•v.•intracatus	Littleleaf Mtn. Mahogany (Intermtn. sw. USA)	(VL-L)
Cercocarpus•ledifolius•v.•paucidentatus	Hairy Mtn. Mahogany (Ariz., N. Mex., Mex.)	(VL-L)
Chamaebatiaria•millefolium	Fernbush (Ore., e. Cal., Wyo., Ariz.)	(VL-L)
Cistus•laurifolius *	Laurel Rock Rose (sw. Europe)	(M+/-)
Coronilla•emerus *	Scorpion senna (c. & s. Europe)	(L-M)
Cotoneaster•congestus *	Pyrenees Cotoneaster (Himalaya Mts.)	(M+/-)
Cotoneaster•conspicuus *	Wintergreen Cotoneaster (c. China, se. Tibet)	(M+/-)
Cotoneaster•dammeri *	Bearberry cotoneaster (c. China)	(M-/-)
Cotoneaster•glaucophyllus *	Brightbead Cotoneaster (w. China)	(L-M)
Cotoneaster•microphyllus *	Littleleaf Cotoneaster (mtns. Afghan. to China)	(L-M)
Cowania•mexicana (syn. Purshia•mexicana)	Cliff Rose (intermtn. sw. USA & Mex.)	(VL-L)
Cytisus•scoparius *	Scotch Broom (Europe)	(M+/-)

Cytisus•x•praecox *	Warminster Broom (hort. hybrid)	(M+/-)
Daphne•cneorum	Daphne (mnts. c. & s. Europe)	(M+/-)
Daphne•retusa *	= Daphne•tangutica	
Daphne•tangutica *	----- (nw. & w. China)	(M+/-)
Daphne•x•burkwoodii	-----	(M+/-)
Daphne•x•burkwoodii•'Carol•Mackie'	Carol Mackie Daphne (hort. cultivar)	(M+/-)
Daphne•pontica *	----- (A. Minor, se. Eur., Cauc.)	(M+/-)
Elaeagnus•pungens *	----- (Jap., China)	(VL, M)
Ephedra•americana•v.•andina *+	----- (Andes, Ecuador. to Patagonia)	(VL-M)
Ephedra•equisetina +	----- (c. Asia, w. china)	(VL)
Ephedra•gerardiana *+	----- (China, Himalaya)	(VL-L)
Ephedra•glauca *	----- (c. Asia-Seravshan Mts.)	(VL-L)
Ephedra•minima *+	----- (China)	(VL-L)
Ephedra•minuta *	----- (c. Asia-Seravshan Mts.)	(VL-L)
Ephedra•nevadensis *+	Nevada Ephedra (Great Basin)	(VL-L)
Ephedra•regaliana *	----- (c. Asia-Pamir Mts.)	(VL-L)
Ephedra•torreyana +	Torrey Ephedra (intermtn. sw. USA)	(VL-L)
Ephedra•viridis +	Green Ephedra, Mormon Tea (Intermtn. sw. USA)	(VL-L)
Euonymus•fortunei•'Vegetus'	Euonymus (c. & w. China)	(M-H)
Euonymus•kiautschovicus•'Manhattan'	Manhattan Euonymus (hort. cultivar)	(M-H)
Fargesia•murielae, A. m., Sinarundinaria m. (see Thamnocalamus•spathaceus) *		
Fargesia•nitida., Arundinaria n., Sinarundinaria n., Thamnocalamus•nitida (see Sinarundinaria•nitida) *		
Fargesia•spathacea, Arundinaria s. (see Thamnocalamus•spathaceus) *		
Fuchsia•magellanica *	Fuchsia (Peru, Chile, Argentina)	(H)
Garrya•flavescens *	Yellow Silktassel (e. Cal., w. Az., s. Utah, s. Nev.)	(L)
Garrya•fremontii *	Fremont's Silktassel (w. Wa., Ore., Cal.)	(M+/-)
Garrya•wrightii *	Wright's Silktassel (sw. AZ., s. N. Mex., w. Tex.)	(L)
Gelsemium•sempervirens *	Carolina Yellow Jasmine (s. USA to c. Am.)	(H)
Hesperaloe•parviflora +	Hesperaloe (sw. Texas)	(VL-M)
Iberis•sempervirens	Evergreen Candytuft (Eurasia)	(M-H)
Ilex•aquifolium *	English Holly (Eur., n. Afr., w. Asia)	(H)
Ilex•cornuta *	Chinese Holly (China, Korea)	(H)
Ilex•crenata *	Japanese Holly (Sakhalin Is., Jap., Korea)	(H)
Ilex•opaca *	American Holly (e. USA)	(H)
Ilex•wilsonii *	Wilson's Holly (c., w., e. China, Taiwan)	(M-H)
Ilex•x•meserveae var.	Blue Prince & Blue Princess Hollies etc. (hort. hybrids)	(H)
Jasminum•fruticans *	----- (Medit. Asia Minor)	(L-M)
Kalmia•angustifolia *	Lambkill Kalmia (Hudson Bay to Georgia)	(H)
Kalmia•latifolia *	Mountain Laurel (e. N. Am.)	(H)
Lavandula•angustifolia var.	English Lavender varieties (Medit.)	(VL-M)
Lavandula•stoechas *	Spanish Lavender (c. Spain, ne. Portugal)	(VL-M)
Leucophyllum•minus *	Cenzia, Texas Ranger (Texas, New Mexico)	(L)
Lonicera•nitida *	Boxleaf Honeysuckle (China)	(H)
Lonicera•pileata *	Privet Honeysuckle (China)	(H)

Mahonia•aquifolium +	Oregon Hollygrape (Cascade mtns.)	(M-H)
Mahonia•fremontii +	Fremont Mahonia (sw. USA)	(VL-L)
Mahonia•haematocarpa +	Redberry Mahonia (sw. USA)	(VL-L)
Mahonia•repens +	Creeping Mahonia (Rocky Mtn. West)	(L-H)
Mahonia•trifoliata *+	Three-leaf Mahonia, Algerita (Ariz., N. Mex., Tex., Mex.)	(L)
x•Mahoberberis•miethkeana *	----- (Berberis•julianae•X•Mahonia•aquifolium)	(M+/-)
Nandina•domestica *	Heavenly Bamboo (India to e. China)	(M-H)
Nolina•microcarpa *	Bear Grass (sw. USA)	(L)
Opuntia•imbricata	Cholla (Colo., Kan., Tex., & Mex., to Ariz.)	(VL-L)
Opuntia•polycantha ,etc.	Prickly Pear Cactus species (w. USA, Can., Mex.)	(VL-L)
Osmanthus•americanus *	Devilwood (se. USA)	(H)
Osmanthus•decorus•Baki•Kasapligil' *	----- (Caucasus)	(H)
Osmanthus•heterophyllus *	Holly Osmanthus (Japan, Taiwan)	(H)
Osmanthus•x•burkwoodii *	----- (garden origin)	(H)
Paxistima•canbyi	Eastern Mtn. Lover (e. N. America)	(M+/-)
Paxistima•myrsinites	= Paxistima•myrtifolia	
Paxistima•myrtifolia *	Western Mtn. Lover (B.C. Cal., Mont., Colo., N. Mex.)	(M-H)
Phillyrea•vilmoriniana *	= Osmanthus•decorus	
Photinia•villosa *	Oriental Photinia (Japan, Korea, China)	(H)
Photinia•serrulata *	Chinese Photinia (China)	(H)
Photinia•x•fraseri *	Photinia (hort. hybrid)	(H)
Phyllostachys•aureosulcata *	Yellow-groove Bamboo (ne. China)	(H)
Phyllostachys•nigra *	Black Bamboo (e., c. China)	(H)
Phyllostachys•nuda *	Bamboo (China)	(H)
Pieris•japonica *	Japanese Pieris (Jap., Taiwan, e. China)	(H)
Prunus•laurocerasus•'Schipkaensis' *	Schipkanensis Cherry Laurel (Bulgaria)	(M-H)
Prunus•laurocerasus•'Zabeliana'*	Zabeliana Cherry Laurel (garden origin)	(M-H)
Purshia•mexicana	= Cowania•mexicana	
Purshia•tridentata	Antelope Bitterbrush (Rocky Mtn. West)	(L-M)
Pyracantha•coccinea	Pyracantha (Eurasia)	(M+/-)
Quercus•grisea *	Gray Oak (Tex., N. Mex., Mex., s. Colo.)	(M+/-)
Quercus•turbinella *	Turban Oak (Cal., & n. Baja. Ca.. to w. Tex. & se. Colo.)	(M+/-)
Quercus•vacciniifolia *	Huckleberry Oak (w. US)	(M+/-)
Quercus•virginiana•v. fusiformis *	Texas Shrub Live Oak (Ok., Tex., Mex.)	(L-M)
Rosmarinus•officinalis•'Arp' *	Rosemary 'Arp' (a hardy cultivar from Arp, Texas)	(L-M)
Santolina•chamaecyparissus	Santolina (w. & c. Medit.)	(VL-M)
Santolina•rosmarinifolia	Green Santolina (Portugal to France)	(L-M)
Santolina•viridis	= Santolina•rosmarinifolia	
Sasa•kurilensis *	Kurile Islands Bamboo (Jap. Kor.)	(H)
Sasa•palmata *	Palmate Bamboo (n. Japan)	(H)
Shepherdia•rotundifolia **	Roundleaf Buffaloberry (Az., Utah)	(L-M)
Sinarundinaria•nitida *	Fountain Bamboo (c. China)	(H)
Thamnocalamus•spathaceus *	Umbrella Bamboo (c. China)	(H)
Viburnum•davidii *	David's Viburnum (w. China)	(M-H)

Viburnum•farreri *	Fragrant Viburnum (China)	(M-H)
Viburnum•rhytidophyllum *	Leatherleaf Viburnum (c. & w. China)	(M-H)
Viburnum•x•burkwoodii	Burkwood Viburnum (hort. hybrid)	(M-H)
Viburnum•x•rhytidophylloides•'Mohican'	Mohican Lantanaphyllum Viburnum (garden origin)	(M-H)
Yucca•baccata +	Banana Yucca (Colo. Plateau)	(VL-L)
Yucca•elata +	Soaptree Yucca (Az., N. Mex., Mex.)	(VL-L)
Yucca•glauca +	Front Range Yucca (w. Great Plains)	(VL-L)
Yucca•harrimaniae +	Harriman Yucca (Colo. Plateau)	(VL-L)

VINES

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

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HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Akebia•quinata *	Five-leaf Akebia (Japan, Korea, China)	(M-H)
Akebia•trifoliata *	Three-leaf Akebia (c. China, Jap.)	(M-H)
Akebia•x•pentaphylla *	(A. quinata x A. trifoliata) (Japan)	(M-H)
Ampelopsis•aconitifolia *	Monkshood Vine (n. China, Mong.)	(M+/-)
Ampelopsis•brevipedunculata *	Porcelain Vine (China, Jap., Korea)	(M+/-)
Ampelopsis•delavayana *	----- (w. China)	(M+/-)
Ampelopsis•humulifolia *	----- (n.China)	(M+/-)
Ampelopsis•megalophylla *	----- (w. China)	(M+/-)
Aristolochia•durior *	= Aristolochia•macrophylla	
Aristolochia•macrophylla *	Dutchman's Pipe (Appalachian Mts.)	(M-H)
Campsis•grandiflora *	Chinese Trumpet Creeper (Jap., China)	(M-H)
Campsis•radicans +	Trumpet Creeper (e. USA)	(M-H)
Celastrus•loeseneri *	Loeserner Bittersweet (c. China)	(M-H)
Celastrus•orbiculatus *	Oriental Bittersweet (ne. Asia)	(M-H)
Celastrus•scandens	Bittersweet (e. N. America)	(M-H)
Clematis (hort. varieties & hybrids)	----- (hort. hybrids & varieties)	(M-H)
Clematis•alpina *	----- (Eurasia)	(M-H)
Clematis•brevicaudata *	----- (Jap., China., w. Mong.)	(M+/-)
Clematis•chrysocoma *	----- (sw. China)	(M+/-)
Clematis•crispa *	Curly Clematis (se. USA)	(H)
Clematis•fargesii *	----- (China)	(M+/-)
Clematis•flammula	----- (s. Eur., to Turkestan)	(M+/-)
Clematis•grata *	----- (China, Himalaya)	(M+/-)
Clematis•ligusticifolia	Western Virgin's Bower (Man. to B.C., Mo., to Calif.)	(M+/-)
Clematis•macropetala *	----- (Siberia, n. China, Mongolia)	(M+/-)
Clematis•maximowicziana	= Clematis•terniflora	
Clematis•montana var. *	----- (Afghanistan. to sw. & c. China, Himalaya)	(M+/-)
Clematis•paniculata *	New Zealand Clematis (New Zealand)	(H)
Clematis•paniculata	= Clematis•terniflora	
Clematis•rehderiana *	Rehder's Clematis (w. China)	(M+/-)
Clematis•tangutica	Golden Lantern Clematis (Mongolia, nw. China)	(M+/-)
Clematis•terniflora	Sweet Autumn Clematis (Korea, China, Japan)	(M+/-)
Clematis•texensis *	Texas Clematis (sw. USA)	(M+/-)
Clematis•tibetana *	----- (Tibet, China, n. India)	(M+/-)
Clematis•vernayi (now C. tibetiana)		
Clematis•viorna *	Leather Flower (s. N. Am.)	(M-H)

Clematis•vitalba *	Traveller's Joy (Eur., Cauc., c. Asia, n. Afr.)	(M+/-)
Clematis•viticella *	----- (s. Europe, w. Asia)	(M+/-)
Dicentra•scandens *	----- (Nepal, to se. China)	(M+/-)
Euonymus•fortunei var.	Wintercreeper varieties (China)	(M-H)
Hedera•colchica *	Persian Ivy (Cauc., Turkey)	(M+/-)
Humulus•americanus	= Humulus•lupulus	
Humulus•lupulus	Hop Vine (n. Temperate regions worldwide)	(M+/-)
Hydrangea•anomala *	Climbing Hydrangea (Himalaya, China)	(H)
Hydrangea•anomala•ssp. •petiolaris*	= Hydrangea•petiolaris	
Hydrangea•petiolaris *	Climbing Hydrangea (Japan, China, Korea, Taiwan)	(H)
Jasminum•beesianum *	----- (China)	(M+/-)
Lathyrus•latifolius	Perennial Sweetpea (c. & e. Europe)	(M+/-)
Lonicera•alesuosmoides *	Evergreen Honeysuckle (w. China)	(M+/-)
Lonicera•caprifolium *	Italian Honeysuckle (Eur., s. Asia)	(M+/-)
Lonicera•flava *	Yellow Honeysuckle (se. USA)	(H)
Lonicera•henryi *	----- (w. China)	(M+/-)
Lonicera•japonica•'Halliana'	Hall's Honeysuckle (e. Asia)	(M-H)
Lonicera•periclymenum	Woodbine Honeysuckle (Eur., w. Asia)	(M+/-)
Lonicera•periclymenum•Graham•Thomas'	Graham Thomas Honeysuckle (hort. cultivar)	(M+/-)
Lonicera•prolifera *	Grape Honeysuckle (c. USA)	(M+/-)
Lonicera•sempervirens	Scarlet Trumpet Honeysuckle (e. & s. USA)	(M-H)
Lonicera•sempervirens•'Alabama•Crimson'	-----	(M-H)
Lonicera•sempervirens•'Sulphurea	-----	(M-H)
Lonicera•tragophylla *	Chinese Woodbine (w. China)	(M+/-)
Lonicera•x•brownii•'Dropmore•Scarlet' (L.s. x L. brownii)		(M+/-)
Lonicera•x•heckrottii	Heckrottii Honeysuckle (hort. hybrid)	(M-H)
Lycium•halimifolium *	Common Matrimony Vine (se. Europe, w. Asia)	(M+/-)
Mennispermum•canadense *	Moonseed Vine (e. N. America)	(M-H)
Parthenocissus•quinquefolia	Virginia Creeper (e. N. America to Rocky Mtns.)	(M-H)
Parthenocissus•tricuspidata	Boston Ivy (Japan, c. China)	(M-H)
Passiflora•incarnata *	Passion Flower (c. USA)	(H)
Polygonum•aubertii	Silver Lace Vine (w. China, Tibet, Tajikistan)	(M+/-)
Polygonum•baldschuanicum *	Buchara Fleeceflower (c. Asia, Tajikistan)	(M+/-)
Schisandra•chinensis *	Magnolia Vine (China)	(H)
Schizophragma•hydrangeoides *	Hydrangea Vine (Japan, Korea)	(M-H)
Smilax•rotundifolia *	Common Greenbriar (e. USA)	(H)
Tripterygium•regelii *	Regel's Tripterygium (Manchuria, Japan, Korea)	(M-H)
Vitis•amurensis *	Amur Grape (Manchuria)	(M+/-)
Vitis•arizonica	Arizona Grape (w. Tex.- Cal. & Mex.)	(M+/-)
Vitis•coignetiae *	Gloryvine (Japan, Korea)	(M+/-)
Vitis•riparia	Riverbank Grape (Nov. Sc. - Man., Tenn. & Tex. - Rocky Mts.)	(M-H)

Vitis•vinifera•varieties *	Eurasian Grape varieties (Eur., A. Minor, Cauc. Turkestan)	(M+/-)
Wisteria•floribunda *	Japanese Wisteria (Japan)	(M-H)
Wisteria•macrostachys *	Kentucky Wisteria (c. USA)	(H)
Wisteria•sinensis *	Chinese Wisteria (China)	(M-H)

GROUND COVERS (Including turf & meadow grasses)

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.
Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Achillea•ageratifolia	Grecian Yarrow (Greece)	(L-M)
Achillea•serbica	Serbian Yarrow (Balkans)	(L-M)
Aegopodium•podagraria	Bishop's Weed (Europe)	(H)
Ajuga•reptans	Ajuga (Eur., Persia, Transcaucasia.)	(H)
Akebia•quinata *	Five-leaf Akebia (Jap., Korea, China)	(M-H)
Andropogon•scoparius	Little Blue Stem (syn. Schizachyrium•scoparium)	(L-M+/-)
Anemopsis•californica *	Yerba Mansa (sw. USA, Mex.)	(M-H)
Antennaria•parvifolia	Pussytoes (G. Plains, w. to B.C., Wash., Ariz.)	(M+/-)
Antennaria•rosea	Pussytoes (Alaska to Cal. & N. Mex.)	(M+/-)
Arabis•alpina *	Alpine Rock-cress (Europe, Siberia)	(M+/-)
Arctostaphylos•uva-ursi	Kinnikinnick (circumpolar)	(M+/-)
Arenaria•balearica *	Corsican Sandwort (Balearic Is. & Corsica)	(M+/-)
Aronia•melanocarpa	Chokeberry (e. N. Am.)	(M-H)
Asperula•odorata	= Galium•odoratum	
Astroturfoides•ultradeceptiverous	Astro Turf (Houston, Texas)	(L+M/-)
Aurinia•saxatilis	Basket-of-gold (c. & se. Europe)	(L-M)
Bouteloua•gracilis	Blue grama (N. America)	(L+/-)
Buchloë•dactyloides	Buffalograss (Great Plains)	(L)
Campanula•poscharskyana	Poscharsky Bellflower (Dalmatia)	(M-H)
Cerastium•tomentosum	Snow-in-summer (Eur. to w. Asia)	(L-M)
Ceratostigma•plumbaginoides	Plumbago (w. China)	(M+/-)
Convallaria•majalis	Lily-of-the-valley (Eurasia, e. N. America)	(M-H)
Cotoneaster•apiculatus *	Cranberry Cotoneaster (China)	(M+/-)
Cotoneaster•dammeri *	Creeping Cotoneaster (China)	(M+/-)
Cotoneaster•microphyllus *	Littleleaf Cotoneaster (Mts. Afghan., China)	(L-M)
Delosperma•cooperi	Hardy Pink Ice Plant (s. Africa)	(M+/-)
Delosperma•nubigenum	Hardy Yellow Ice Plant (s. Africa)	(M+/-)
Duchesnea•indica	Mock Strawberry (Korea, Jap., to India)	(M-H)
Epimedium•alpinum *	Alpine Epimedium (s. & c. Europe)	(M-H)
Epimedium•grandiflorum *	Longspur Epimedium (n. Japan, Korea, s. Manch.)	(M-H)
Euonymus•fortunei•'Coloratus'	Purpleleaf Wintercreeper (hort. cult.)	(M+/-)

Euonymus•obovatus *	Running Euonymus (e. USA)	(H)
Festuca•elatior•cvs.	Turf-type Tall Fescue (Eur., Siberia)	(M+/-)
Galium•odoratum	Sweet Woodruff (Eurasia)	(M-H)
Genista•pilosa *	Dwarf Broom (Europe)	(M+/-)
Geranium•spp.	Hardy Geraniums	(M+/-)
Hosta•spp.	Host species (Jap., China, Korea)	(H)
Juniperus•spp. & cultivars +	Juniper species and cultivars	(L-M)
Lamium•maculatum	Spotted Deadnettle, Lamium (Eur., n. Afr., w. Asia)	(M-H)
Lathyrus•latifolius	Perennial Sweetpea (c. & e. Europe)	(M-H)
Lonicera•japonica•'Halliana'	Hall's Honeysuckle (e. Asia)	(M+/-)
Lonicera•sempervirens	Scarlet Trumpet Honeysuckle (e. & s. N. America)	(M-H)
Lonicera•x•heckrottii	Heckrottii Honeysuckle (hort. hybrid)	(M+/-)
Lysimachia•nummularia	Moneywort (Europe)	(H)
Mahonia•repens	Creeping Mahonia (Rocky Mtn. West)	(L-M-H)
Mazus•reptans *	----- (Himalayas)	(M-H)
Marrubium•rotundifolium	----- (Asia Minor)	(L-M)
Poa•pratensis	Kentucky Bluegrass (Eurasia, n. Africa)	(H)
Osteospermum•berberae	South African Daisy (S. Africa)	(M+/-)
Pachysandra•terminalis	Pachysandra (Japan, nc. China)	(M-H)
Parthenocissus•quinquefolia	Virginia Creeper (e. N. America to Rocky Mts.)	(M-H)
Phlox•stolonifera	Creeping Phlox (se. USA)	(M+/-)
Phlox•subulata	Moss Phlox (Penn. to Ga.)	(M+/-)
Polygonum•affine•'Border•Jewel'	Himalayan Border Jewel (Himalayas)	(M-H)
Polygonum•japonicum•var. •compactum	Fleece Flower (e. Asia)	(M-H)
Polygonum•reynoutria	= Polygonum•japonicum•var. •compactum	
Potentilla•nevadensis	----- (Spain)	(L-M)
Potentilla•verna•'Nana'	Creeping Potentilla (hort. cult.)	(M-H)
Rhus•trilobata	Three-leaf Sumac (w. N. Am.)	(L-M)
Saponaria•ocymoides	Saponaria (mtns. sw. & sc. Europe)	(M+/-)
Schizachyrium•scoparium	= Andropogon•scoparius	
Symphoricarpos•x•chenaultii•'Hancock'	Hancock Coralberry (hort. cult.)	(M+/-)
Teucrium•chamaedrys	Germander (c. & s. Europe, w. Asia)	(M+/-)
Thymus•spp.	Thyme species (Eurasia, N. Africa)	(L-M)
Waldsteinia•fragarioides	Barren Strawberry (e. USA)	(H)

Veronica•liwanensis	Turkish Veronica (ne. Anatolia, Cauc.)	(M-H)
Veronica•pectinata	Woolly Veronica (e. Balkans, A. Minor)	(L-M)
Vinca•major	----- (Italy, Balk.)	(M-H)
Vinca•minor	Vinca (Europe , w. Asia)	(H)

SELECTED PERENNIALS

[Revised April '03]

WATER NEEDS OF PLANTS

The following chart shows how to group plants based on their water needs.

Reference Location: Denver. Numbers illustrate typical conditions.

* = Plants with potential, but requiring caution due to limited history in Rocky Mountain landscaping.

HIGH WATER	MODERATE WATER	LOW WATER	VERY LOW WATER
Reference plant: Bluegrass turf (Always wet at surface)	Reference plant: Turf-type Tall Fescue (Half of Bluegrass turf)	Reference plant: Buffalograss turf (Like Denver without irrigation)	Reference plant: Too dry for any turf (drier than Denver)
18-20 gals./S.F./season July: 5" -- 3 times per week	10 gals./S.F./season .75" -- once per week	0-3 gals./S.F./season .5" per 2 weeks, optional	No irrigation No irrigation

Achillea x 'Coronation Gold'	Coronation Gold Yarrow	(VL)
Achillea x 'Moonshine'	Moonshine Yarrow	(VL-L-M)
Aesclepias•tuberosa	Butterfly Weed	M-H
Agastache cana	Double Bubble Mint	(M+/-)
Alchemilla•vulgaris	Lady's Mantle	M-H
Anthemis•tinctoria	Golden Marguerite	M-H
Aquilegia•spp.	Columbines	H
Arum•italicum	Italian Arum	M-H
Aster porteri	Porter's Aster	(VL-L)
Aster•novae-angliae	New England Aster	M-H
Aster•x•frikartii	Frikart's Aster	M-H
Aurinia saxatilis	Basket-of-gold	(L-M)
Baptisia•australis	Baptisia	M-H
Berlandiera lyrata	Chocolate Flower	(VL-L)
Boltonia•asteroides	Boltonia	H
Borago•laxiflora	Borage	M-H
Callirhoe involucrata	Poppy Mallow	(L-M)
Centranthus ruber	Centranthus	(L-M-H)
Cerastium tomentosum	Snow-in-summer	(L-M)
Chrysanthemum•x•morifolium	Chrysanthemums	H
Chrysanthemum•x•superbum	Shasta Daisy	M-H
Convallaria•majalis	Lily-of-the-valley	H
Crocsmia•x•crocsmiiflora	Crocsmia	H
Crocus spp. *	Crocus species	(L-M)
Datura meteloides	Sacred Datura	L-M
Delosperma cooperi	Hardy Pink Ice Plant	(M+/-)
Delphinium•x•elatum	Hybrid Delphiniums	H
Dianthus•spp.	Various Dianthus	L-M
Dicentra•eximia	Bleeding Heart	H
Dictamnus•albus	Gas Plant	L-M
Digitalis•purpurea	Common Foxglove	H
Echinacea•purpurea	Echinacea	M+/-
Echinops•ritro	Globe Thistle	H
Eremurus•spp.	Foxtail Lily	L-M
Eryngium•spp.	Sea Holly	L-M
Gaillardia aristata	Native Gaillardia	(L-M)
Geranium•spp.	Hardy Geraniums	M-H
Helianthemum•spp.	Sun-roses	M+/-
Helianthus maximiliani	Maximilian Sunflower	(M+/-)

Helianthus•spp.	Sunflowers	M+/-
Helleborus•spp.	Hellebores	M-H
Hemerocallis•spp.	Daylilies	M-H
Hosta•spp.	Hostas	H
Iberis•sempervirens	Candytuft	M+/-
Incarvillea•delavayii	Hardy Gloxinia	M+/-
Iris bucharica	Buchara Iris	(M+/-)
Iris germanica cvs..	Bearded Iris varieties	(L-M)
Kniphofia•spp.	Poker Plants	M-H
Lavandula spp.	Various Lavenders	(VL-M)
Liatris punctata	Dotted Gay Feather	(VL-L)
Liatris•punctata	Dryland Gayfeather	VL-L
Liatris•spicata	Wetland Gayfeather	H
Limonium•spp.	Sea Lavenders	L-M
Linum•perenne	Blue Flax	L-H
Lobelia•cardinalis	Cardinal Flower	H
Lobelia•syphilitica	Great Blue Lobelia	H
Lychnis•coronaria	Rose Campion	L-H
Malva•alcea	Hollyhocks	M+/-
Mirabilis multiflora	Native Four O'clock	(VL-L-M)
Monarda•spp.	Monardas	M-H
Narcissus spp.	Daffodils	(L-M)
Nepeta x faassenii	Faassen's Catnip	(L-M)
Paeonia•spp.	Peonies	M+/-
Papaver•orientale	Oriental Poppies	M-H
Penstemon pinifolius	Pineleaf Penstemon	(L-M)
Penstemon strictus	Rocky Mountain Penstemon	(L-M)
Perovskia atriplicifolia	Russian Sage	(VL-L)
Phlomis russeliana	Russel Phlomis	(M+/-)
Phlox subulata	Moss Phlox	(M+/-)
Phlox•paniculata	Garden Phlox	H
Platycodon•grandiflorus	Platycodon	H
Primula•spp.	Primroses	H
Ruta•graveolens	Rue	M+/-
Salvia azurea var. grandiflora	Pitcher Sage	(L-M)
Salvia officinalis	Cooking Sage	(L-M)
Salvia•spp.	Salvias	M+/-
Santolina chamaecyparissus	Santolina	(VL-M)
Saponaria ocymoides	Soapwort	(L-M-H)
Saponaria•ocymoides	Rock Soapwort	M+/-
Scabiosa ochroleuca	Yellow Pincushion Flower	(L-M)
Scabiosa•ochroleuca	Yellow Scabiosa	L-H
Secum•spp.	Sedums	M+/-
Silene laciniata	Mexican Campion	(M+/-)
Tanacetum niveum	Silver Tansy	(L-M)
Verbascum•chaxii	Nettle-leaf Mullein	M+/-
Zauschneria arizonica	Arizona Zauschneria	(L-M)
Zinnia grandiflora	Prairie Zinnia	(VL-L)

WaterWise Landscaping
Best Practices

Section 4 – Natural Areas and Native Plants

A. Proactive Multi-Purpose Drainage Design

1. Introducing the Opportunity

The Front Range prairie is frequently characterized as a rolling grassy landscape folded into meandering wooded drainages. The natural processes that developed this landscape can support the erosion control goals of the drainage design while providing enhanced recreational open space and habitat value. Proactively planned multipurpose drainage design can deliver these goals while saving installation costs and maintenance effort by working with the natural processes.

2. Natural Landscape and Generative Processes

Expanding Front Range developments are covering upland prairies with homes and roads, but the regional landscape can still be seen in the natural drainages. The fundamental character of these drainage areas is defined by the distribution of the thickets of woody species. Wild Plum, Chokecherry, Golden Currant, Snowberry, Sandbar willow and Three-leaf sumac are scattered along the native drainages among occasional towering Plains cottonwoods and the smaller Peach-leaved willows. These species generally occupy the sub-irrigated zones intermediate between the moist central channel areas and the drier upland grasslands.

The natural processes by which woody vegetation expands into upland drainages depend upon a connection to the larger riparian systems below. (Remember: nature abhors a vacuum.) A shallow, young grassy drainage will eventually develop into a deeper, wooded channel. In natural systems normal precipitation cycles coupled with disturbance (grazing, fire, or drought), eventually will lead to erosion and deposition along the grassy channels. In development areas the process is accelerated by the installation of roads or trails, pipelines, and drainage features. Any action that weakens a grassland root system can provide an opening for change.

Seeds of woody species use either wind or wildlife to relocate into disturbed areas in drainages. Native deciduous trees such as the Plain cottonwood and Peach-leaved willow and the smaller Sandbar willows release seeds on the spring winds. When a newly exposed moist soil deposit occurs within a few miles of a well-vegetated river, stream or irrigation ditch, a few seeds from these species will blow into to the site. Once a tree has taken root, it will attract birds as well as raccoons, fox, coyote, and skunks. All these animals follow the drainages in their search for food. They eat the plums, chokecherries, currants, snowberries, hawthorns, sumac or any other wild fruits. As they travel, they rest in and under small trees. Seeds are dropped in these locations as the animals move

on. Droppings from animals are concentrated near existing trees. The shade and leaf litter beneath the trees provide a moist protected site favorable for establishment.

3. Choices

Engineers design channels for expected run off from the new paved surfaces (roofs and pavement) and existing or proposed vegetation. When a natural channel contains a well-developed woody plant community, the plans may accommodate the existing vegetation conditions, allowing the woody vegetation to remain. Woody vegetation supports to goals of the drainage program by decreasing peak flows, slowing flow rates, protecting slopes channel edges from excess erosion.

New developments, lacking historic drainage channels, must make decisions related to the establishment of woody vegetation. In a short time, windblown woody species will find suitable sites in new drainages. Heavier seeded plants will eventually follow. If plans do not create channels with adequate flow capacity for the natural process of woody plant establishment, they will predetermine a maintenance program including expensive woody vegetation control. The erosion control and recreational benefits possible from woody vegetation will be diminished in the battle to prevent the inevitable. Channels can be sized to accommodate woody vegetation to improve slope stabilization. If this is done well, the maintenance program will be able to allow the natural process of woody vegetation development to occur. This requires an approach acknowledging and working with the natural processes typical of these riparian corridors.

4. Cost effectiveness

Proactive, multipurpose drainage design is more cost effective than rigorous maintenance designed to remove all woody vegetation. The woody vegetation serves the underlying purpose of slope stability and erosion control, becoming an ally to the drainage program, instead of a problem. Installation costs of woody vegetation become part of the erosion control program. Costly maintenance aimed at prevention or removal of woody vegetation is no longer necessary. Mowing requirements may mostly be eliminated as perennial vegetation becomes well established. Multipurpose corridors can become more diverse, improving in habitat and passive recreational value, overtime.

5. Lower water usage

In the interest of developing a more water efficient landscape, multipurpose designed drainages within a development can provide a cool, shady wooded retreat area without requiring installation and maintenance of a supporting irrigation system. Properly selected and placed native woody species can be largely selfsufficient once installed.

6. Urban Drainage and Flood Control Support

UDFCD encourages the natural channel concept in drainage design (V. 1, MD-3-9). "Open channel planning and design objectives are often best met by using natural-like vegetated channels". Guidance for planning and execution of this concept is included within the Drainage Criteria manual (V. 2.) revegetation section. Native seed mixtures for a variety of soil types as well as recommended uses and installation methods for trees and shrubs within drainage designs, are included.

7. Success

During the spring of the drought year of 2002, a number of drainage improvement projects were installed. Native woody plantings of trees and shrubs were successfully established in spite of limited or no irrigation. Marcy Gulch at Highlands Ranch, Niver Creek in Thornton, Cottonwood Creek in Greenwood Village, and Lilly Gulch in Littleton were successfully established in spite of many days of unseasonably hot dry conditions.

B. Native Seed Mixes

1. Colorado Native Seed Mix Summary

- a. Short Grass Prairie (grasses & wildflowers)
- b. Mixed Grass Prairie (grasses & wildflowers)
- c. Tall Grass Prairie (grasses & wildflowers)
- d. Moist or Wetland Soils (grasses & wildflowers)
- e. Sandy Loam Soils (grasses & wildflowers)
- f. Clay Loam Soils (grasses & wildflowers)
- g. Select Shrubs and Trees for natural areas

The complete Native Seed lists are provided on the following pages.



Shortgrass prairie species Easter daisy/Townsendia grandiflorus



Heavily grazed native shortgrass prairie

Table 1. Native shortgrass mixture for loam to clay loam dry upland sites. Some taller species included. Fall broadcast seed, rake or harrow to cover 1/10 to 1/3 inch, mulch recommended.

COMMON NAME	SCIENTIFIC NAME	VARIETY	MATURE HEIGHT	SEEDS/LB	PLS LBS/ACRE	SUGGESTIONS
GRASSES AND GRASS-LIKE PLANTS						
Buffalograss	<i>Buchloe dactyloides</i>	Sharp's	4-6"	56000	6.5	
Sideoats grama	<i>Bouteloua curtipendula</i>	Butte	18"	191000	3.0	
Blue grama	<i>Chondrosum gracile</i>	Hachita	6-8"	825000	8.0	
Western wheatgrass	<i>Pascopyrum smithii</i>	Barton	18"	110000	4.0	
Sand dropseed	<i>Sporobolus cryptandrus</i>	Native	18"	5,200,000	2.0	
TOTAL POUNDS/ACRE					23.5	
						1 acre=43560 square feet. Divide this per acre seed quantity by 20 to 40 for each to 1000 square feet to be seeded.
ADAPTED NATIVE WILDFLOWERS					OUNCES /ACRE	Double wildflower seeding rate for more color.
Purple prairieclover	<i>Dalea purpurea</i>		12"	210000	3.0	
Blanket flower	<i>Gaillardia aristata</i>		12-18"	132000	4.0	
Golden aster	<i>Heterotheca villosa</i>		6-8"	920000	2.0	
Gayfeather	<i>Liatris punctata</i>		12-18"	138000	4.0	
Flax	<i>Linum lewisii</i>		18"	293000	2.0	
Bluemist penstemon	<i>Penstemon virens</i>		8"	850000	3.0	
Sidebells penstemon	<i>Penstemon secundiflorus</i>		18"	610000	2.0	
Scarlet globemallow	<i>Sphaeralcea coccinea</i>		6-8"	500000	3.0	
Easter daisy	<i>Townsendia grandiflora</i>		6-8"	1200000	0.5	
TOTAL OUNCES/ACRE					23.5	
AV - Arkansas Valley Seed 303-665-6642, WNS - Western Native Seed 719-942-3935. Prepared by The Restoration Group, Inc. 5/03.						

Shortgrass Prairie

This vegetation type is typical of high plains areas with 10- 16 inches on annual precipitation. In native areas shallow soil depth, clay soil, low precipitation, alkaline conditions, heavy grazing or compaction all may contribute to a



Prairie coneflower/*Ratibida columnifera* in restored mixed grass prairie



Restored mixed grass prairie with wildflowers.

Table 2. Native mixed grass for sandy loam, loam, clay loam upland sites. Fall broadcast seed, rake or harrow to cover 1/10 to 1/3 inch, mulch recommended.

COMMON NAME	SCIENTIFIC NAME	VARIETY	MATURE HEIGHT	SEEDS/LB	PLS LBS/ACRE	SUGGESTIONS
GRASSES AND GRASS-LIKE PLANTS						
Sideoats Grama	<i>Bouteloua curtipendula</i>	Butte	18"	191000	4.8	
Buffalograss	<i>Buchloe dactyloides</i>	Texoca	4-6"	56000	5.0	
Blue Grama	<i>Chondrosium gracile</i>	Hachita	6-8"	825000	4.5	
Switchgrass	<i>Panicum virgatum</i>	Blackwell	24-36"	389000	2.0	
Western wheatgrass	<i>Pascopyrum smithii</i>	Ariba	18"	110000	3.0	
Little bluestem	<i>Schyzachrium scoparium</i>	Pastura	18-24"	260000	2.0	
Sand dropseed	<i>Sporobolus cryptandrus</i>	native	18"	5,200,000	0.5	
Green needlegrass	<i>Stipa viridula</i>	native	24"		1.5	
TOTAL POUNDS PLS/ACRE					23.3	
						1 acre=43560 square feet. Divide this per acre seed quantity by 20 to 40 for each to 1000 square feet to be seeded.
ADAPTED NATIVE WILDFLOWERS						
					OUNCES /ACRE	Double wildflower seeding rate for more color.
Smooth aster	<i>Aster laevis</i>				2.0	
Purple prairieclover	<i>Dalea purpurea</i>			210000	3.0	
Blanket flower	<i>Gaillardia aristata</i>			132000	6.0	
Golden aster	<i>Heterotheca villosa</i>				2.0	
Gayfeather	<i>Liatris punctata</i>			138000	4.0	
Flax	<i>Linum lewisii</i>			293000	2.0	
Penstemon	<i>Penstemon angustifolia</i>		24"	590000	2.0	
Prairie coneflower	<i>Ratibida columnifera</i>			1230000	2.0	
TOTAL OUNCES/ACRE					23.0	
*AV - Arkansas Valley Seed 303-665-6642, WNS - Western Native Seed 719-942-3935. Prepared by The Restoration Group, Inc. 5/03.						

Mixed grass midgrass Prairie

Native areas with richer clay-loam to loamy soil, 14-18 inches of precipitation, and less grazing impact may exhibit the taller grasses typical of mixed grass prairie. Restored mixed grass prairie is possible on sites withg



Purple prairie clover/*Dalea purpurea* in restored tallgrass prairie. Grasses will later become 36" or more in height.

Table 3. Native tallgrass mixture for north and east facing sites, low areas. Fall broadcast seed, rake or harrow to cover 1/10 to 1/3 inch, mulch recommended.

COMMONNAME	SCIENTIFIC NAME	VARIETY	MATURE HEIGHT	SEEDS/LB	TOTAL LBS PLS/ACRE	SUGGESTIONS
GRASSES AND GRASS-LIKE PLANTS						
Big bluestem	<i>Andropogon gerardi</i>	Pawnee	3-4'	130,000	1.5	
Sideoats grama	<i>Bouteloua curtipendula</i>	Butte	18"	191000	2.8	
Blue grama	<i>Chondrosum gracile</i>	Hachita	6-8"	825000	3.5	
Switchgrass	<i>Panicum virgatum</i>	Blackwell	36"	389000	3.0	
Western wheatgrass	<i>Pascopyrum smithii</i>	Ariba	18"	110000	6.0	
Little bluestem	<i>Schizachyrium scoparium</i>	Pastura	24"	26000	3.4	
Yellow Indiangrass	<i>Sorghastrum avenaceum</i>	Holt	3-4'	170000	2.1	
TOTAL POUNDSPLS/ACRE					22.3	
						1 acre=43560 square feet. Divide this per acre seed quantity by 20 to 40 for each to 1000 square feet to be seeded.
ADAPTED NATIVE WILDFLOWERS					OUNCES /ACRE	Double wildflower seeding rate for more color.
Showy milkweed	<i>Asclepias speciosa</i>	native				
Blue aster	<i>Aster laevis</i>	native	18"		2.0	
Blanket flower	<i>Gaillardia aristata</i>	native	12-18"	132000	2.0	
Prairie coneflower	<i>Ratibida columnifera</i>	native	18-24"	1230000	4.0	
Purple prairieclover	<i>Dalea (Petalostemum) purpurea</i>	native	12"	210000	4.0	
Flax	<i>Linum lewisii</i>	native	18"	293000	3.0	
Penstemon	<i>Penstemon strictus</i>	native	24"	590000	4.0	
TOTAL OUNCES/ACRE					19.0	

*AV - Arkansas Valley Seed 303-665-6642, WNS - Western Native Seed 719-942-3935. Prepared by The Restoration Group, Inc. 5/03.

Tallgrass seed mixture

The taller grasses are limited to areas of higher precipitation 16-18 inches along the foothills and moist bottomlands near streams. Rocky soils may contribute to greater moisture availability and the presence of remnant tallgrass



Scarlet globemallow/*Sphaeralcea coccinea* and Western wheatgrass/*Agropyron smithii* in mixed grass prairie remnant along Coal Creek in Erie.



Restored shortgrass prairie with Sidebells penstemon/*Penstemon secundiflorus*.

Table 5. Recommended native sand prairie for sandy to sandy loam soil. Fall broadcast seed, rake or harrow to cover 1/10 to 1/3 inch, mulch recommended.

COMMON NAME	SCIENTIFIC NAME	VARIETY	MATURE HEIGHT	SEEDS/LB	TOTAL PLS /ACRE	SUGGESTIONS
GRASSES AND GRASS-LIKE PLANTS						
Sand bluestem	<i>Andropogon hallii</i>	Garden	36"	113300	2.0	
Sideoats grama	<i>Bouteloua curtipendula</i>	Butte	18"	191000	3.2	
Prairie sandreed	<i>Calamovilfa longifolia</i>	Goshen	24-36"	273000	2.1	
Blue grama	<i>Chondrosium gracile</i>	Hachita	6-8"	825000	2.5	
Switchgrass	<i>Panicum virgatum</i>	Blackwell	36"	389000	2.0	
Western wheatgrass	<i>Pascopyrum smithii</i>	Arriba	18-24"	110000	6.5	
Little bluestem	<i>Schizachyrium scoparium</i>	Pastura	24"	26000	3.0	
Sand dropseed	<i>Sporobolus cryptandrus</i>		18"	1758000	0.5	
TOTAL POUNDS/ACRE					21.8	
						1 acre = 43560 square feet. Divide this per acre seed quantity by 20 to 40 for each 1000 square feet to be seeded.
ADAPTED NATIVE WILDFLOWERS					TOTAL OZ/ACRE	Double wildflower seeding rate for more color.
Blue aster	<i>Aster laevis</i>		18"		2.0	
Blanket flower	<i>Gaillardia aristata</i>		12-18"	132000	6.0	
Prairie coneflower	<i>Ratibida columnifera</i>		24"	1230000	3.0	
Purple prairieclover	<i>Dalea (Petalostemum) purpurea</i>		12"	210000	3.0	
Flax	<i>Linum lewisii</i>		18"	293000	4.0	
Penstemon	<i>Penstemon strictus</i>		18-24"	592000	4.0	
TOTAL OUNCES/ACRE					22.0	
* AV - Arkansas Valley Seed 303-665-6642, WNS - Western Native Seed 719-942-3935. Prepared by The Restoration Group, Inc. 5/03.						

Sandy loam seed mixture

Isolated areas of sandy soil are better suited to these deep rooted species. Some native shrubs such as Yucca/Yucca glauca, Rabbitbrush/Chrysothamnus nauseosus, and Sand sagebrush/Artemisia filifolia are well suited to these areas



Needle-and-threadgrass/*Stipa comata* with Blanketflower/*Gaillardia aristata* in mixedgrass prairie.

Table 6. Native seed mixture for use on clay loam soils. Application rate on clean seed bed 1/2-1 pound PLS/1000 sq. ft. Fall broadcast seed, rake or harrow to cover 1/10 to 1/3 inch, mulch recommended.

[illegible]



Native woody shrubs and trees stabilize stream channel in Front range open space area. Shade, habitat, and passive recreational value area also enhanced. No irrigation water is required for this amenity.

Table 7. Native shrub and tree species adapted to the Front Range high plains area. Little or no water is required for these species if properly located on landscape. Useful for erosion control, shade, and habitat improvement in drainages.

COMMON NAME	SCIENTIFIC NAME	VARIETY	MATURE HEIGHT	SEEDS/LB	PLS LBS/ACRE	LOCATION
NATIVE WOODY VEGETATION						
Rabbitbrush	<i>Chrysothamnus nauseosus</i>	Native	2-4'			Upland areas, establishment watering. Use smaller plants or seed for best results.
Plains Cottonwood	<i>Populus sargentii</i>	Native	45-60'			Naturally subirrigated lowlands, moist areas, open space drainages. Plant rootball 2-4' into saturated soil, monthly deep watering if planted in upland areas.
Chokecherry	<i>Padus virginiana</i>	Native	10-12'			Naturally subirrigated lowlands, shady sites, northfacing slopes, open space drainages. Deep water once a month in upland areas.
Wild plum	<i>Prunus americana</i>	Native	6-8'			Naturally subirrigated lowlands, shady sites, northfacing slopes, open space drainages. Deep water once a month in upland areas.
Golden current	<i>Ribes aureum</i>	Native	3-4'			Naturally subirrigated lowlands, shady sites, northfacing slopes, open space drainages. Deep water once a month in upland areas.
Three-leaf sumac	<i>Rhus trilobata</i>	Native	4-8'			Upland areas, water monthly 1 year to establish
Peachleaf willow	<i>Salix amygdaloides</i>	Native	15-35'			Naturally subirrigated lowlands, moist areas, open space drainages.
Sandbar willow	<i>Salix exigua</i>	Native	5-6'			Naturally subirrigated lowlands, moist areas, open space drainages.
Snowberry	<i>Symphoricarpos occidentalis</i>	Native	2'			Naturally subirrigated lowlands, shady sites, northfacing slopes, open space drainages.
Yucca	<i>Yucca glauca</i>	Native	2'			Upland areas, water 1 year to establish
TOTAL POUNDS PLS/ACRE					0	
WaterWise Landscaping						
* AV - Arkansas Valley Seed 303-665-6642, WNS - Western Native Seed 719-942-3935. Prepared by The Restoration Group, Inc. 5/03.						

Woody plants

Most native woody vegetation are adapted to drainages and sites with elevated moisture, such as springs or north-facing slopes. These species provide critical habitat for wildlife, shade and diversity, and erosion control in drainage areas.

Best Practices

Section 4 – Natural Areas and Native Plants

C. Plants to Avoid – The 2003 State Noxious Weed List

The following noxious weed listings have been excerpted from the Rules and Regulations Pertaining to the Administration and Enforcement of the Colorado Weed Management Act, as of May 2003. The full text and current listing are available at <www.ag.state.co.us/DPI/weeds/weed.html>.

"Noxious weed" means an alien plant or parts of an alien plant that have been designated by rule as being noxious or has been declared a noxious weed by a local advisory board, and meets one or more of the following criteria:

- (a) Aggressively invades or is detrimental to economic crops or native plant communities;
- (b) Is poisonous to livestock;
- (c) Is a carrier of detrimental insects, diseases, or parasites;
- (d) The direct or indirect effect of the presence of this plant is detrimental to the environmentally sound management of natural or agricultural ecosystems.

The following weed species, listed in alphabetical order, are identified as the State Noxious Weeds. They have been identified by individual counties as problem weeds in the county's area or have been recommended for management through public testimony. These weed species should be considered by each local advisory board and local governing body in the development, adoption and enforcement of their noxious weed list and noxious weed management plan. The State Noxious Weeds are:

Absinth wormwood (<i>Artemisia absinthium</i>)	Meadow knapweed (<i>Centaurea pratensis</i>)
African rue (<i>Peganum harmala</i>)	Mediterranean sage (<i>Salvia aethiopis</i>)
Black henbane (<i>Hyoscyamus niger</i>)	Medusahead rye (<i>Taeniatherum caput-medusae</i>)
Black nightshade (<i>Solanum nigrum</i>)	Moth mullein (<i>Verbascum blattaria</i>)
Blue mustard (<i>Chorispora tenella</i>)	Musk thistle (<i>Carduus nutans</i>)
Bouncingbet (<i>Saponaria officinalis</i>)	Myrtle spurge (<i>Euphorbia myrsinites</i>)
Bull thistle (<i>Cirsium vulgare</i>)	Orange hawkweed (<i>Hieracium aurantiacum</i>)
Camelthorn (<i>Alhagi pseudalhagi</i>)	Oxeye daisy (<i>Chrysanthemum leucanthemum</i>)
Canada thistle (<i>Cirsium arvense</i>)	Perennial pepperweed (<i>Lepidium latifolium</i>)
Chicory (<i>Cichorium intybus</i>)	Perennial sowthistle (<i>Sonchus arvensis</i>)
Chinese clematis (<i>Clematis orientalis</i>)	Plumeless thistle (<i>Carduus acanthoides</i>)
Coast tarweed (<i>Madia sativa</i>)	Poison hemlock (<i>Conium maculatum</i>)
Common burdock (<i>Arctium minus</i>)	Puncturevine (<i>Tribulus terrestris</i>)
Common crupina (<i>Crupina vulgaris</i>)	Purple loosestrife (<i>Lythrum salicaria</i>)
Common groundsel (<i>Senecio vulgaris</i>)	Quackgrass (<i>Elytrigia repens</i>)
Common mullein (<i>Verbascum thapsus</i>)	Redstem filaree (<i>Erodium cicutarium</i>)
Common St. Johnswort (<i>Hypericum perforatum</i>)	Rush skeletonweed (<i>Chondrilla juncea</i>)
Common tansy (<i>Tanacetum vulgare</i>)	Russian knapweed (<i>Centaurea repens</i>)
Common teasel (<i>Dipsacus fullonum</i>)	Russian-olive (<i>Elaeagnus angustifolia</i>)
Cypress spurge (<i>Euphorbia cyparissias</i>)	Russian thistle (<i>Salsola collina</i> and <i>S. iberica</i>)
Dalmatian toadflax, broad-leaved (<i>Linaria dalmatica</i>)	Saltcedar (<i>Tamarix parviflora</i> and <i>T. ramosissima</i>)
Dalmation toadflax, narrow-leaved (<i>L. genistifolia</i>)	Scentless chamomile (<i>Anthemis arvensis</i>)
Dame's rocket (<i>Hesperis matronalis</i>)	Scotch thistle (<i>Onopordum acanthium</i> and <i>O. tauricum</i>)
Diffuse knapweed (<i>Centaurea diffusa</i>)	Sericea lespedeza (<i>Lespedeza cuneata</i>)
Downy brome (<i>Bromus tectorum</i>)	Shepherdspurse (<i>Capsella bursa-pastoris</i>)
Dyer's woad (<i>Isatis tinctoria</i>)	Spotted knapweed (<i>Centaurea maculosa</i>)
Eurasian watermilfoil (<i>Myriophyllum spicatum</i>)	Spurred anoda (<i>Anoda cristata</i>)
Field bindweed (<i>Convolvulus arvensis</i>)	Squarrose knapweed (<i>Centaurea virgata</i>)
Flixweed (<i>Descurainia sophia</i>)	Sulfur cinquefoil (<i>Potentilla recta</i>)
Giant salvinia (<i>Salvinia molesta</i>)	Swainsonpea (<i>Sphaerophysa salsula</i>)
Green foxtail (<i>Setaria viridis</i>)	Tansy ragwort (<i>Senecio jacobaea</i>)
Hairy nightshade (<i>Solanum sarrachoides</i>)	Velvetleaf (<i>Abutilon theophrasti</i>)

Halogeton (*Halogeton glomeratus*)
Hoary cress (*Cardaria draba*)
Houndstongue (*Cynoglossum officinale*)
Hydrilla (*Hydrilla hydrilla*)
Johnsongrass (*Sorghum halepense*)
Jointed goatgrass (*Aegilops cylindrica*)
Kochia (*Kochia scoparia*)
Leafy spurge (*Euphorbia esula*)
Mayweed chamomile (*Anthemis cotula*)

Venice mallow (*Hibiscus trionum*)
Wild caraway (*Carum carvi*)
Wild mustard (*Brassica kaber*)
Wild oats (*Avena fatua*)
Wild proso millet (*Panicum miliaceum*)
Yellow foxtail (*Setaria glauca*)
Yellow nutsedge (*Cyperus esculentus*)
Yellow starthistle (*Centaurea solstitialis*)
Yellow toadflax (*Linaria vulgaris*)

The following weed species are recognized as the top ten prioritized weed species for the State of Colorado. After analysis of a statewide survey of counties, these species are acknowledged to be the most widespread and to cause the greatest economic impact in the State of Colorado. These species shall be considered by each local advisory board and local governing body in the development, adoption and enforcement of their noxious weed list and noxious weed management plan. They are listed in alphabetical order:

Canada thistle (*Cirsium arvense*)
Dalmation toadflax (*Linaria dalmatica* and *L. genistifolia*)
Diffuse knapweed (*Centaurea diffusa*)
Field bindweed (*Convolvulus arvensis*)
Hoary cress (*Cardaria draba*)

Houndstongue (*Cynoglossum officinale*)
Leafy spurge (*Euphorbia esula*)
Musk thistle (*Carduus nutans*)
Russian knapweed (*Centaurea repens*)
Yellow toadflax (*Linaria vulgaris*)

The following weed species may not be present or are not yet widespread or causing great economic impact within the State of Colorado. However, counties and local advisory boards are encouraged to contain and eradicate these species before they proliferate and significantly impact the economic and environmental values of the lands of the State. They are listed in alphabetical order:

Absinth wormwood (*Artemisia absinthium*)
African rue (*Peganum harmala*)
Bouncingbet (*Saponaria officinalis*)
Camelthorn (*Alhagi pseudalhagi*)
Coast tarweed (*Madia sativa*)
Common crupina (*Crupina vulgaris*)
Common teasel (*Dipsacus fullonum*)
Cypress spurge (*Euphorbia cyparissias*)
Dyer's woad (*Isatis tinctoria*)
Eurasian watermilfoil (*Myriophyllum spicatum*)
Giant salvinia (*Salvinia molesta*)
Hydrilla (*Hydrilla hydrilla*)

Meadow knapweed (*Centaurea pratensis*)
Moth mullein (*Verbascum blattaria*)
Myrtle spurge (*Euphorbia myrsinites*)
Orange hawkweed (*Hieracium aurantiacum*)
Rush skeletonweed (*Chondrilla juncea*)
Sericea lespedeza (*Lespedeza cuneata*)
Spurred anoda (*Anoda cristata*)
Squarrose knapweed (*Centaurea virgata*)
Sulfur cinquefoil (*Potentilla recta*)
Tansy ragwort (*Senecio jacobaea*)
Venice mallow (*Hibiscus trionum*)
Yellow starthistle (*Centaurea solstitialis*)

WaterWise Landscaping
Best Practices

Section 5 – Understanding Soils and Soil Preparation

A. Introduction to Soils (See Native Plant Revegetation Guide available at:
http://parks.state.co.us/cnap/revegetation-guide/reveg_index.html)

Prairie soils have developed over thousands of years. Native topsoil is a living material containing soil microorganisms, seeds, plant roots, and invertebrate animal in a matrix of minerals (derived from rocks) and dead organic matter (developed from the breakdown of dead plants and animals). Areas with adequate topsoil are better able to develop and support healthy vegetation. Native drought tolerant vegetation may be adapted to a broad or narrow range of soil types. Successful native and drought tolerant landscapes should consider soil properties when designing planting areas. Soil properties include texture, chemistry, and structure. Soil pH, salinity, and percent organic matter may be more critical to the establishment of native and drought tolerant vegetation than soil macronutrient levels (nitrogen, phosphorus, and potassium). In order to better plan for specific soils, consult the reference above.

Topsoil may be recognized in general by its darker color (very dark to deeper brownish earth tones). The distinct transition to brighter earth tones may mark the boundary with subsoil. Recent precipitation may color surface soils darker and should not be mistaken for topsoil. In general topsoil may be 6 to 12 inches deep, deeper in drainages and shallower on slopes and hilltops. Old agricultural fields may have less distinct boundaries due to years of mixing of upper soils and accelerated erosional loss. Pits may be dug to identify topsoil depths prior to removal

B. Salvage of Soils

Topsoil is a living material and must be handled carefully to preserve its quality. Planned developments are frequently re-graded. Topsoil should be salvaged from all areas and stockpiled prior to grading. Topsoil under roads and staging areas should also be removed and stock piled. All salvaged topsoil should be reapplied to the portions of the development site to be revegetated. Salvage topsoil in drainages before erosion of denuded upland areas can contaminate them.

Topsoil is best if it can be removed and hauled directly to the placement site. If storage is necessary it should be for as short a time as possible. The topsoil should be placed in a low mound, in a weed free area, with side slopes of 7:1 or less. A ditch and berm structure around the pile will help reduce loss to erosion. If the pile is to remain for more than four weeks, it should be seeded with a sterile hybrid wheatgrass such as “Regreen”. The depth of the pile should be no greater than 2-3 feet to minimize loss of living microbial components. In general it is best to move topsoil when it is moist. Avoid moving wet soils (may harden to brick-like consistency) or overly dry soils. Dormant hauled soils preserve residual native seed and propagules.

C. Topsoil Sources

If topsoil is to be imported to a site a soil sample or recent soil test should be obtained from the supplier. If possible the source site should be visited to check for weed contamination. Soil sources should be free of noxious weed species. If a prepared soil is to be used, the organic content should only be 2 percent for native seeding areas. (Conventional lawns and higher water usage areas may utilize higher organic matter.)

D. Topsoil Testing

Imported topsoil should be a sandy loam or loam soil as defined by the USDA Soil Conservation Service soil Classification system, as follows:

<u>Textural Class</u>	<u>% Total Weight</u>	<u>Average %</u>
Sand (0.05-2.0 mm dia. Range)	45 to 75	60
Silt (0.002-0.05 mm dia. range)	15 to 35	25
Clay (less than 0.002 mm dia. range)	5 to 25	15

Topsoil should be free of stones over 1" in diameter (lawns and gardens) or over 4" (native seeded areas). Topsoil should be free of debris and excessive plant litter.

Topsoil should have a pH of 6-7.5 and salinity less than 4 mmhos/cm.

Soil Testing is available through the **Colorado State University Extension Service:**

Contact Information:	CSU Soil Testing Lab, Ft. Collins, Colorado
	Phone: 970-491-5061
	Fax: 970-491-2930
	Web: www.colostate.edu/Depts/SoilCrop/soillab.html
Cost:	Routine Analysis = \$18.00 (as of 6/03)
Procedure:	Application & Instruction Forms follow

E. Soil Amendments

It is best to plan native and drought tolerant vegetation around the existing soil conditions. If extreme soil conditions exist, some amendments may improve the soil conditions:

1. pH

If the pH is very high it may be possible to adjust by adding aluminum sulfate. Soil in the Front Range tends to have a high pH and thus, does not generally require the addition of lime, which would further elevate the pH value.

2. Texture

Soil texture effects water availability within soils. Very sandy soils do not retain water well. Very clayey soils do not allow water to penetrate or drain easily. Organic matter may improve both of these extreme soils. Native or to low water usage landscapes generally no more than 2 percent organic matter. Generally, if sandy or

clay soils are amended, 2 cubic yards of composted organic matter/1000 square feet is adequate. To improve deep root penetration in a heavy clay or sandy subsoil (under all water usage levels of landscape) apply 2 cubic yards of compost prior to re-application of topsoil. All compost should be deeply ripped into the soil at least 12 inches. This helps with root penetration into the deeper layers of the soil and makes all landscape types more drought tolerant. Avoid over-working the soil to preserve the soil structure.

3. Organic Amendment

Organic amendments should be composted. Compost may be a mixture of manures (not from stock yards, which may be high in salts), yard wastes (ground grass clippings, leaves and branches), organic byproducts such as brewery wastes, and sewage sludge (should not be used alone due to a high clay content.) Prepared topsoil companies maintain sanitary controlled compost production and are a good source of organic amendments.

4. Nutrient Amendment

Nutrient amendments may not be required for native vegetation. Macro nutrient (N,P,K) levels are low in native prairies. Addition of nutrients to native and drought tolerant planting areas may encourage weeds and damage root systems. If topsoil is very poor or lacking, a slow release organic amendment such as Biosol may be added at a rate of 800 to 1200 pounds per acre to improve plant growth.

SUGGESTED INSTRUCTIONS FOR SUBMITTING SOIL SAMPLES

Use the following steps to submit soil samples:

1. Obtain a spade, trowel, soil tube, or soil auger free of rust and soil.
2. Dig 5-10 samples (depending on the size of the area) from the soil depth where your plants will be rooting. The samples should represent a uniform area consisting of land that is similar in slope, texture, drainage, or other characteristics that make the soil the same. A front and back yard would most likely be very similar to each other, however a garden area may be different from a turf grass area.
3. Place all of the samples into a plastic container and mix well to get your final sample for submittal to the lab. If possible, air dry the sample by spreading it out on paper towels.
4. Remove about 1 1/2 - 2 pints of soil from the container and place it in a plastic bag or soil sample bag.
5. Seal the bag and label the sample with name, address and location of the sample.
6. Complete this soil sample information form as much as possible and include it with the soil sample.
7. Mail the sample to the lab using the following address:

**Soil, Water and Plant Testing Laboratory
Colorado State University
Room A 319 NESB
Fort Collins, CO 80523-1120**
8. Be sure to keep samples cool before mailing. If samples heat up; the nitrogen readings can change dramatically. Keeping the samples in the shade will prevent excessive heating.
9. **DO NOT PREPAY**, you will be billed for the analysis.
10. The lab **DOES NOT** do herbicide or pesticide analysis.
11. If you have additional questions please contact the lab at: (970) 491-5061 or your local county Cooperative Extension agent.

SOIL TESTS AVAILABLE	
TEST	COMMENTS
Routine- pH, soluble salts, organic matter, nitrate-nitrogen, phosphorus, potassium, zinc, iron, lime (estimate), texture, copper and manganese.	Basic evaluation for characterizing the soil fertility status for growing crops. a fertilizer recommendation is given. Normally this test is sufficient unless a special problem is suspected.
Subsoil Nitrate	Evaluation of nitrate supply below soil surface. Fertilizer nitrogen recommendation based on routine soil test of surface soil is adjusted if subsoil nitrate is unusually high.
Subsoil Salinity	It is important to determine the salt content of subsoil for crop management.
Sodium Evaluation - sodium adsorption ratio (ratio of sodium to calcium and magnesium), gypsum, and % lime.	Some Colorado soils contain excess sodium. This test determines whether or not chemical amendments such as gypsum or sulfur will be effective and the amounts of these materials needed.
Routine plus Sodium Evaluation	See above explanations. A recommendation for fertilizer and/or amendments for sodium reclamation is given.
Boron, Sulfate and Molybdenum	Colorado soils usually have sufficient quantities of these nutrients. However, in some soils near mine sites, boron or molybdenum may be found in toxic quantities.

SOIL SAMPLE INFORMATION FOR HORTICULTURAL APPLICATIONS - PLEASE PRINT IN
LANDSCAPE MODE:

See the reverse side for sampling information

DATE: _____
FULL NAME: _____
SSN: _____
ADDRESS: _____
CITY: _____ STATE: _____
ZIP CODE: _____
PHONE: _____ FAX: _____
COUNTY: _____ SAMPLE ID: _____

The following information will help us give you a written
explanation of the laboratory results:

PLEASE CIRCLE ALL THAT APPLY.

1. The sample is from:

- A. Lawn E. Golf course
B. Vegetable garden F. Container plantings
C. Flower bed G. Reclamation site
D. Greenhouse H. Other (please specify) _____

2. What do you plan to grow at the site or what is currently growing at the site?

- A. Vegetables B. Flowers C. Turfgrass (How old is the lawn?) _____ D. Trees E. Other _____

If you are growing turf please answer the following :

Is this site to be _____ Seeded _____ Sodded?

Is it an existing lawn? _____

If the lawn is established was it:

Seeded _____ Sodded _____

3. Will this site be

irrigated/watered?

Yes _____ or No _____

4. If yes which method?

- A. Sprinkler C. Drip
B. Flood D. Other please specify _____

5. If sprinkler is used is it:

- A. Automatic C. Hose end
B. In ground D. Other _____

6. About how much water do you apply each time you irrigate/water?

- A. Less than 1 inch. B. 1-3 inches C. 4-6 inches D. More than 6 inches

7. How often do you irrigate/water? Daily _____ Once per week _____ Twice per week _____ Other _____

8. If possible, indicate the types of previous crops or plants that grew at this site. _____

9. What have you added or plan to add to the soil? _____

10. Is there a specific problem with this site? Yes _____ No _____

If yes, please describe the problem, what caused the problem and why you think it was the cause (use a separate sheet if necessary).

11. If you wish to have a fertilizer recommendation based on organic fertilizers please answer the following questions.

What is the type of material that will be used for organic fertilizer?

- A. Composted manure B. Composted sludge C. Other _____

Do you know the nutrient levels in the organic fertilizer? Yes _____ No _____

If so please supply the following information for the organic fertilizer.

% nitrogen	% phosphorus	% potassium	pH	Salts (mmhos/cm)

Additional Comments: _____

By accepting service or goods, I agree to submit payment in full to Colorado State University upon receipt of invoice or University Billing Statement. Late payment charges of 1.5% per month and other penalties specified may be assessed for late payment.

Please call lab for prices.

revised 10-11-2001

SOIL, WATER & PLANT TESTING LABORATORY

CLIENT TYPE (Check One)

- Homeowner Operator
Dealers/Distributor Extension Agent
Lawn Care Company Regulatory Agency
Golf Course Consultant
Nursery /Garden Center Government/School
Other _____

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PLEASE CIRCLE

ANALYSIS DESIRED

Routine (pH, conductivity,
organic matter, NO₃, P, K, Zn, Fe
Cu, Mn, lime estimate, texture estimate)

Routine + Sodium Evaluation (SAR)

Routine + Boron, Molybdenum,
Cadmium, Lead

Routine + Nitrate OR Salinity on Subsoil

Routine + Salinity + Nitrate on Subsoil

**NOTE: A subsoil is a separate sample taken 6" underneath
your surface sample.**

MINIMUM CHARGE

WaterWise Landscaping *Best Practices*

Section 6 – Irrigation Design Techniques and Equipment

The following information builds upon some of the Guidelines described above in Section 2, Principle #5.

A. Consider plant water requirements in irrigation design schemes

1. Each valve should irrigate a landscape with similar site, slope and soil conditions and plant material with similar watering needs.
2. Soil types, infiltration rate & slopes should be considered in order to avoid runoff, & overspray, where water flows onto adjacent property, non-irrigated areas, walks, roadways, or structures. Proper irrigation equipment, schedules, and repeat cycles should be used to minimizing runoff.
3. Special attention should be given to avoid runoff from slopes, and to avoid overspray in planting areas with a width less than ten feet, like medians.
4. Turf and non-turf areas should be irrigated on separate valves.
5. Drip emitters and sprinklers should be place on separate valves.
6. Bubblers for trees should be placed on a separate valve. Bubbler selected should not exceed 1.5 gallons per minute (gpm) for each device.
7. Hand watering may be considered for Low and Very Low hydrozones.

B. Employ hydraulic principles when designing the irrigation system.

1. The irrigation system should be designed to provide peak season irrigation within a six night, six hour per night watering period.
2. The tap size should be based on the water demand of the site and will take into consideration the areas of each plant type (i.e., turf, native seed, perennials and annuals and shrubs), the evapotranspiration for the site, the water demand of each plant type at peak season, and the water window.
3. The maximum flow rate required for the site should be based on the tap size:

3/4" meter	15 gallons per minute
1" meter	25 gpm
1.5" meter	50 gpm
2" meter	80 gpm
4. The mainline system should be designed such that velocities within the mainline piping do not exceed five feet per second.
5. A reduced pressure backflow preventer should be used on all systems. Where the irrigation point of connection is from the domestic water service, the irrigation tap and backflow preventer shall be installed after the water meter but before any backflow or pressure-reducing valve for the building.
6. A pressure-reducing valve should be used when the static water pressure exceeds the pressure needed by the system by 15 pounds per square inch (psi). Pressure reducing valves can be installed within the project, on the mainline or at the valve, if elevation changes require it.

7. Turf and grass area design principles:
 - a. No single zone should mix head types, such as rotors and pop-up spray heads on the same zone.
 - b. Sprinklers should be spaced for “head-to-head” coverage, where the spray pattern from one head will reach to the next head. (Another way to describe this is that all sprinkler heads should be spaced at a maximum of 50% of design performance diameter of the sprinkler.) Spacing should be reduced below 50% of design performance diameter when conditions demand.
 - c. No overhead sprinkler irrigation systems should be installed in strips less than 8 feet wide.
 - d. Small areas (25 ft wide or less) should be irrigated with fixed nozzle pop-up spray heads with matched precipitation nozzles. Nozzles should be sized to provide head to head coverage. Heads shall pop-up a minimum of 4” in turf areas. Heads can be specified with pressure reducing features, where needed.
 - e. Large areas (wider than 25 ft) should be irrigated with gear driven rotor heads with a minimum precipitation rate of 0.45” per hour for a full circle head. Heads should pop-up a minimum of 4” in turf areas.
 - f. Check valves should be included in heads or valves where low-head drainage will occur due to elevation changes. See irrigation head catalogs for elevation change tolerances.
8. Shrub bed areas with plant material one gallon in size or larger should be irrigated with a drip or subsurface system.
9. Perennial and annual beds should be spray irrigated with 12” pop-up spray heads with a maximum spacing of 10’ on center.
10. Booster pumps should be installed on systems where supply pressure does not meet minimum recommended pressure of the irrigation system, based on hydraulic calculations.
11. Where the water supplied will be from secondary or other non-potable water sources, the use of non-potable color indicators on the equipment is recommended. This includes purple handles on quick coupler valves and gate valve, caps for irrigation heads, valve box lids and marker tape buried above the mainline.
12. All systems should be equipped with an automatic rain shut-off device.
13. All wire connections should be made with watertight connectors and contained in a valve box.

C. Employ irrigation control systems that offer flexibility in programming.

1. All irrigation systems should include an electric automatic controller with multiple programs and multiple repeat and rest cycle capabilities and a flexible calendar program.
2. All controllers should be capable of temporarily shutting down the system by utilizing internal/external options such as rain and wind sensors.
3. The controller should have the ability to adjust run times based on a percentage of maximum ET (evapotranspiration) rate.
4. Each zone/valve should have its own station on the controller. The exception is drip valves, which can be doubled on the controller.

D. Ensure installation of irrigation system is per plan and is accurate.

1. Irrigation system should be installed per plans.

2. The irrigation system should be monitored during installation, especially to verify mainline and lateral line depth, spacing of irrigation heads and construction of valve clusters and quick coupler components.
3. Mainline should be tested to ensure its ability to maintain required pressure for 2 hours.
4. Before acceptance, each zone should be operated and each valve box opened to verify accurate installation.

E. Provide “as-built” drawings of irrigation system after installation with dimensions shown for irrigation components.

1. The “as-built” drawings should show all points of connection, including tap size, line size and static water pressure of service. Dimensions that will be used to locate components shall be shown on plans. Components to be located include meters, backflow preventers, all valves, including quick coupler, control, gate, and manual drain valves, and controller locations.
2. The drawings should also show zone number, valve size and gallons per minute.

F. Operate systems to maximize irrigation waterefficiency.

1. Irrigation should be scheduled to operate between 10 PM and 8 AM to reduce water loss from wind and evaporation and to take advantage of the better water pressure.
2. The target efficiency for rotor heads should be 70%, and 55% for spray heads.
3. Program valves for multiple repeat cycles to reduce runoff, especially on slopes and with soils with slow infiltration rates.
4. All zone run times should be determined based on the precipitation rate of the heads on that zone. The run times should be adjusted seasonally and at least once a month to accommodate the ET rate.
5. System should be winterized in the fall using a compressor to remove water in the lines and components. System should be reopened and adjusted for proper operation in the spring.
6. After each mowing, each zone should be operated for a very short period of time to verify the heads are operating as designed and no damage has occurred.
7. When repairs are made, the new components installed should match exactly those damaged and removed.
8. Run times for zones should be adjusted based on exposure (north and east vs. south and west), slope and soil types to reduce overwatering.

WaterWise Landscaping Best Practices

Section 7 – Water Budgeting

A. Calculating a Water Budget

A Water Budget is the target amount of water a landowner should use in a typical watering season. This target provides simple-to-achieve, realistic goals for landscape irrigation. Water Budgeting focuses less on watering time limits, and is more concerned with a user's water allotment and reducing over-watering. This form can help any user create a target Water Budget from which to work.

The information below will help guide you through the Water Budget Worksheet on the following page.

Step 1. ET Reference Location:

Because climate conditions vary throughout Colorado, the rate at which water evaporates (evaporation) and the rate at which plants use water (transpiration) varies in different areas of the state. Based on those climatic differences, it is important to identify the general Evapo-Transpiration (ET) Reference Locations in which you are located. The four largest regions can be categorized as: Denver, Colorado Springs, Grand Junction and Pueblo.

Step 2. Gallons of Water Needed by Plant Category:

Different plants have different water needs. A plant list that identifies the water needs of landscape plants (High, Moderate, Low, Very Low) is included in Section Three of this Best Practices Manual. The ET Rates are provided on the worksheet, and will need to be applied in the calculations in Step 4 below.

Step 3. Irrigation Areas (zones) based on Plant Water Need Category:

Both automatic irrigation systems and hand-placed yard sprinklers deliver water to plants by watering areas or "zones", and have set watering amounts determined by you, the user. If you have High water need plants within Low or Very Low water plant groupings, the entire area must be considered a High-water area and irrigated as such; however some plants may be over-watered if this occurs. The area of each watering zone can be determined by physically measuring the zone, and multiplying Length (in feet) by Width (in feet). The resulting areas (in square feet, or S.F.) can be entered in Step 4 below.

Step 4. Water-Use Calculations:

Fill in the blanks with area and water need per zone. For example, in the Denver region you might have an area of 300 S.F. in a High Water Zone that would require 20 gallons of water per S.F. After multiplying you would find that area requires 6,000 gallons of water per season.

After calculating the irrigation needs of all areas, determine your average overall water needs per season. To do this, add the total gallons needed for all zones, and divide by the total Square Footage for all zones. The average for the overall site needs to be no more than 15 gallons per S.F. per season. If your average is more than this, you might consider modifying your planting layout to create more Low/Very Low Water Zones that would balance your High/Moderate Water Zones, and reduce over-watering.

WaterWise Landscaping Best Practices

B. Water Budget Worksheet

1. ET Reference Location:

Identify the general Evapo-Transpiration (ET) Reference Location in which you are located. The four largest regions are listed below and include surrounding metropolitan areas:

___Denver ___Colorado Springs ___Grand Junction ___Pueblo

2. Gallons of Water Needed by Plant Category:

Determine the water needs of the various plants in your design. A plant list that identifies water needs (High, Moderate, Low, Very Low) is included in Section Three of this Best Practices Manual.

Plant Water Need Category	Gallons of Water used (ET Rate)*
H = High water plants	(20 gallons/SF/season -- Denver)
M = Moderate water plants	(10 gallons/SF/season -- Denver)
L = Low water plants	(0-3 gallons/SF/season -- Denver)
VL = Very Low water plants	(no irrigation needed; typical rainfall is sufficient)

The ET Rates for regions other than Denver are not yet accurate. One might assume that the ETR for Colorado Springs is 10% less than Denver's, and those for Grand Junction and Pueblo may be as much as 25% higher than Denver's.

3. Irrigation Areas (zones) based on Plant Water Need Category:

Identify each zone requiring irrigation, and calculate the area (in square feet) of each zone. If plants are already installed and/or not grouped together by water need, pick the highest water need category included in each zone.

4. Water-Use Calculations:

HIGH WATER ZONES: _____ S.F. x (_____ gals./S.F.) = _____ gals / season

MODERATE WATER ZONES: _____ S.F. x (_____ gals. /S.F.) = _____ gals / season

LOW WATER ZONES: _____ S.F. x (_____ gals./S.F.) = _____ gals / season

VERY LOW WATER ZONES: _____ S.F. x (_____ gals./S.F.) = _____ gals / season TOTAL

gallons needed by ALL ZONES: _____ = _____ gals / season

TOTAL Square Feet (S.F.) of ALL ZONES: _____ = _____ S.F.

*AVERAGE GALS./S.F./SEASON, ALL ZONES: Total Gals / Total SF = _____ gals / season

**The average needs to be a maximum of 15 gals. / S.F. / season.*

WaterWise Landscaping
Best Practices

Section 8 – Additional Resources

Water Conservation Internet Sources

- Waterwiser, National Water Efficiency Clearinghouse, www.waterwiser.org
- Water Saver Home, www.h2ouse.org
- U.S. Geologic Survey, Water use in the United States, www.water.usgs.gov/watuse
- Western States Water Council, www.westgov.org/wswc
- Colorado Water Conservation Board, www.cwcb.state.co.us
- Colorado Nonpoint Source Program, www.ourwater.com
- Denver Water, www.water.denver.co.gov/indexmain.html
- WaterSaver from Denver Water, www.watersaver.org

WaterWise Landscaping Internet Sources

- GreenCO Best Management Practices, www.grennco.org/bmp_list.html
- National Association of Irrigation Design/ Certification, www.irrigation.org/certification.html
- American Nursery and Landscape Association, www.anla.org
- Associated Landscape Contractors of Colorado, www.alcc.com
- Smart Gardening, www.smartgardening.com
- Xeriscaping, www.xeriscape.org
- Colorado State University Horticulture Department, www.hla.agsci.coloradostate.edu
- CSU Cooperative Extension Service, www.ext.colostate.edu/garden
- Colorado Nurseries, www.colorado-nusery-assn.org

- Gardening Colorado, www.gardeningcolorado.com
- Xeriscape Gardening, www.xratedgardening.com

Seed and Plant Sources

- Garden Centers of Colorado, www.gardencentersofcolorado.org
- Colorado Native Plant Society, www.carbon.cudenver.edu/~shill/conps.html
- High Country Gardens, www.highcountrygardens.com
- Arkansas Valley Seed Solutions, www.seedsolutions.com
- Rocky Mountain Sod Growers Association, www.rockymountainsodgrowers.com

Demonstration Gardens

- Colorado Xeriscape Demonstration Gardens, www.xeriscape.org/demogardens.html

Waterwise Gardening Books

- *The Xeriscape Flower Gardener*, Jim Knopf, Boulder, CO, Johnson Books, 2003
- *Waterwise Landscaping with Trees, Shrubs, and Vines*, Jim Knopf
- *Xeriscape Plant Guide*, Rob Proctor/David Winger, Fulcrum Publishing, 1996
- *Xeriscape Handbook*, Gayle Weinstein/ David Winger, Fulcrum Publishing, 2003
- *Xeriscape Color Guide*, David Winger/Denver Water, Fulcrum Publishing, 1998
- *Western Garden Book*, Kathleen Norris Brenzel, Sunset Publishing, 2001
- *Water-Efficient Landscape Guidelines*, Richard E Bennett/ Michael S. Hazinski, American Water Works Association, 1993
- *The Rocky Mountain Perennial Plant Guide*, Colorado Nursery Association, 1995
- *Rocky Mountain Plant Guide*, Colorado Nursery Association, 1993

Appendix G

5-Year Opinion of Probable Construction and Capital Improvement Plan Costs

OPCCs and CIP total estimates for 5-Year recommended CIP Projects are presented below in **Table G-1** through **Table G-12**. The estimated cost for each line item, also known as the extended cost within a project is determined by multiplying the line item quantity times the unit cost. Each line item extended cost is added to the project total cost column to determine OPCC estimates. All costs are August 2020 dollars from ENR-CCI.

Table G-1 – SA-44 Centennial Park OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	3,520	\$172/LF	\$605,939	\$605,939
Water Distribution 8" (Trenchless J&B)	200	\$478/LF	\$95,617	\$95,617
Pump Station - 1,300 gpm	1	LS	\$1,734,548	\$1,734,548
New Pond	3	\$60,964/AF	\$154,330	\$154,330
Tier 1 Dewatering	1,800	\$105/LF	\$189,000	\$189,000
Unit Cost Subtotal				\$2,779,435
Erosion Control/Stormwater Pollution Prevention		2%		\$55,589
Mobilization & Demobilization		5%		\$138,972
Subtotal				\$2,973,995
Contingency		35%		\$1,040,900
Opinion of Probable Construction Cost (rounded)				\$4,020,000
Feasibility and Site Studies		6% of OPCC		\$242,000
Preliminary and Final Design		6% of OPCC		\$242,000
Engineering Services During Construction		5% of OPCC		\$201,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$201,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$121,000
Capital Improvement Plan Total				\$5,030,000

Table G-2 – Boomerang PS OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 3,100 gpm	1	LS	\$3,064,486	\$3,064,486
Pond Expansion	12.52	\$60,964/AF	\$763,000	\$763,000
Unit Cost Subtotal				\$3,827,486
Erosion Control/Stormwater Pollution Prevention		2%		\$76,550
Mobilization & Demobilization		5%		\$191,374
Subtotal				\$4,095,410
Contingency		35%		\$1,433,400
Opinion of Probable Construction Cost (rounded)				\$5,530,000
Feasibility and Site Studies		6% of OPCC		\$332,000
Preliminary and Final Design		6% of OPCC		\$332,000
Engineering Services During Construction		5% of OPCC		\$277,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$277,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$166,000
Capital Improvement Plan Total				\$6,920,000

Table G-3 – Boomerang Regional Phase 2 OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 10"	5,472	\$178/LF	\$974,896	\$974,896
Tier 2 Dewatering	5,472	\$52.50/LF	\$287,280	\$287,280
Unit Cost Subtotal				\$1,262,176
Erosion Control/Stormwater Pollution Prevention		2%		\$25,244
Mobilization & Demobilization		5%		\$63,109
Subtotal				\$1,350,528
Contingency		35%		\$472,690
Opinion of Probable Construction Cost (rounded)				\$1,830,000
Easement		5% of OPCC		\$92,000
Feasibility and Site Studies		6% of OPCC		\$110,000
Preliminary and Final Design		6% of OPCC		\$110,000
Engineering Services During Construction		5% of OPCC		\$92,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$92,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$55,000
Capital Improvement Plan Total				\$2,390,000

Table G-4 – Greeley West Pump Station Replacement OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 10"	6,993	\$178/LF	\$1,245,879	\$1,245,879
Pump Station - 2,000 gpm	1	LS	\$2,299,902	\$2,299,902
Pond Expansion	9.55	\$60,964/AF	\$582,203	\$582,203
Unit Cost Subtotal				\$4,127,984
Erosion Control/Stormwater Pollution Prevention		2%		\$82,560
Mobilization & Demobilization		5%		\$206,399
Subtotal				\$4,416,943
Contingency		35%		\$1,545,930
Opinion of Probable Construction Cost (rounded)				\$5,970,000
Feasibility and Site Studies		6% of OPCC		\$359,000
Preliminary and Final Design		6% of OPCC		\$359,000
Engineering Services During Construction		5% of OPCC		\$299,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$299,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$180,000
Capital Improvement Plan Total				\$7,470,000

Table G-5 – Upper Equalizer Project OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 36"	25,646	\$421/LF	\$10,805,334	\$10,805,334
Water Distribution 36" (Trenchless J&B)	850	\$1,960/LF	\$1,665,681	\$1,665,681
Water Distribution 36" (Trenchless HDD)	250	\$1,796/LF	\$449,047	\$449,047
Tier 1 Dewatering	350	\$105/LF	\$36,750	\$36,750
Tier 2 Dewatering	17,000	\$52.50/LF	\$892,500	\$892,500
Unit Cost Subtotal				\$13,849,313
Erosion Control/Stormwater Pollution Prevention		2%		\$276,986
Mobilization & Demobilization		5%		\$692,466
Subtotal				\$14,818,764
Contingency		35%		\$5,186,570
Opinion of Probable Construction Cost (rounded)				\$20,010,000
Easement		5% of OPCC		\$1,001,000
Feasibility and Site Studies		5% of OPCC		\$1,001,000
Preliminary and Final Design		5% of OPCC		\$1,001,000
Engineering Services During Construction		5% of OPCC		\$1,001,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$1,001,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$601,000
Capital Improvement Plan Total				\$25,620,000

Table G-6 – SA-14 Tech Center Supply OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 16"	3,286	\$224/LF	\$735,751	\$735,751
Pump Station - 1,120 gpm	1	LS	\$1,573,250	\$1,573,250
New Pond	13	\$60,964/AF	\$818,868	\$818,868
Tier 1 Dewatering	250	\$105/LF	\$26,250	\$26,250
Unit Cost Subtotal				\$3,154,120
Erosion Control/Stormwater Pollution Prevention		2%		\$63,082
Mobilization & Demobilization		5%		\$157,706
Subtotal				\$3,374,908
Contingency		35%		\$1,181,220
Opinion of Probable Construction Cost (rounded)				\$4,560,000
Easement		5% of OPCC		\$228,000
Feasibility and Site Studies		6% of OPCC		\$274,000
Preliminary and Final Design		6% of OPCC		\$274,000
Engineering Services During Construction		5% of OPCC		\$228,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$228,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$137,000
Capital Improvement Plan Total				\$5,930,000

Table G-7 – Promontory Park Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 10"	2,237	\$178/LF	\$398,546	\$398,546
Unit Cost Subtotal				\$398,546
Erosion Control/Stormwater Pollution Prevention		2%		\$7,971
Mobilization & Demobilization		5%		\$19,927
Subtotal				\$426,444
Contingency		35%		\$149,260
Opinion of Probable Construction Cost (rounded)				\$580,000
Feasibility and Site Studies		9% of OPCC		\$53,000
Preliminary and Final Design		9% of OPCC		\$53,000
Engineering Services During Construction		5% of OPCC		\$29,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$0
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$0
Capital Improvement Plan Total				\$720,000

Table G-8 – Monfort Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	1,458	\$172/LF	\$250,983	\$250,983
Tier 1 Dewatering	200	\$105/LF	\$21,000	\$21,000
Unit Cost Subtotal				\$271,983
Erosion Control/Stormwater Pollution Prevention		2%		\$5,440
Mobilization & Demobilization		5%		\$13,599
Subtotal				\$291,022
Contingency		35%		\$101,860
Opinion of Probable Construction Cost (rounded)				\$400,000
Feasibility and Site Studies		9% of OPCC		\$36,000
Preliminary and Final Design		9% of OPCC		\$36,000
Engineering Services During Construction		5% of OPCC		\$20,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$0
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$0
Capital Improvement Plan Total				\$500,000

Table G-9 – Twin Rivers Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	5,574	\$172/LF	\$959,519	\$959,519
Tier 1 Dewatering	256	\$105/LF	\$26,880	\$26,880
Tier 2 Dewatering	5,318	\$52.50/LF	\$279,195	\$279,195
Unit Cost Subtotal				\$1,265,594
Erosion Control/Stormwater Pollution Prevention		2%		\$25,312
Mobilization & Demobilization		5%		\$63,280
Subtotal				\$1,354,185
Contingency		35%		\$473,970
Opinion of Probable Construction Cost (rounded)				\$1,830,000
Easement		5% of OPCC		\$92,000
Feasibility and Site Studies		6% of OPCC		\$110,000
Preliminary and Final Design		6% of OPCC		\$110,000
Engineering Services During Construction		5% of OPCC		\$92,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$92,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$55,000
Capital Improvement Plan Total				\$2,390,000

Table G-10 – SA-38 1st Ave. Pond OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	4,558	\$172/LF	\$784,623	\$784,623
Water Distribution 8" (Trenchless HDD)	350	\$585/LF	\$204,582	\$204,582
Pump Station - 260 gpm	1	LS	\$604,548	\$604,548
New Pond	0.55	\$60,964/AF	\$33,253	\$33,253
Tier 1 Dewatering	807	\$105/LF	\$84,735	\$84,735
Tier 2 Dewatering	3,751	\$52.50/LF	\$196,928	\$196,928
Unit Cost Subtotal				\$1,908,669
Erosion Control/Stormwater Pollution Prevention		2%		\$38,173
Mobilization & Demobilization		5%		\$95,433
Subtotal				\$2,042,276
Contingency		35%		\$714,800
Opinion of Probable Construction Cost (rounded)				\$2,760,000
Easement		5% of OPCC		\$138,000
Feasibility and Site Studies		6% of OPCC		\$166,000
Preliminary and Final Design		6% of OPCC		\$166,000
Engineering Services During Construction		5% of OPCC		\$138,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$138,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$83,000
Capital Improvement Plan Total				\$3,590,000

Table G-11 – SA-25 Westgate Regional PS OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 860 gpm	1	LS	\$1,323,329	\$1,323,329
New Pond	2.40	\$60,964/AF	\$146,386	\$146,386
Unit Cost Subtotal				\$1,469,716
Erosion Control/Stormwater Pollution Prevention		2%		\$29,394
Mobilization & Demobilization		5%		\$73,486
Subtotal				\$1,572,596
Contingency		35%		\$550,410
Opinion of Probable Construction Cost (rounded)				\$2,130,000
Feasibility and Site Studies		6% of OPCC		\$128,000
Preliminary and Final Design		6% of OPCC		\$128,000
Engineering Services During Construction		5% of OPCC		\$107,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$107,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$64,000
Capital Improvement Plan Total				\$2,670,000

Table G-12 – SA-25 Westgate Regional Phase 1 OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	3,527	\$172/LF	\$607,144	\$607,144
Tier 1 Dewatering	100	\$105/LF	\$10,500	\$10,500
Unit Cost Subtotal				\$617,644
Erosion Control/Stormwater Pollution Prevention		2%		\$12,353
Mobilization & Demobilization		5%		\$30,882
Subtotal				\$660,880
Contingency		35%		\$231,310
Opinion of Probable Construction Cost (rounded)				\$900,000
Easement		5% of OPCC		\$45,000
Feasibility and Site Studies		9% of OPCC		\$81,000
Preliminary and Final Design		9% of OPCC		\$81,000
Engineering Services During Construction		5% of OPCC		\$45,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$0
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$0
Capital Improvement Plan Total				\$1,160,000

Table G-13 – SA-60 Lake Bluffs OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	3,424	\$172/LF	\$589,414	\$589,414
Water Distribution 8" (Trenchless J&B)	250	\$478/LF	\$119,521	\$119,521
Water Distribution 10"	3,786	\$178/LF	\$674,517	\$674,517
Pump Station - 1,120 gpm	1	LS	\$1,573,250	\$1,573,250
New Pond	4.25	\$60,964/AF	\$258,879	\$258,879
Unit Cost Subtotal				\$3,215,581
Erosion Control/Stormwater Pollution Prevention		2%		\$64,312
Mobilization & Demobilization		5%		\$160,779
Subtotal				\$3,440,672
Contingency		35%		\$1,204,240
Opinion of Probable Construction Cost (rounded)				\$4,650,000
Easement		5% of OPCC		\$233,000
Feasibility and Site Studies		6% of OPCC		\$279,000
Preliminary and Final Design		6% of OPCC		\$279,000
Engineering Services During Construction		5% of OPCC		\$233,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$233,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$140,000
Capital Improvement Plan Total				\$6,050,000

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Appendix H

20-Year Opinion of Probable Construction and Capital Improvement Plan Costs

OPCCs and CIP total estimates for 20-Year recommended CIP Projects are presented below in **Table H-1** through **Table H-11**. The estimated cost for each line item, also known as the extended cost within a project is determined by multiplying the line item quantity times the unit cost. Each line item extended cost is added to the project total cost column to determine OPCC estimates. All costs are August 2020 dollars from ENR-CCI.

Table H-1 – SA-34 30th St./17th Ave. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 1,000 gpm	1	LS	\$1,460,713	\$1,460,713
New Pond	2.14	\$60,964/AF	\$130,246	\$130,246
Unit Cost Subtotal				\$1,590,959
Erosion Control/Stormwater Pollution Prevention		2%		\$31,819
Mobilization & Demobilization		5%		\$79,548
Subtotal				\$1,702,326
Contingency		35%		\$595,820
Opinion of Probable Construction Cost (rounded)				\$2,300,000
Feasibility and Site Studies		6% of OPCC		\$138,000
Preliminary and Final Design		6% of OPCC		\$138,000
Engineering Services During Construction		5% of OPCC		\$115,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$115,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$69,000
Capital Improvement Plan Total				\$2,880,000

Table H-2 Boomerang Regional Phase 3 OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 16"	15,382	\$224/LF	\$3,444,104	\$3,444,104
Tier 2 Dewatering	15,382	\$52.50/LF	\$807,555	\$807,555
Unit Cost Subtotal				\$4,251,659
Erosion Control/Stormwater Pollution Prevention		2%		\$85,033
Mobilization & Demobilization		5%		\$212,583
Subtotal				\$4,549,275
Contingency		35%		\$1,592,250
Opinion of Probable Construction Cost (rounded)				\$6,150,000
Easement		5% of OPCC		\$308,000
Feasibility and Site Studies		6% of OPCC		\$369,000
Preliminary and Final Design		6% of OPCC		\$369,000
Engineering Services During Construction		5% of OPCC		\$308,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$308,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$185,000
Capital Improvement Plan Total				\$8,000,000

Table H-3 – SA-4 35th Ave./O St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 280 gpm	1	LS	\$634,613	\$634,613
New Pond	0.86	\$60,964/AF	\$52,560	\$52,560
Unit Cost Subtotal				\$687,172
Erosion Control/Stormwater Pollution Prevention		2%		\$13,743
Mobilization & Demobilization		5%		\$34,359
Subtotal				\$735,274
Contingency		35%		\$257,350
Opinion of Probable Construction Cost (rounded)				\$1,000,000
Feasibility and Site Studies		6% of OPCC		\$60,000
Preliminary and Final Design		6% of OPCC		\$60,000
Engineering Services During Construction		5% of OPCC		\$50,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$0
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$0
Capital Improvement Plan Total				\$1,170,000

Table H-4 – SA-3 35th Ave./AA St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 620 gpm	1	LS	\$1,068,076	\$1,068,076
New Pond	2.33	\$60,964/AF	\$141,861	\$141,861
Unit Cost Subtotal				\$1,209,937
Erosion Control/Stormwater Pollution Prevention		2%		\$24,199
Mobilization & Demobilization		5%		\$60,497
Subtotal				\$1,294,633
Contingency		35%		\$453,130
Opinion of Probable Construction Cost (rounded)				\$1,750,000
Feasibility and Site Studies		6% of OPCC		\$105,000
Preliminary and Final Design		6% of OPCC		\$105,000
Engineering Services During Construction		5% of OPCC		\$87,500
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$87,500
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$53,000
Capital Improvement Plan Total				\$2,190,000

Table H-5 – Bittersweet Park Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	6,296	\$172/LF	\$1,083,805	\$1,083,805
Water Distribution 8" (Trenchless J&B)	600	\$478/LF	\$286,851	\$286,851
Tier 1 Dewatering	200	\$105/LF	\$21,000	\$21,000
Tier 2 Dewatering	6,696	\$52.50/LF	\$351,540	\$351,540
Unit Cost Subtotal				\$1,743,196
Erosion Control/Stormwater Pollution Prevention		2%		\$34,864
Mobilization & Demobilization		5%		\$87,160
Subtotal				\$1,865,220
Contingency		35%		\$652,830
Opinion of Probable Construction Cost (rounded)				\$2,520,000
Feasibility and Site Studies		6% of OPCC		\$152,000
Preliminary and Final Design		6% of OPCC		\$152,000
Engineering Services During Construction		5% of OPCC		\$126,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$126,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$75,600
Capital Improvement Plan Total				\$3,160,000

Table H-6 – SA-35 44th Ave./F St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 820 gpm	1	LS	\$1,282,689	\$1,282,689
New Pond	2.34	\$60,964/AF	\$142,566	\$142,566
Unit Cost Subtotal				\$1,425,256
Erosion Control/Stormwater Pollution Prevention		2%		\$28,505
Mobilization & Demobilization		5%		\$71,263
Subtotal				\$1,525,023
Contingency		35%		\$533,760
Opinion of Probable Construction Cost (rounded)				\$2,060,000
Feasibility and Site Studies		6% of OPCC		\$124,000
Preliminary and Final Design		6% of OPCC		\$124,000
Engineering Services During Construction		5% of OPCC		\$103,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$103,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$62,000
Capital Improvement Plan Total				\$2,580,000

Table H-7 – SA-36 59th Ave./10th St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	134	\$172/LF	\$23,067	\$23,067
Water Distribution 10"	8,754	\$178/LF	\$1,559,620	\$1,559,620
Water Distribution 10" (Trenchless J&B)	400	\$581/LF	\$232,590	\$232,590
Pump Station - 1,580 gpm	1	LS	\$1,970,903	\$1,970,903
New Pond	3.40	\$60,964/AF	\$207,115	\$207,115
Tier 1 Dewatering	900	\$105/LF	\$94,500	\$94,500
Tier 2 Dewatering	8,388	\$52.50/LF	\$440,370	\$440,370
Unit Cost Subtotal				\$4,528,165
Erosion Control/Stormwater Pollution Prevention		2%		\$90,563
Mobilization & Demobilization		5%		\$226,408
Subtotal				\$4,845,137
Contingency		35%		\$1,695,800
Opinion of Probable Construction Cost (rounded)				\$6,550,000
Feasibility and Site Studies		6% of OPCC		\$393,000
Preliminary and Final Design		6% of OPCC		\$393,000
Engineering Services During Construction		5% of OPCC		\$327,500
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$327,500
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$197,000
Capital Improvement Plan Total				\$8,190,000

Table H-8 – SA-16 95th Ave./16th St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 10"	4,640	\$178/LF	\$826,666	\$826,666
Pump Station - 1,220 gpm	1	LS	\$1,663,880	\$1,663,880
New Pond	3.99	\$60,964/AF	\$243,309	\$243,309
Tier 1 Dewatering	575	\$105/LF	\$60,375	\$60,375
Unit Cost Subtotal				\$2,794,230
Erosion Control/Stormwater Pollution Prevention		2%		\$55,885
Mobilization & Demobilization		5%		\$139,711
Subtotal				\$2,989,826
Contingency		35%		\$1,046,440
Opinion of Probable Construction Cost (rounded)				\$4,040,000
Easement		5% of OPCC		\$202,000
Feasibility and Site Studies		6% of OPCC		\$243,000
Preliminary and Final Design		6% of OPCC		\$243,000
Engineering Services During Construction		5% of OPCC		\$202,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$202,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$122,000
Capital Improvement Plan Total				\$5,260,000

Table H-9 – SA-14 Tech Center Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 16"	8,221	\$224/LF	\$1,840,722	\$1,840,722
Unit Cost Subtotal				\$1,840,722
Erosion Control/Stormwater Pollution Prevention		2%		\$36,814
Mobilization & Demobilization		5%		\$92,036
Subtotal				\$1,969,572
Contingency		35%		\$689,360
Opinion of Probable Construction Cost (rounded)				\$2,660,000
Easement		5% of OPCC		\$133,000
Feasibility and Site Studies		6% of OPCC		\$160,000
Preliminary and Final Design		6% of OPCC		\$160,000
Engineering Services During Construction		5% of OPCC		\$133,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$133,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$80,000
Capital Improvement Plan Total				\$3,460,000

Table H-10 – SA-15 37th St./SH-257 Pump Station OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Pump Station - 1,400 gpm	1	LS	\$1,820,808	\$1,820,808
New Pond	5.33	\$60,964/AF	\$325,186	\$325,186
Unit Cost Subtotal				\$2,145,994
Erosion Control/Stormwater Pollution Prevention		2%		\$42,920
Mobilization & Demobilization		5%		\$107,300
Subtotal				\$2,296,213
Contingency		35%		\$803,680
Opinion of Probable Construction Cost (rounded)				\$3,100,000
Feasibility and Site Studies		6% of OPCC		\$186,000
Preliminary and Final Design		6% of OPCC		\$186,000
Engineering Services During Construction		5% of OPCC		\$155,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$155,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$93,000
Capital Improvement Plan Total				\$3,880,000

Table H-11 – SA-12 Cobblestone Regional OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 10"	2,023	\$178/LF	\$360,419	\$360,419
Pump Station - 1,180 gpm	1	LS	\$1,627,947	\$1,627,947
New Pond	4.44	\$60,964/AF	\$270,436	\$270,436
Unit Cost Subtotal				\$2,258,802
Erosion Control/Stormwater Pollution Prevention		2%		\$45,176
Mobilization & Demobilization		5%		\$112,940
Subtotal				\$2,416,918
Contingency		35%		\$845,930
Opinion of Probable Construction Cost (rounded)				\$3,270,000
Easement		5% of OPCC		\$164,000
Feasibility and Site Studies		6% of OPCC		\$196,200
Preliminary and Final Design		6% of OPCC		\$196,200
Engineering Services During Construction		5% of OPCC		\$164,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$164,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$99,000
Capital Improvement Plan Total				\$4,260,000

Table H-12 – Glenmere Park Expansion OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	4,136	\$172/LF	\$711,979	\$711,979
Water Distribution 8" (Trenchless J&B)	100	\$478/LF	\$47,808	\$47,808
Pond Expansion	2.91	\$60,964/AF	\$177,404	\$177,404
Tier 1 Dewatering	143	\$105/LF	\$15,015	\$15,015
Tier 2 Dewatering	4,093	\$52.50/LF	\$214,883	\$214,883
Unit Cost Subtotal				\$1,167,089
Erosion Control/Stormwater Pollution Prevention		2%		\$23,342
Mobilization & Demobilization		5%		\$58,354
Subtotal				\$1,248,785
Contingency		35%		\$437,080
Opinion of Probable Construction Cost (rounded)				\$1,690,000
Easement		5% of OPCC		\$85,000
Feasibility and Site Studies		6% of OPCC		\$102,000
Preliminary and Final Design		6% of OPCC		\$102,000
Engineering Services During Construction		5% of OPCC		\$85,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$85,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$51,000
Capital Improvement Plan Total				\$2,200,000

Table H-13 – SA-25 Westgate Regional Phase 2 OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	3,782	\$172/LF	\$651,041	\$651,041
Unit Cost Subtotal				\$651,041
Erosion Control/Stormwater Pollution Prevention		2%		\$13,021
Mobilization & Demobilization		5%		\$32,552
Subtotal				\$696,613
Contingency		35%		\$243,820
Opinion of Probable Construction Cost (rounded)				\$950,000
Easement		5% of OPCC		\$48,000
Feasibility and Site Studies		9% of OPCC		\$86,000
Preliminary and Final Design		9% of OPCC		\$86,000
Engineering Services During Construction		5% of OPCC		\$48,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$0
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$0
Capital Improvement Plan Total				\$1,220,000

Table H-14 – SA-42 23rd Ave./Northwest C St. OPCC and CIP Total

Item	Quantity	Unit Cost	Extended Cost	Total Cost
Water Distribution 8"	5,924	\$172/LF	\$1,019,769	\$1,019,769
Water Distribution 8" (Trenchless J&B)	150	\$478/LF	\$71,713	\$71,713
Pump Station - 1,180 gpm	1	LS	\$1,627,947	\$1,627,947
New Pond	2.75	\$60,964/AF	\$167,555	\$167,555
Tier 1 Dewatering	41	\$105/LF	\$4,305	\$4,305
Tier 2 Dewatering	5,883	\$52.50/LF	\$308,858	\$308,858
Unit Cost Subtotal				\$3,200,146
Erosion Control/Stormwater Pollution Prevention		2%		\$64,003
Mobilization & Demobilization		5%		\$160,007
Subtotal				\$3,424,156
Contingency		35%		\$1,198,460
Opinion of Probable Construction Cost (rounded)				\$4,630,000
Easement		5% of OPCC		\$232,000
Feasibility and Site Studies		6% of OPCC		\$278,000
Preliminary and Final Design		6% of OPCC		\$278,000
Engineering Services During Construction		5% of OPCC		\$232,000
Outside Construction Management - not used if OPCC value is < \$1M		5% of OPCC		\$232,000
Outside Project Management - not used if OPCC value is < \$1M		3% of OPCC		\$139,000
Capital Improvement Plan Total				\$6,030,000

Appendix I

CIP Development

I.1.1 Variability in Data

Data was obtained from past contractor bidding information provided by the City and other Front Range communities, as well as national sources. This data included unit costs for different potential capital expenditures within wastewater, water, and NP projects. The data varied in level of detail and definition of each cost element. For example, pipeline costs may or may not include dewatering, restoration, or paving project sites. Pipe cost data from the different sources also varied by construction depth, ground conditions, and method of installation for pipeline. For example, one data source may have identified unit price for a given pipe diameter size at a given depth, while another data source provided unit costs for given pipe diameter sizes of various depths within developed or undeveloped land areas. Both data sources provide information regarding pipe installation costs but need to be considered based on the level of detail that is desired for project CIP development.

I.1.2 Unknown Elements and Assumptions

Assumptions made during CIP development mean planning level costs will vary from construction bid costs. The assumptions are necessary to capture costs for project elements that cannot be defined at the planning level. Examples of undefinable costs include dewatering areas, utility pipeline crossings, permitting for project implementation, final contractor bid quantities, seasonal soil and ground conditions, and stormwater management of project sites. Assumptions are also made for method of pipe installation, timing of projects, and materials of construction. During design development, additional field information including survey, geotechnical data, groundwater levels, traffic control requirements, and final pipe alignment of project areas should be available to help refine the project elements and construction methods.

Trendlines and linear interpolation were used to develop costs for project elements with insufficient data. For example, cost data was obtained for the trenchless installation of water distribution and transmission lines for 4 inch through 60-inch diameter pipe, however there was limited cost information for 36-inch pipe. Trend line equations for linear, polynomial, and logarithmic and their respective R² values were compared to identify the most probable estimation equation. In this case, the trendline equation with an R² value closest to 1 was selected as the most probable estimation equation. Because the trendline with the most pertinent R² value may not reflect the true cost, CDM Smith recommends the City readjust cost data throughout the planning horizon.

An example of comparing different trend line equations and their respective R² values for approximating missing data is shown in **Figure I-1**. This example highlights the jack and bore (J&B) trenchless installation of water distribution and transmission pipeline items. In this example, the second order polynomial trend line (shown by the purple dotted line below) has the closest R² value to 1 compared to the exponential and logarithmic trend lines (shown by the blue and green dotted lines below, respectively) based on available data. As a result, without

additional industry knowledge and experience, the linear trend line would be assumed to best approximate unit costs for J&B trenchless pipe installation for pipe diameter sizes not available from the given data set. This assumption may conflict with actual J&B trenchless pipe installation data trends known in industry, which may better be approximated by exponential or logarithmic trend lines. This would especially be true when predicting trenchless pipe installation for large pipe diameter sizes (i.e., greater than 24 inch) where predictions of data points of the trend lines begin to greatly diverge. At a planning level, this limitation is acceptable when a cushion of construction cost contingency (i.e., 30%) is added to help absorb this unit cost uncertainty. However, at an engineering design level, where construction cost contingency is lowered, the chosen trend line that best reflects industry data trends should be used to model trenchless pipe installation. This should also be used for all unit cost items where trendlines are used, regardless of if the chosen trend line has an R2 value closest to 1 in order to avoid unnecessary error.

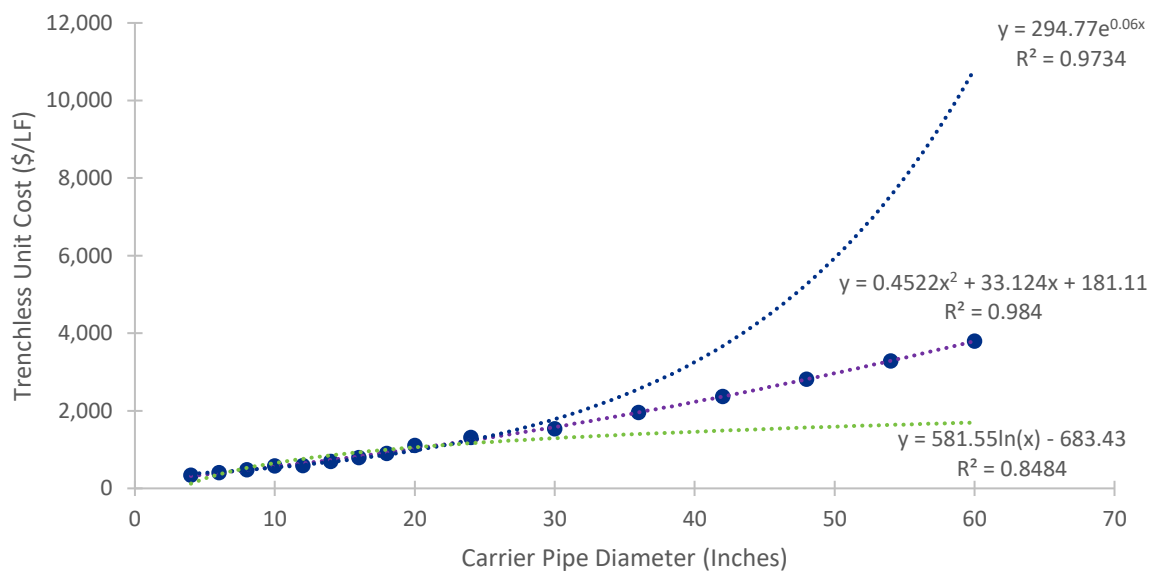


Figure I-1 Example of Different Trendlines for Finding Missing Data of a Line Item

I.1.3 Unpredictability

There is inherent unpredictability to consider during CIP development. This unpredictability is captured in the cost range that is provided for the overall CIP. Examples of unpredictability include future economic trends and inflation rates. Prior to COVID-19, a global pandemic, cost inflation tools provided high confidence for predicting unit prices within a given year. However, after COVID-19, these cost inflation tools may not prove to be as accurate.

I.1.4 Data Sources

Major sources for cost factors included city bid tabs and databases, past project data and contractor construction bid tabs, vendor quotes and cost estimates from CDM Smith's estimating department. A list of external sources that CDM Smith used to develop unit costs for the City's CIP water transmission and distribution cost estimates includes the following:

- City of Greeley Project Initiation Form (City of Greeley, 2021)
- Operation Rehab Project 2021 – 2025 Spreadsheet (City of Greeley, 2021)
- Water and Sewer Department 10 Year CIP 2021 – 2030 Spreadsheet (City of Greeley, 2021)
- Collection, Distributions, Transmission Projects Phase I – (CMAR) (City of Greeley, 2019)
- City of Greeley Pipe Rehabilitation Cost Estimating Template (City of Greeley, 2019)
- Keep Greeley Moving Phase 2 by Neighborhood 2023 – 2029 (City of Greeley, 2021)
- City of Aurora Wastewater Master Plan (AECOM, 2017)

The data was compiled in a single file with line item data reflected as unit costs (dollars per linear foot, dollars per each, etc.). When needed, unit costs for specific line items were calculated using trend line equations. Line items that were not specific or harder to estimate using specific unit cost quantity were reflected as a percentage addition to project costs (mobilization and demobilization, erosion control and stormwater pollution prevention, etc.).

The costs estimated for each project are in August 2020 dollars. Historical data was adjusted to the equivalent August 2020 data by using Engineering News Record's 20-City Construction Cost Index (ENR-CCI). ENR estimates a project each month in 20 different cities around the U.S. and calculates the composite index. Costs are adjusted by multiplying a cost element with the ratio of the current day 20-City ENR-CCI and date of data.

$$\text{Construction Unit Cost (T2)} = \text{Construction Cost (T1)} \times \frac{\text{CCI(T2)}}{\text{CCI(T1)}}$$

T2 and T1 reflect the desired projected year and month desired and the originally year and month of unit costs, respectively.

I.1.5 Major Cost Elements

NP water distribution system CIP costs were developed using five general cost element categories, as shown in **Figure I-2** and described below.



Figure I-2 CIP Categories for Cost Definition

Each of these cost elements is discussed in more detail in the following subsections. Unit priced line items, mobilization and demobilization, and stormwater pollution prevention and erosion control was rounded to the nearest whole dollar. Project contingency was rounded to the nearest \$10 and added to the OPCC subtotals to determine the OPCC project totals which were rounded to the nearest \$10,000. Subsequent costing factors were added to the OPCC project totals to determine CIP estimates used for high-level planning of water transmission and distribution, sewer, and NP master plans.

I.1.6 Pipeline, Pump Stations, & Ponds

Installation of Pipe

NP water lines were generally assumed to be installed using open cut construction. Open cut construction is where contractors remove surface soils to insert pipe, except for arterial roadway and highway, railroad, irrigation ditch, river, and lake crossings. In such instances, trenchless pipe installation was assumed which inserts pipe through tunneling and boring, J&B, or horizontal direct drilling (HDD) methods. Open cut pipeline installation unit costs (in dollars per linear foot of pipe, \$/LF) include the pipe and bedding, excavation, installation including traffic control, tie-ins for service laterals, backfill, restoration, and flow and throttle control valves. Distribution pipelines were classified with pipe diameters up to 20 inch while transmission lines were classified with pipe diameters 24 inch and above.

The open cut installation was divided into developed and undeveloped categories. The developed category includes pipe installed in developed areas such as in neighborhoods, along major City streets, across two lane roads, through developed commercial property and designated agricultural land, and around City boundaries. The undeveloped category was assigned to pipe installed in permanent open space designated as city parks. It was assumed that all NP water lines were installed at less than 10 ft depth unless using trenchless installation for crossings.

Trenchless installation costs (in \$/LF of pipe) include the casing and carrier pipe, supports and grouting of the interstitial space, launching and receiving pits, and ground monitoring using J&B drilling or HDD. Unit prices were developed using bid tabs and CDM Smith's construction cost data base.

Table I-1 gives the unit cost breakdown for installation of NP water lines.

Table I-1 – Unit Costs for NP Lines

Pipe Diameter Size (In.)	Unit Cost (\$/LF of Pipe)			
	Undeveloped Land Designation	Developed Land Designation	Trenchless J&B (Crossings)	Trenchless HDD (River Crossings)
8	119	172	478	585
12	131	184	584	803
16	158	224	791	944
18	171	256	897	1,023
20	184	289	1,105	1,107
24	211	315	1,314	1,272
30	237	368	1,531	1,530
36	264	421	1,960	1,796
42	302	486	2,370	2,054
48	355	566	2,813	2,312
54	395	657	3,288	2,570
60	460	763	3,796	2,827

Pump Stations

Construction costs of new pump stations were developed using Chapter 29 of *Pumping Station Design, Revised 3rd Ed.* (Jones et al. 2006). High and low trend line estimates were averaged based on 2006 cost projections and then projected to the inflated August 2020 equivalents. The cost estimates only include construction of new pump station infrastructure including enclosures, wet wells, instrumentation, electrical, and pumps. The updated August 2020 high, low, and averaged pump station equations are shown below:

$$\text{Low Limit New PS Cost(\$)} = \$2,367 \times \text{PS Flow Rate (gpm)}^{0.77}$$

$$\text{High Limit New PS Cost(\$)} = \$33,648 \times \text{PS Flow Rate (gpm)}^{0.62}$$

$$\text{Averaged Limit New PS Cost(\$)} = \$15,844 \times \text{PS Flow Rate (gpm)}^{0.66}$$

Figure I-3 depicts the comparison of the three equations used for new pump station construction estimates. This master plan assumes all new pump stations costs using the averaged pump station equation.

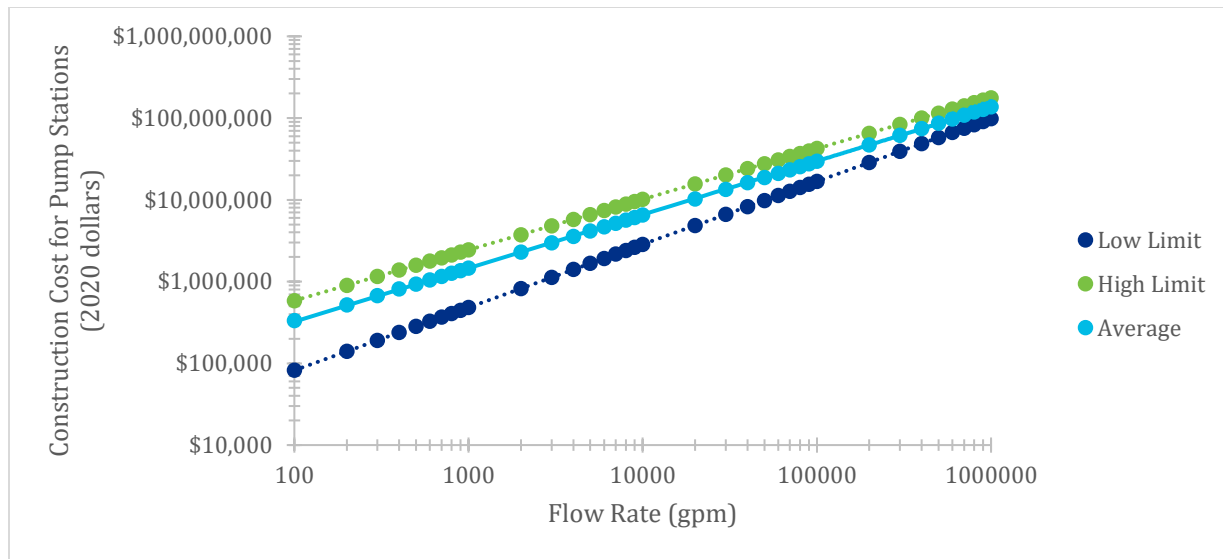


Figure I-3 Pump Station Design High, Low, and Averaged Estimated Construction Costs (Jones et al. 2006)

Ponds

Construction costs for either ponds to accommodate additional storage, or the installation of new ponds, assumed the installation cost of new ponds as a conservative estimate. Pond replacement and new pond installation in \$/AF included costs for pond excavation, subgrade, pond liners and fabric, covering of soil over lake bottom, rip rap, and aeration systems. Pond sizing (in AF) for each project was estimated on future buildout conditions identified in the future system model.

I.1.7 Crossings, Land Considerations, and Dewatering

Irrigation Ditch, River Crossings, and Lake Crossings

ArcMap GIS and City-provided information was used to identify irrigation ditch, river, and lake crossing locations. Irrigation ditch, river, and lake crossings were assumed as 100 ft in length, 250 ft in length, and estimated lake crossing length, respectively. Unit costs for irrigation ditch, river, and lake crossings were approximated by trenchless pipe installation, regardless of pipe depth, using J&B for ditch crossings and HDD drilling for river and lake crossings.

Utility, Roadway, and Railway Crossings

ArcMap GIS, the City's online GIS, and Google Maps were used to identify road, utility, and railroad crossings. Unit prices were developed assuming installation by J&B, where applicable, using the following assumptions:

- Roads were separated into typical (defined as: two to three lane roads located on side streets and in neighborhoods), arterial (defined as: major roadways of four lanes or more assumed at 200 ft wide), and highways (defined as: major roadways with Colorado Department of Transportation Right-of-way requirements at 250 ft wide). Widths were based on the U.S. Department of Transportation Federal Highway Administration (USDOT, 2014). Typical road crossings were included as part of overall open cut installation

described in **Section I.3.3**, while arterial road and highway crossings were accounted as a part of trenchless pipe installation costs described in **Section I.2.2**.

- Railway crossings were estimated as 150 ft in length included in trenchless installation costs, described in **Section I.2.2**.
- Other City and non-City utilities were not included as unit cost estimates but assumed to be covered under project contingency, described in **Section 5.3.5**.

Easements

Easement acquisition was assumed to be required for all new pipeline, not in a City right-of-way or on City-owned property. Easement acquisition was assumed as a costing factor multiplier of the total OPCC at 5%.

Dewatering

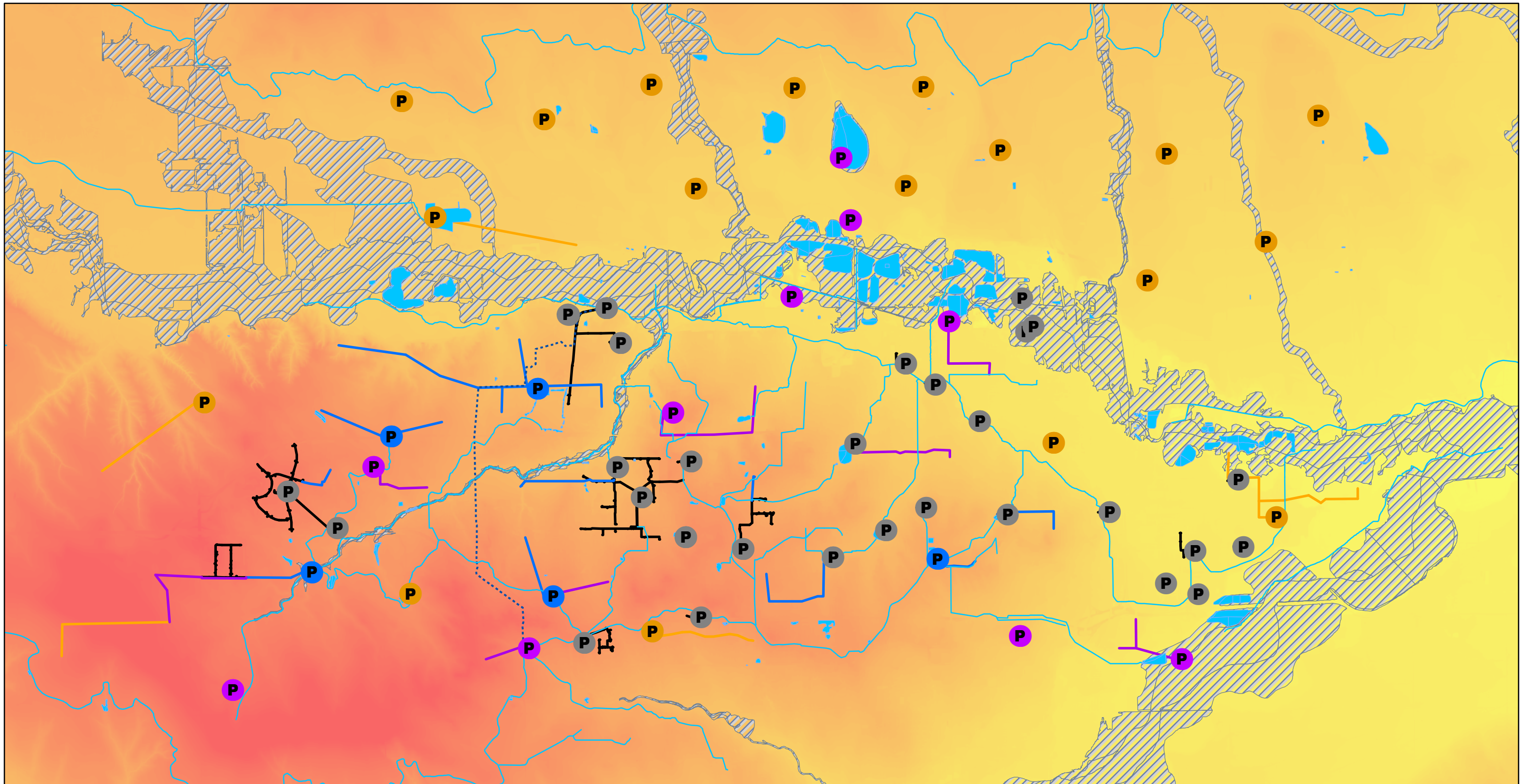
A three-tiered approach was used to determine projected dewatering. The three tiers used for unit cost estimation were developed considering land elevations in and around the City (between approximately 4,600 ft to 5,060 ft), 100-year floodplain maps, and proximity to irrigation ditches and water bodies. Tier 1 includes water distribution and transmission line construction within the 100-year floodplain or within 50 ft of an irrigation ditch, pond, or lake. Tier 2 includes pipe that is not in Tier 1, is below the median elevation of the City (4,828 ft), and is assumed to require 50% of the dewatering needed for Tier 1. Tier 3 includes pipe in areas above the median elevation and assumes no dewatering is required.

Figure I-4 illustrates the three-tiered dewatering profile. **Table I-2** lists the unit costs developed for the three-tiered dewatering categories in \$/LF of pipe.

Table I-2 – Unit Costs for Dewatering by Tier

Tier	Unit Cost (\$/LF of Pipe)
1	105
2	52.50
3	0

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June 02, 2021

Legend

Tier 1

 100-yr FloodPlain

 Lake

 Greeley Ditch

Tier 2

 4828 ft

 4596 ft

Tier 3

 5059 ft

 4828 ft

 Existing Pump Station	 Existing NP Pipes
 2025 Pump Station	 2025 Proposed NP Pipes
 2040 Pump Station	 2040 Proposed NP Pipes
 Buildout Pump Station	 Buildout Proposed NP Pipes
	 Upper Equalizer Project

N



0 0.5 1 2

Miles

3-Tiered Dewatering Profile

Figure I-4

Greeley Non-Potable Water System Master Plan

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1.1.8 Project Implementation and Additional Project-Related Costs

Project elements considered part of project implementation as well as additional project related costs are difficult to quantify at the planning level. Construction elements include items such as erosion control and stormwater pollution prevention and contractor mobilization and demobilization. These costs are estimated as a percentage of the subtotal pipe, pump stations, ponds, and equipment. Contingency is applied to the subtotal of these construction cost elements to account for variations in unit prices or quantity estimates. Programmatic elements include engineering, permitting, legal and administration and are estimated as a percentage of the construction cost.

Table I-3 provides a breakdown of the different assumptions used for project implementation and contingency.

Table I-3 – Costing Factors for Construction Bid and Total CIP Project Costs

Category	Item	Costing Factor
Construction Bid Cost (includes infrastructure and contractor overhead, profit, bonds, and insurance)	Erosion Control/Stormwater Pollution Prevention ¹	2%
	Mobilization and Demobilization ¹	5%
	Contingency ²	35%
Project Implementation ³	Feasibility and Site Studies	9% for OPCC ≤ \$1M 6% for OPCC of \$1M to \$10 Mil. 5% for OPCC > \$10M
	Preliminary and Final Design	9% for OPCC ≤ \$1M 6% for OPCC of \$1M to \$10M 5% for OPCC > \$10M
	Engineering Services During Construction	5%
Additional Project-Related Costs ³	Outside Construction Management - not used if project value is < \$1M	5%
	Outside Project Management - not used if project value is < \$1M	3%

¹ Construction Bid Cost costing factors erosion control/stormwater pollution prevention and mobilization and demobilization are added to the subtotal of unit cost items.

² Contingency costing factor is 35% of the subtotal of the unit cost items and contractor born costs determined by costing factors.

³ Project Implementation and Additional Project-Related Cost categories are determined as a percentage of the construction cost and part of the total CIP project costs.

Project Erosion Control/Stormwater Pollution Prevention

The Project Erosion Control and Stormwater Pollution Prevention cost element includes the contractors cost to manage the stormwater during construction through best management practices. These best management practices include items such as silt fences, rock socks, vehicle tracking, and silt prevention at storm inlets. This category is assumed as 2% of the OPCC subtotal of the items that have unit costs and is based on estimator's judgement and prior reports. This costing factor is added to calculate project OPCC totals.

Mobilization and Demobilization

The Contractor Mobilization and Demobilization cost element includes the contractor's start-up costs and close-out costs. Start-up costs include items such as moving equipment and personnel to the project location, obtaining permits and bonds, etc. Close-out costs include items such as project cleanup, moving equipment and personnel from the project location, etc. The mobilization and demobilization category is assumed as 5% of the OPCC subtotal of the items that have unit costs and is based on estimator's judgement and prior reports. This costing factor is added to calculate project OPCC totals.

Contingency

During the planning phase, the field work and design have not yet been completed for the projects. Therefore, the cost development relies on estimated quantities for each construction element. Project contingency provides for these uncertainties by adding additional costs to the project total. The contingency at the planning level is typically 35% of the OPCC subtotal, after erosion control and stormwater pollution prevention and mobilization and demobilization costing factors have been included. Project contingency also provides for cost associated with items that are difficult to itemize at a planning level.

Feasibility and Site Studies

The Feasibility and Site Studies cost element includes the planning and field investigations (such as geotechnical, survey, ground sampling, utility locates, etc.) required to implement a project and is estimated as a percentage of the subtotal of the previous elements. The percentage varies based on the OPCC, plus cost contingency.

Preliminary and Final Design

The Preliminary and Final Design cost element includes the cost for engineering services to develop biddable plans and specifications in accordance with applicable standards. This cost is estimated using a percentage of the OPCC, plus cost contingency.

Engineering Services During Construction

The Engineering Services During Construction cost element includes a review of contractor submittals, requested changes, and design adjustments that may be required during construction. A flat percentage of the OPCC is used to estimate this cost element.

Additional Project-Related Costs

Outside construction and project management are estimated for projects that are not directly managed by the City. For purposes of this master plan, only projects in excess of \$1M were assigned these cost elements.

Appendix J

Annual Funding Requirements for City NP CIP Projects (2020 – 2043)

Annual funding requirements per identified City NP CIP project and fiscal year totals are shown in the following table. It was assumed that each project stage (planning, design, and construction) will take at least one year with the construction phase taking two, three, or four years if the total CIP cost for a project was greater than \$1 million, \$5 million, or \$10 million, respectively.

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Appendix J – Annual Funding Requirements for City NP CIP Projects (2020-2043)

W/S Expense		Planning Start Year	Design Start Year	Construction Start Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Project Names	Planning Start Year	Design Start Year	Construction Start Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
SA44 Centennial Park	2020	2021	2022	\$ 167,819	\$ 167,819	\$ 1,050,140	\$ 1,050,140	\$ 1,050,140	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional PS	2021	2021	2022	\$ -	\$ 21,239	\$ 66,637	\$ 66,637	\$ 66,637	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional Phase 2	2021	2021	2022	\$ -	\$ 9,980	\$ 31,089	\$ 31,089	\$ 31,089	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Greeley West PS	2021	2022	2023	\$ -	\$ 296,110	\$ 296,110	\$ 1,855,015	\$ 1,855,015	\$ 1,855,015	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Upper Equalizer	2022	2023	2024	\$ -	\$ -	\$ 2,002,000	\$ 1,001,000	\$ 5,653,000	\$ 5,653,000	\$ 5,653,000	\$ 5,653,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Tech Center Supply	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Prom Park Exp	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA38 1st Ave Pond	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ 244,011	\$ 133,243	\$ 1,251,763	\$ 1,251,763	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Twin Rivers Exp	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ 25,607	\$ 25,607	\$ 298,748	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Monfort Exp	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ 246,259	\$ 134,412	\$ 842,610	\$ 842,610	\$ 842,610	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA-25 Westgate Reg. Phase 1	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA60 Lake Bluffs	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,205	\$ 1,205	\$ 11,339	\$ 11,339	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA25 Westgate Reg. PS	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 390,887	\$ 213,003	\$ 1,337,312	\$ 1,337,312	\$ 1,337,312	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA34 30st 17Ave	2027	2028	2029	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 92,599	\$ 92,599	\$ 871,972	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA4 35 Ave Ost	2028	2029	2030	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,457	\$ 13,457	\$ 117,747	\$ 117,747	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional Phase 3	2028	2029	2030	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 21,054	\$ 11,803	\$ 74,100	\$ 74,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA3 35 Ave AA st	2029	2030	2031	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Bittersweet Park Exp.	2029	2030	2031	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 82,245	\$ 82,245	\$ 774,669	\$ 774,669	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA35 44ave Fst	2030	2031	2032	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 7,980	\$ 7,980	\$ 74,909	\$ 74,909	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA36 59 ave 10st	2031	2032	2033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 182,863	\$ 182,863	\$ 1,148,049	\$ 1,148,049	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA16 95ave 16st	2034	2035	2036	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 17,365	\$ 9,482	\$ 59,391	\$ 59,391	\$ 59,391	\$ -	\$ -	\$ -	\$ -	\$ -	
SA14 Tech Cent Exp	2035	2036	2037	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA15 37st SH257	2036	2037	2038	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA12 Cobblestone	2037	2038	2039	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,128	\$ 1,161	\$ 10,875	\$ 10,875	\$ -	\$ -	\$ -	
Glenmere Park Exp	2037	2038	2039	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 234,308	\$ 127,863	\$ 1,199,450	\$ 1,199,450	\$ -	\$ -	\$ -	
SA25 Westgate Reg. Phase 2	2038	2039	2040	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 94,171	\$ 60,438	\$ 350,683	\$ 350,683	\$ -	\$ -	
SA42 23ave Cst	2039	2040	2041	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 112,568	\$ 115,870	\$ 727,038	\$ 727,038	\$ 727,038	
Total				\$ 167,819	\$ 495,147	\$ 3,447,976	\$ 4,005,882	\$ 9,140,670	\$ 8,193,370	\$ 8,260,329	\$ 9,188,622	\$ 2,318,971	\$ 2,316,788	\$ 1,154,044	\$ 1,157,360	\$ 1,106,541	\$ 1,222,958	\$ 1,165,414	\$ 1,157,532	\$ 59,391	\$ 295,828	\$ 282,587	\$ 1,483,331	\$ 1,676,878	\$ 1,077,721	\$ 727,038	\$ 727,038	
Parks																												
Project Names	Planning Start Year	Design Start Year	Construction Start Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
SA44 Centennial Park	2020	2021	2022	\$ 66,361	\$ 66,361	\$ 415,257	\$ 415,257	\$ 415,257	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional PS	2021	2021	2022	\$ -	\$ 66,595	\$ 208,945	\$ 208,945	\$ 208,945	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional Phase 2	2021	2021	2022	\$ -	\$ 31,292	\$ 103,754	\$ 103,754	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Greeley West PS	2021	2022	2023	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Upper Equalizer	2022	2023	2024	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Tech Center Supply	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Prom Park Exp	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA38 1st Ave Pond	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Twin Rivers Exp	2024	2025	2026	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA-25 Westgate Reg. Phase 1	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA60 Lake Bluffs	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA25 Westgate Reg. PS	2025	2026	2027	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA34 30st 17Ave	2027	2028	2029	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA4 35 Ave Ost	2028	2029	2030	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Boomerang Regional Phase 3	2028	2029	2030	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA3 35 Ave AA st	2029	2030	2031	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Bittersweet Park Exp.	2029	2030	2031	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA35 44ave Fst	2030	2031	2032	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA36 59 ave 10st	2031	2032	2033	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA16 95ave 16st	2034	2035	2036	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA14 Tech Cent Exp	2035	2036	2037	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA15 37st SH257	2036	2037	2038	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA12 Cobblestone	2037	2038	2039	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Glenmere Park Exp	2037	2038	2039	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA25 Westgate Reg. Phase 2	2038	2039	2040	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
SA42 23ave Cst	2039	2040	2041	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Total				\$ 66,361	\$ 164,247	\$ 727,957	\$ 727,957	\$ 708,438	\$ 170,693	\$ 419,637	\$ 688,902	\$ 756,801	\$ 600,812	\$ 413,435	\$ 600,007	\$ 865,365	\$ 1,071,095	\$ 825,728	\$ 802,291	\$ 176,586	\$ 275,570	\$ 230,602	\$ 626,905	\$ 572,229	\$ 411,095	\$ 411,095	\$ 411,095	
Development																												
Project Names	Planning Start Year	Design Start Year	Construction Start Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
SA44 Centennial Park	2020	2021																										

¹ Refer to 5- and 20-year recommended improvements map in Section 5 for project locations

² Construction span was set based on total CIP cost estimates per project: \$10M – 4 years, \$5M – 3 years, \$1M – 2 years, < \$1M – 1 year

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Appendix K

Comprehensive Plan Action Item List

The City adopted the *Imagine Greeley Comprehensive Plan* in 2018, which is a policy guide that provides framework for public and private growth and development decisions made by the City over the next ten to twenty years. As a part of the Comprehensive Plan, a list of recommended actions was identified in Section 5 to assist in implementation of this plan. A summary of action items addressed with the development of this NPMP to ensure implementation of the Comprehensive Plan is summarized in the following table.



INFRASTRUCTURE (IN)

IMPLEMENTATION ACTION	NON-POTABLE MASTERPLAN ACTION ITEM RESPONSE
Goal IN-1: Ensure developed areas in Greeley are served by adequate public facilities and services.	
IMP IN-1.1 Annually review and update the City's Adequate Public Facilities Area (APFA) concurrent with annual growth and development projections to assist in the planning and funding of municipal infrastructure to accommodate growth. Prepare maps depicting the boundaries of existing and budgeted service areas for infrastructure included in the APFA requirements.	While the NPMP does not review or update the APFA, it identifies the critical infrastructure needed to serve all major developable areas within the LREGA (Section 5) and the anticipated CIP cost (Section 6). This masterplan will assist in planning and funding of municipal infrastructure and determine the anticipated infrastructure to meet the APFA requirements.
IMP IN-1.2 Continue to support timely and effective development in the Long Range Expected Growth Area as it relates to 208 Wastewater planning and treatment. Where possible and practical, look for opportunities to share and/or coordinate such capital improvements with other jurisdictions to efficiently use public resources.	Not Applicable
IMP IN-1.3 Through the annual Population Growth and Projections and Capital Improvements Plan, identify the location for new fire stations, parks and other public facilities commensurate with the City's expected growth.	Not Applicable
IMP IN-1.4 Complete and implement a basin-wide study that addresses drainage improvements through larger, shared, facilities which could also achieve an attractive, functional community or regional park use.	Not Applicable
IMP IN-1.5 Evaluate existing capacity within established areas of the city to understand where investments in expanding infrastructure will be needed in order to support the type and/or intensity of development envisioned in the Land Use Guidance Map	This masterplan has evaluated existing infrastructure to confirm sufficient capacity with the existing conditions, with future development of infill and densification of parcels, and full buildout as envisioned by the Land Use Guidance Map.

IMPLEMENTATION ACTION	NON-POTABLE MASTERPLAN ACTION ITEM RESPONSE
IMP IN-1.6 Update existing functional master plans for infrastructure and services as needed to account for changes in land uses and intensities that result from the adoption of this Comprehensive Plan and completion of implementation actions.	This masterplan incorporates improvements made to the NP water distribution system from the most recent masterplan completed in 2004. This masterplan has incorporated recent land use applications, utilized the Comprehensive Plan to update land uses and anticipated densities, and addressed areas outside of the 20-year plan through guidance and coordination with the Planning department.
IMP IN-1.7 Develop functional master plans detailing the maintenance, operation, and expansion of infrastructure and public facilities where such documents do not currently exist.	Not Applicable
IMP IN-1.8 Consider the extension of water lines to serve larger groups of users and along primary roadways to provide non-potable water to landscaped medians and parkways.	Not Applicable

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Appendix L

Greeley Policy for Non-Potable Irrigation

[Final NP policy will be appended here when approved by the City.]



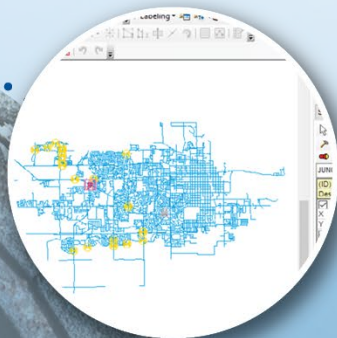
**CDM
Smith**[®]
cdmsmith.com



Non-Potable Water Master Plan

August 18, 2021

Water & Sewer Board Presentation



**CDM
Smith**

CDM Smith Experience

- CDM Smith has successfully completed over 500 Master Plans in the past 10 years
- CDM Smith has over 40 years of national experience in master planning
- Firmwide modeling capabilities include more than 200 professionals versed in hydraulic modeling
- Local team led by a PM who has worked on over 20 water/sewer master plans

Mission Statement

Provide City of Greeley a *reliable, defensible, and accurate* Master Plan that will serve as a 20-year planning guide by analyzing the infrastructure needed to improve system operations, serve population growth areas, and to integrate water, sewer, and non-potable water systems to make it a *cohesive plan*.



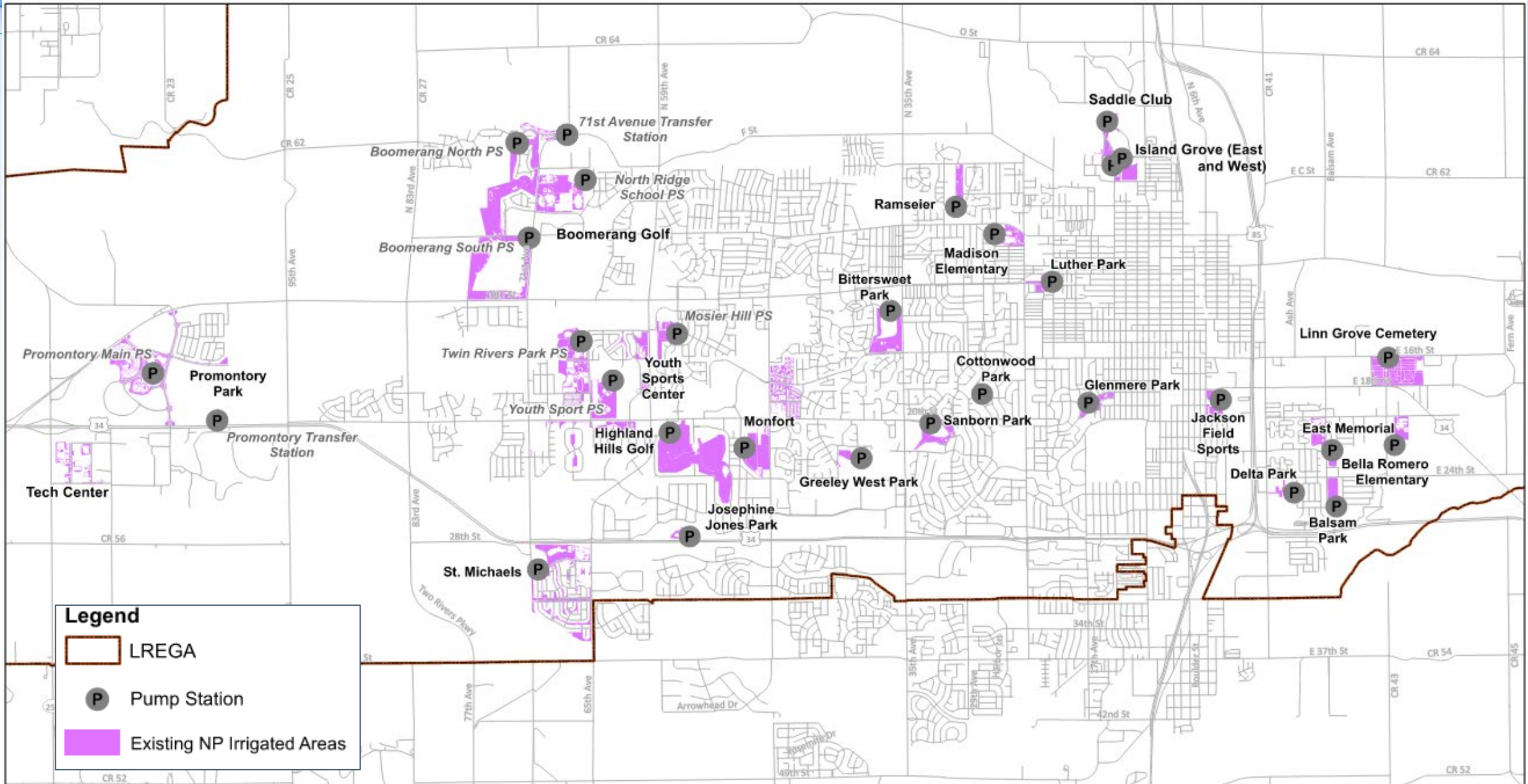
Greeley Non-Potable Water Master Plan

Existing Water Sources for the Non-Potable Irrigation System

- The Greeley Irrigation Company (GIC) Ditch #3
 - Runs April through October.
- The Greeley Loveland Irrigation Company (GLIC) Ditch runs May through September.
 - Customers on the Greeley Loveland Irrigation Ditch are supplemented with potable water in April and October.
- Exchanged wholly-consumable wastewater effluent
 - Poudre Ponds
 - Augmented wells

Existing Non-Potable System

- Field inventory conducted to identify key infrastructure
- Typically, water goes from a ditch, into a pond, then pumped into the system
- System summary:
 - Over 37 pump stations and 10 wells
 - Maintains 90,000 feet of pipe
 - Over 100 customers
 - 24 unique service areas
- Stakeholder research confirmed that Greeley's system is unique and mature compared to other municipalities





Demands Development

Existing Demands

- Data Sources
 - NP Billing Data (2014 – 2019)
 - Pumping Record Data (2014 – 2019)
 - SCADA Data (2015 – 2020)
 - Note: Not all data sources available for all pump stations
- Allocate demands based on summer 2018/2019 billing or pumping data
- Developed unique peaking factors for all sites with SCADA
- Adjusted demands and peaking factors through calibration to match SCADA data where available
 - Calibrated primarily to peak hour, with checks on total volume and pressure

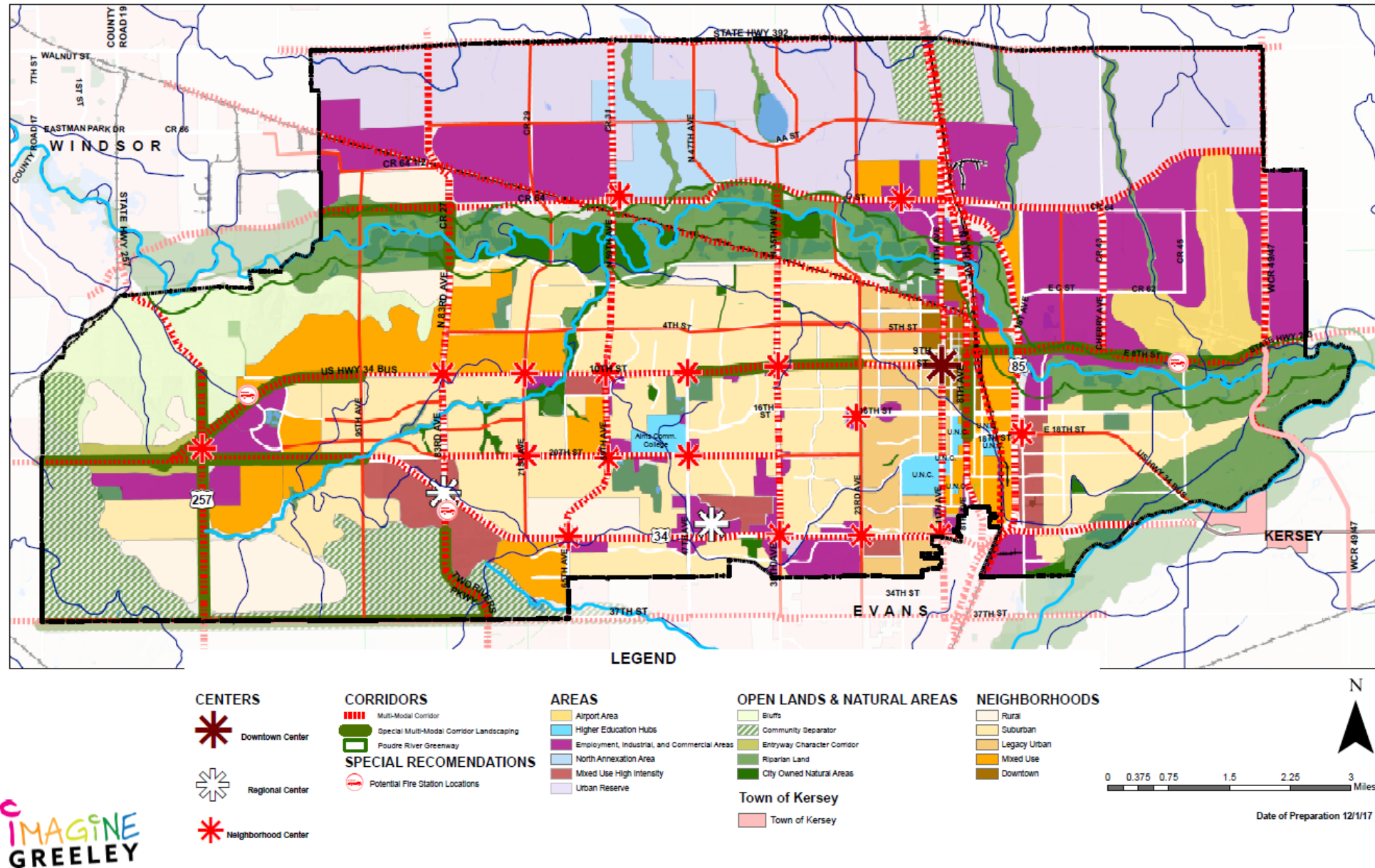
Expanding the Non-Potable System Goals

- Reduce use of potable water for irrigation
 - Allows use of cheaper, untreatable water sources.
 - \$30,000+ for potable sources vs ~\$8,000 for non-potable sources
 - Frees up potable sources for use during droughts
 - Reduces potable water infrastructure expansion
- Increase non-potable use to over 10,000 AF per year
 - Current use: 2,500 AF per year

Future Demand Projections

- Projected future land use developed using:
 - Greeley Comprehensive Plan (with Planning input/customization)
 - Planned development reports
 - 2019 Zoning
- Determine flow rates by land use category from historic billing data
- Coordinate with other sources, including:
 - Planning Department and Parks Department
 - BBC population projections
 - Data from other Front Range communities
- Coordination & integration between all three Master Plans

Comprehensive Plan – Land Use Guidance Map



Adoption Rates

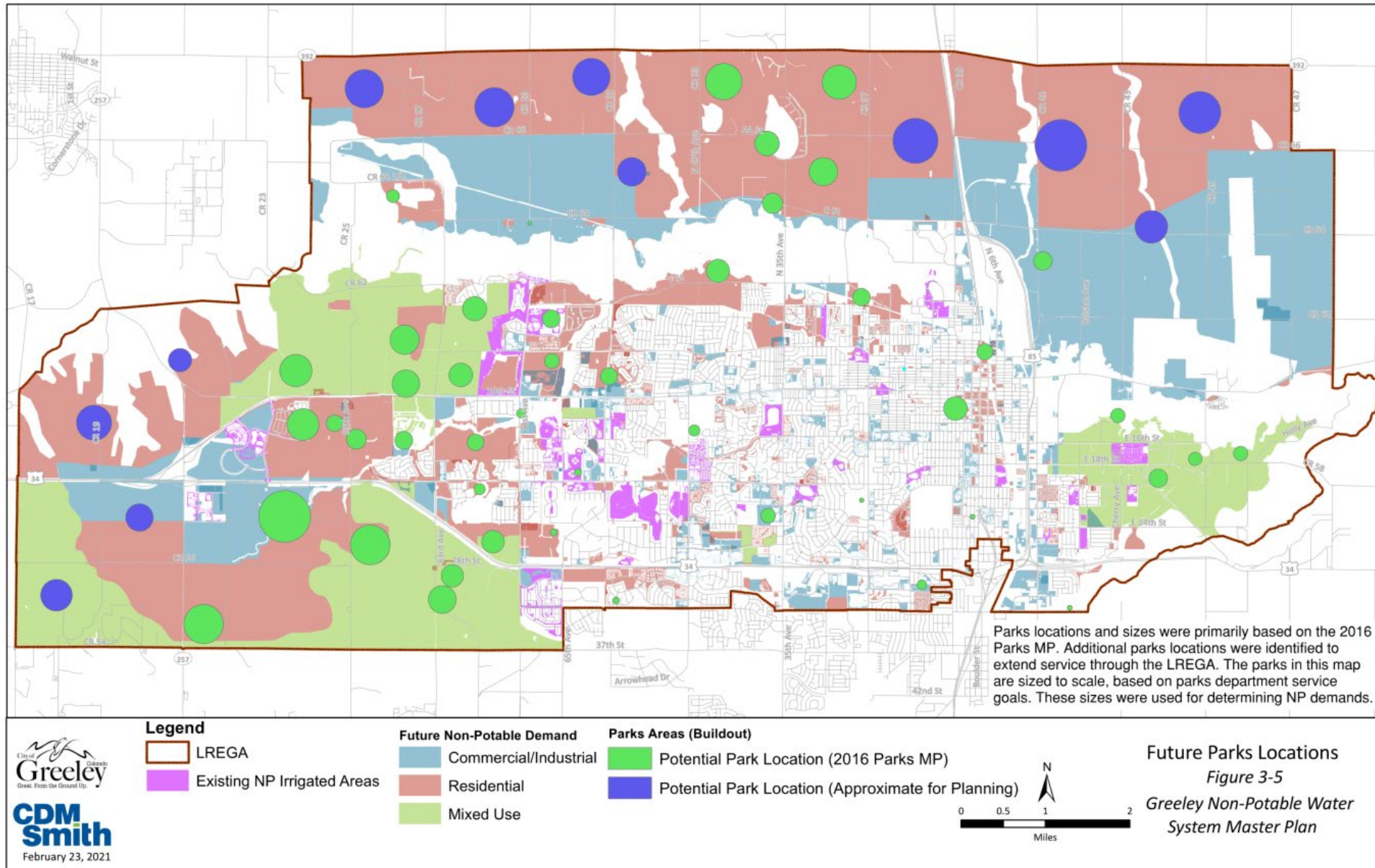
- BBC-RAS Report provided likely adoption rates per customer type
- Applied to both undeveloped land and conversion areas
- **Difference between planning and design**
 - Planning = general quantities across the whole system, unknown what specifically will be on NP
 - Expected demands are spread across the total undeveloped land area; low/even density
 - Design = know the exact amount of demand needed, hyper-localized
 - Expected demands are “gathered” into places where demand is actually built; high/varied density

Peak Month Flow Factors and Adoption Rates

Category	Bulk Land Flow Factor gpd/ac	Irrigated Land Flow Factor gpd/ac	Adoption Rate
Park	1,600	3,500	90%
Commercial	1,300	3,200	20%
Multifamily HOA	1,500	4,400	15%
School	2,100	4,300	75%
Church	1,300	2,000	75%
I-L	500	NA	20%
I-M	125	NA	20%
R-L	1,200	4,700	20%
Residential (R-M)	900	5,200	20%
R-E	80	NA	15%

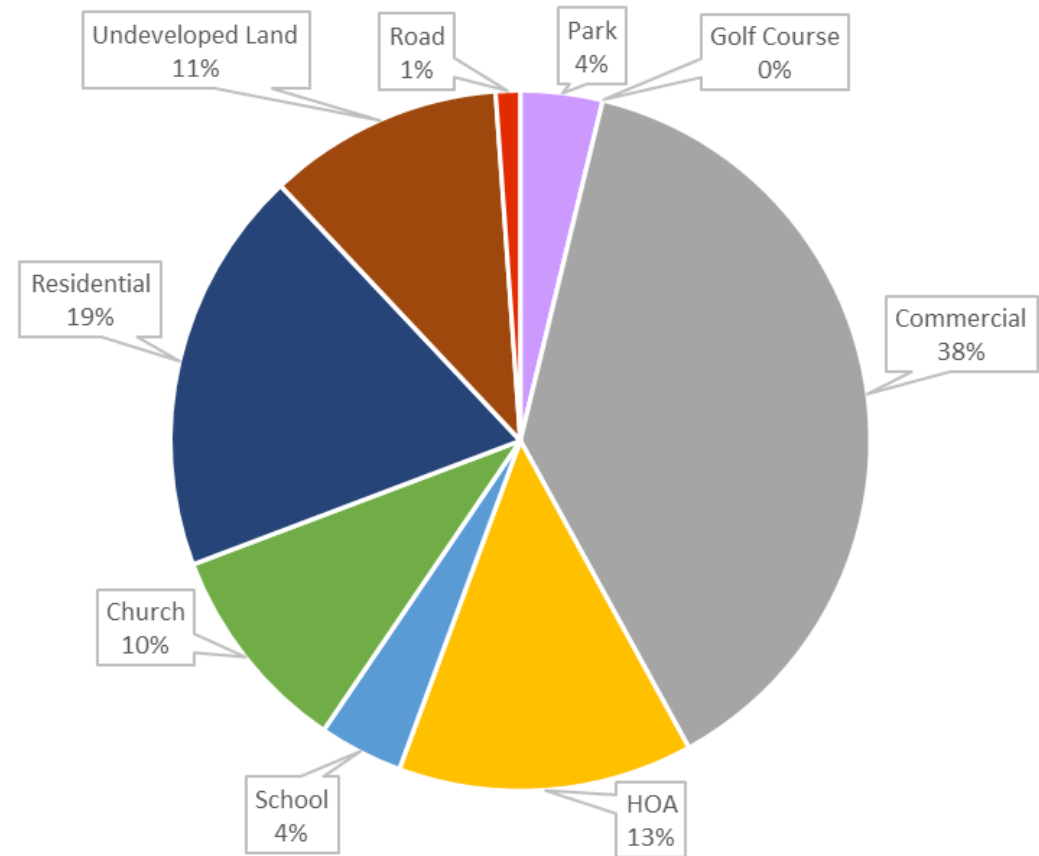
Note: Future adoption rates are highly dependent on policy decisions

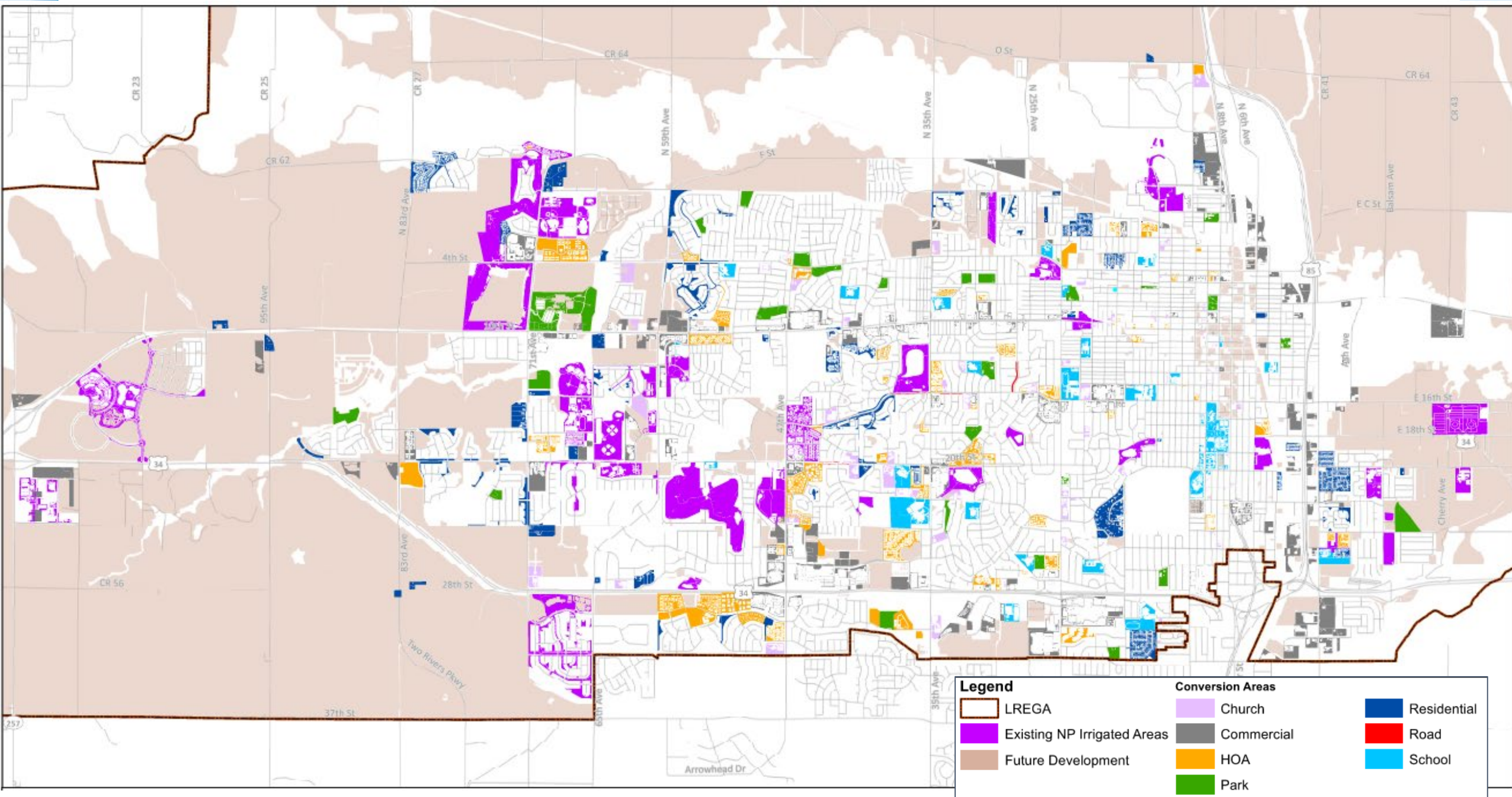
Future Non-Potable Sites



Conversion Areas

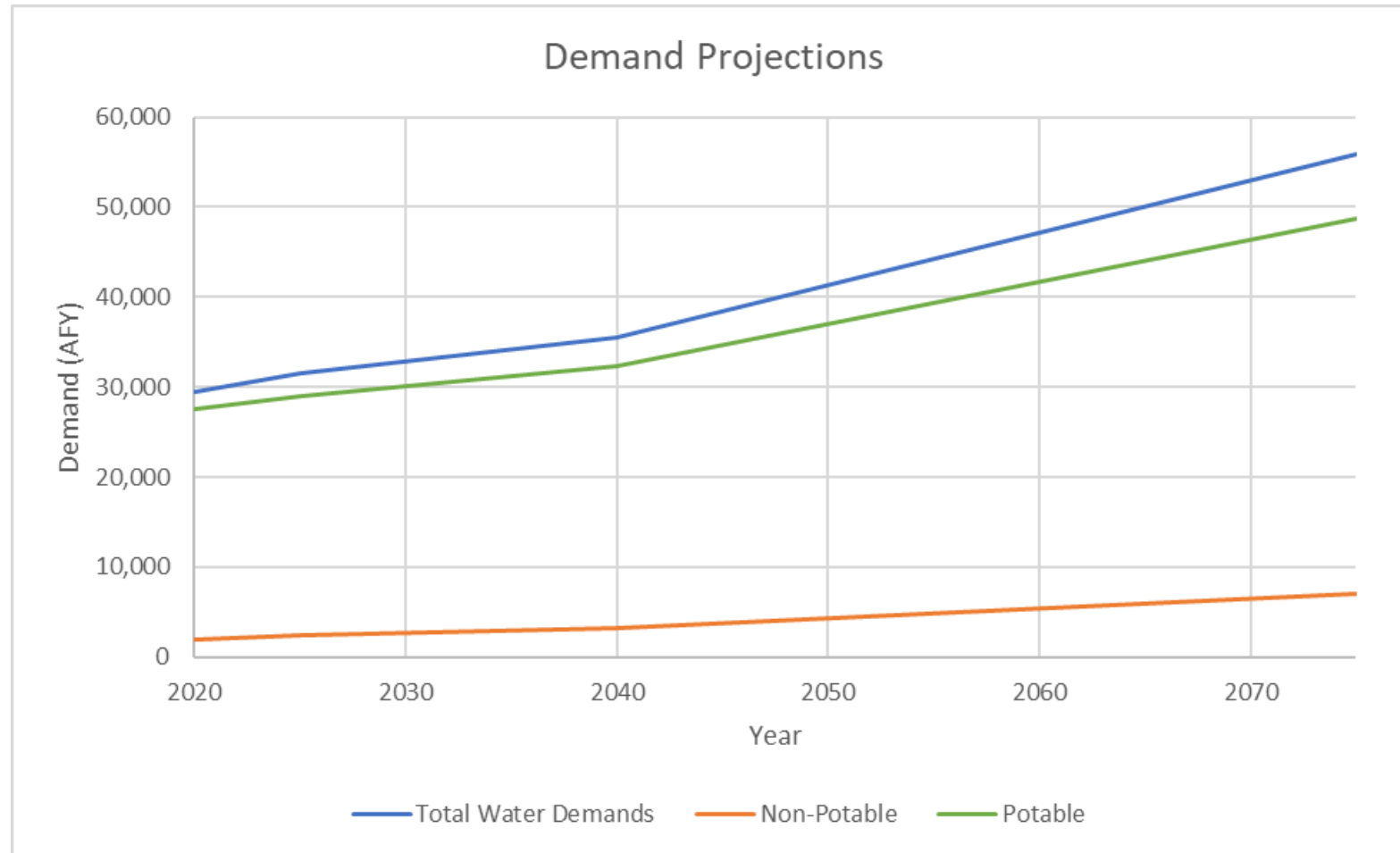
- **Potential** areas identified for conversion to non-potable irrigation
 - Over 400 locations at roughly 2,280 acres
- Applied irrigated area flow factors & adoption rates to calculate total demands
- Conversion areas from Potable to non-potable is 2.3 MGD





Future Demand Projections by Planning Horizon

Buildout estimated at 2075 for visualization purposes



Demands Summary

- Existing non-potable demand is 6.3% of total water demand (AFY)
- Future development non-potable demand is 15.5% of total
- Projecting that at buildout, non-potable will be 11.1% of total

Development Type	Total Water Demand MGD (AFY)	Potable Water Demand MGD (AFY)	Non-Potable Water Demand, MGD (AFY)
Existing Demand	47.3 (30,500)	46.0 (28,600)	1.3 (1,900)
Future Development (Buildout)	56.4 (33,500)	47.2 (29,300)	9.2 (4,200)
Potable to NP Conversion	2.3 (0)	0 (-1,000)	2.3 (1,000)
Total	106.8 (64,000)	93.2 (56,900)	12.8 (7,100)

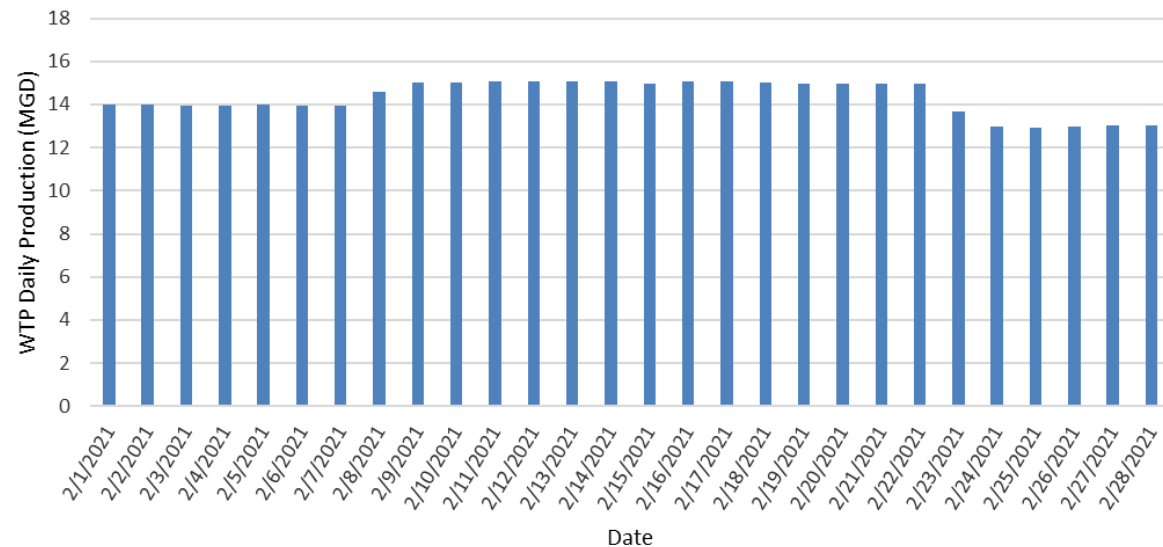
MGD is peak month, AFY is annual total

Note: Future non-potable usage is highly dependent on policy decisions

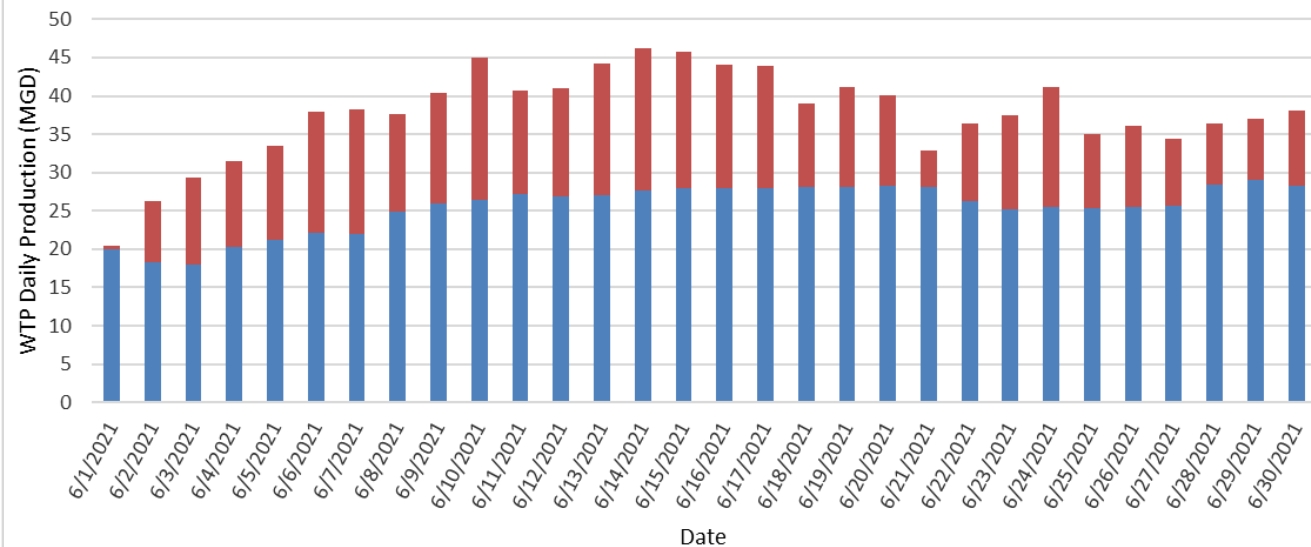
WTP Water Production Comparison

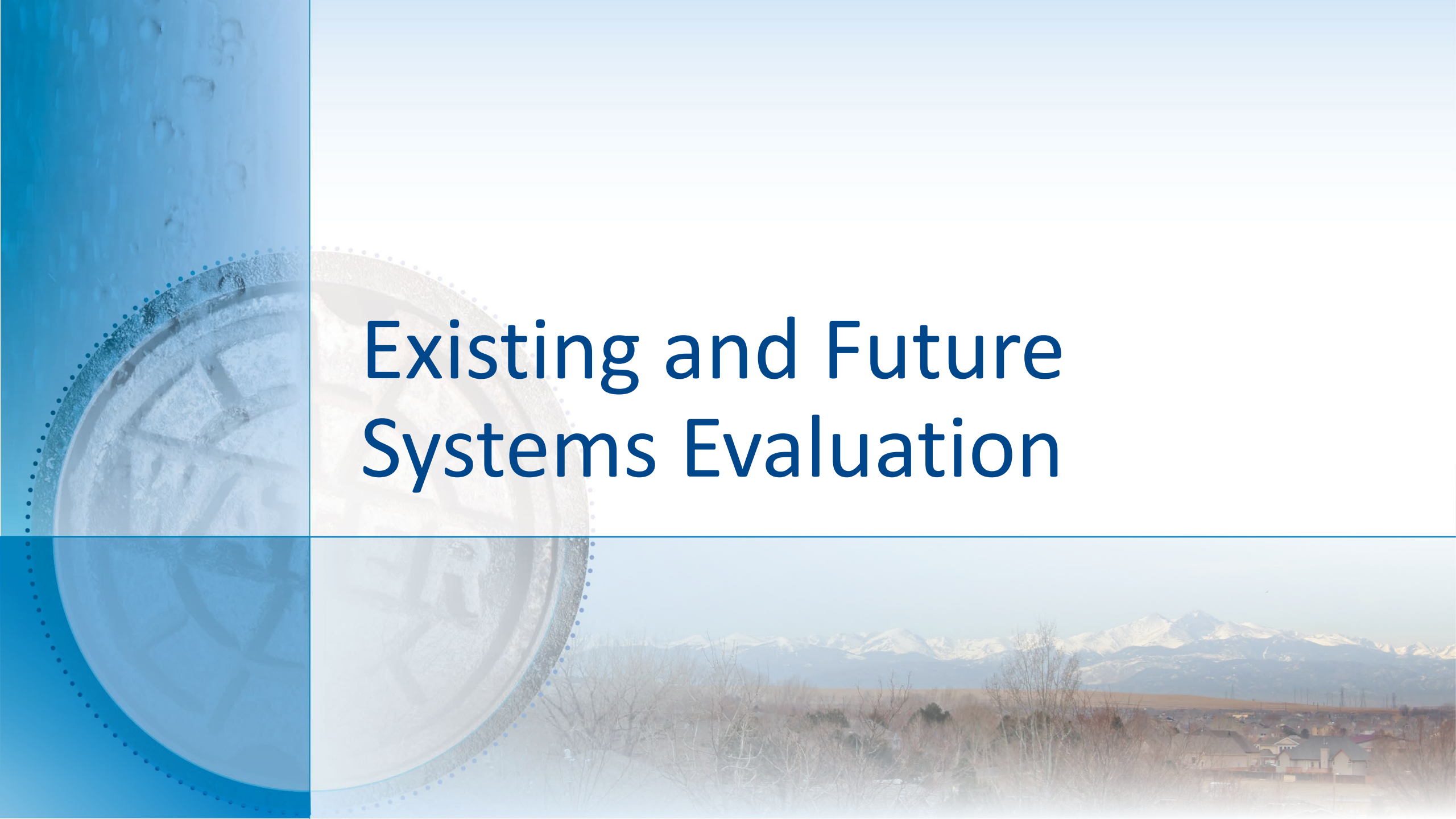
- Base potable demand $\approx$ 14 MGD
- Summer peak potable demand $\approx$ 46 MGD
- Irrigation Demand range 0-32 MGD

Feb. 2021 WTP Production (MGD)



June 2021 WTP Production (MGD)





Existing and Future Systems Evaluation

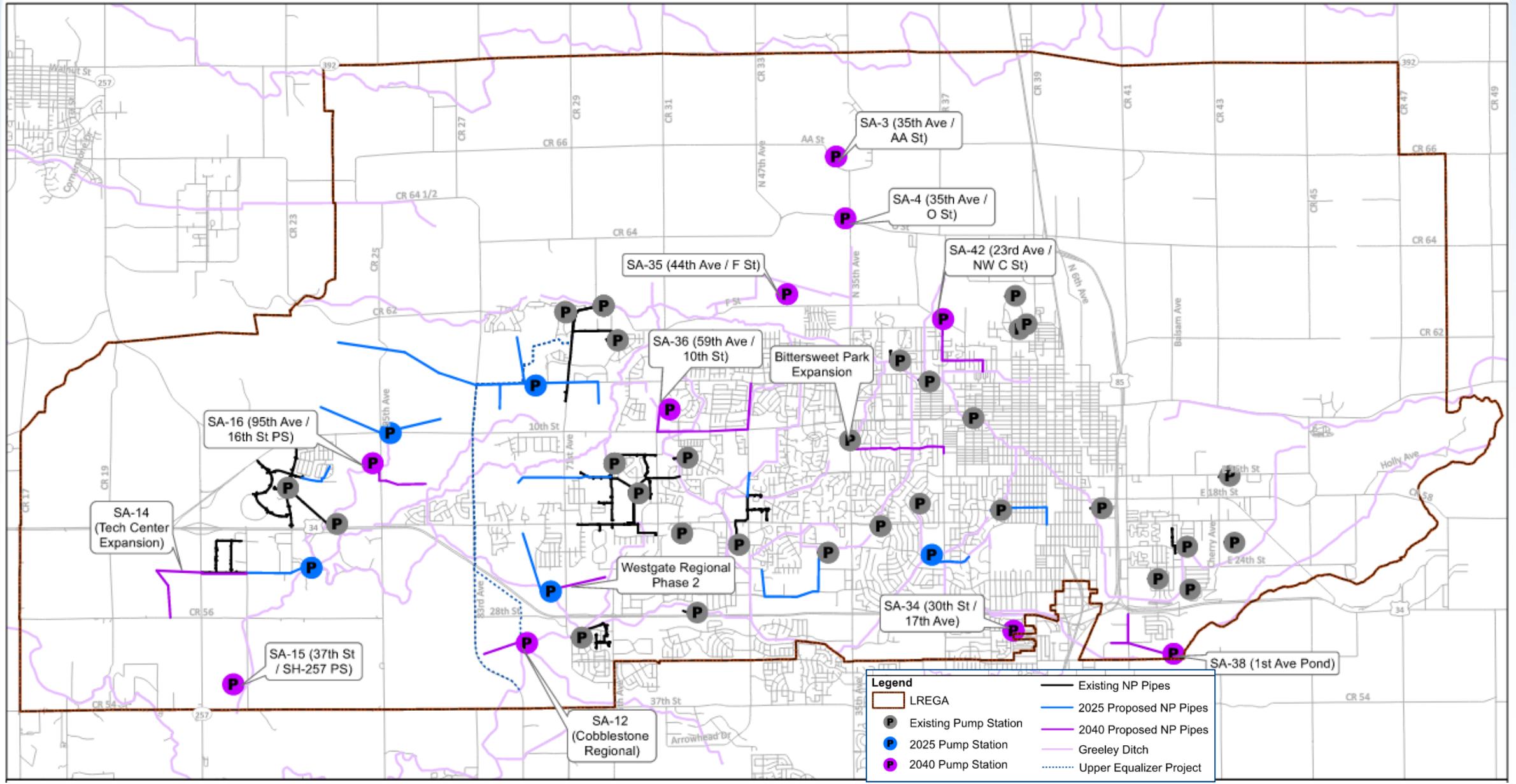
Future System – Service Areas

- Parks locations will be “hubs” of the future systems
 - Each will have a pond and pump station
 - Park locations coordinated with Parks Department
- Guiding principles and assumptions:
 - Loop systems where economically/hydraulically feasible
 - Gravity into ponds (in parks), then pressure pipe from pump stations
- 33 pump stations expected
 - 5 new PS by 2025
 - 10 new PS between 2025 and 2040
 - 18 new PS between 2040 and buildout

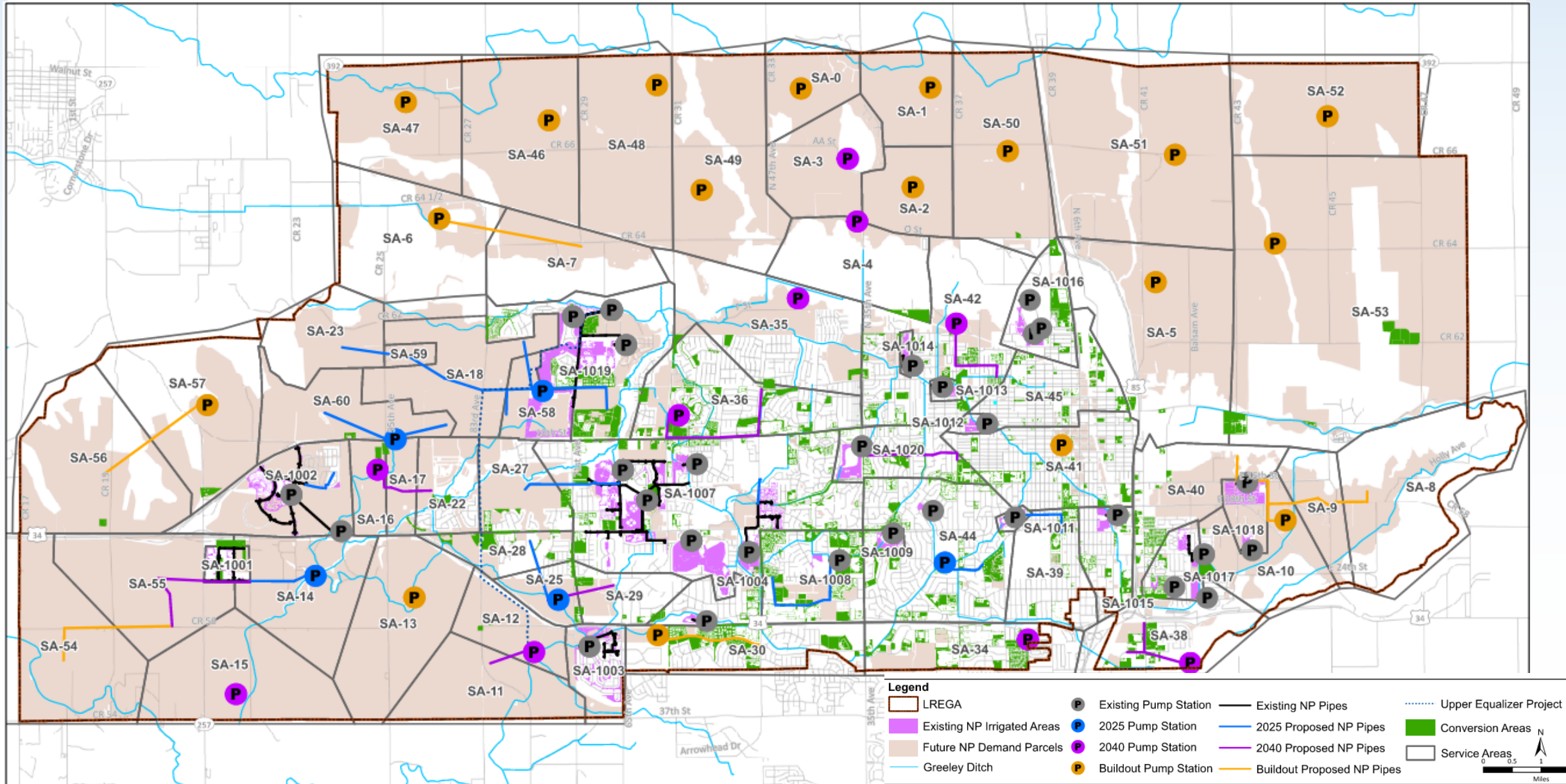


Capital Improvements Plan

Recommended Improvements: 20-Year



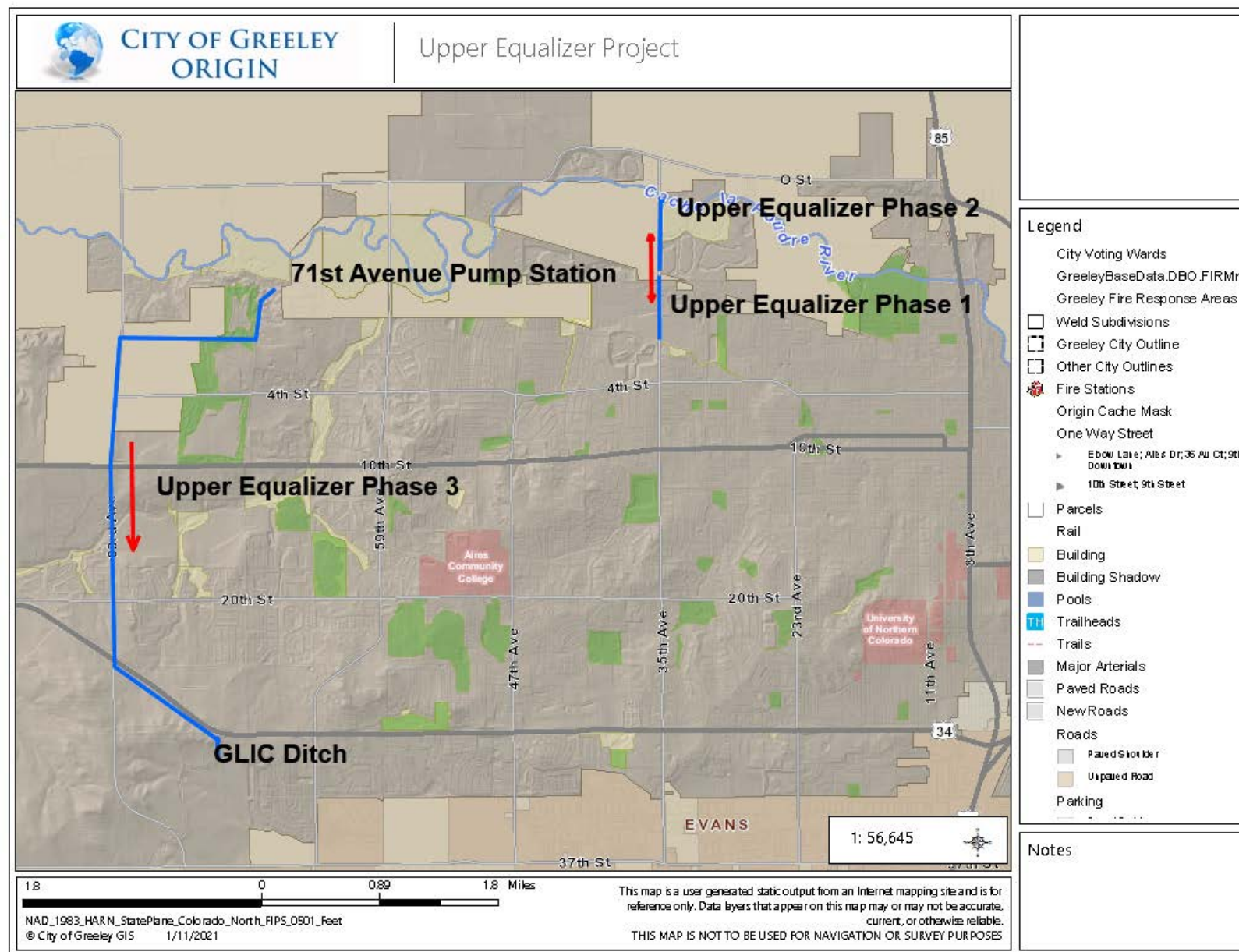
Recommended Capital Improvements: Build Out



Upper Equalizer Project

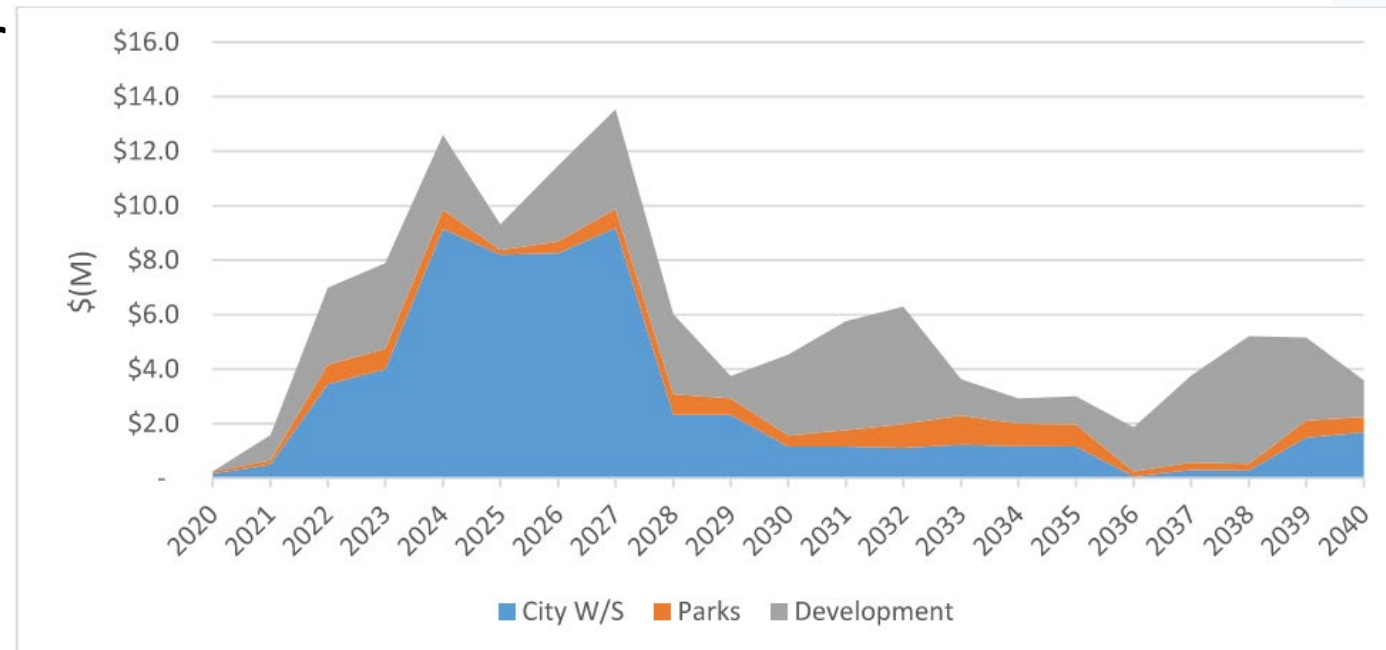
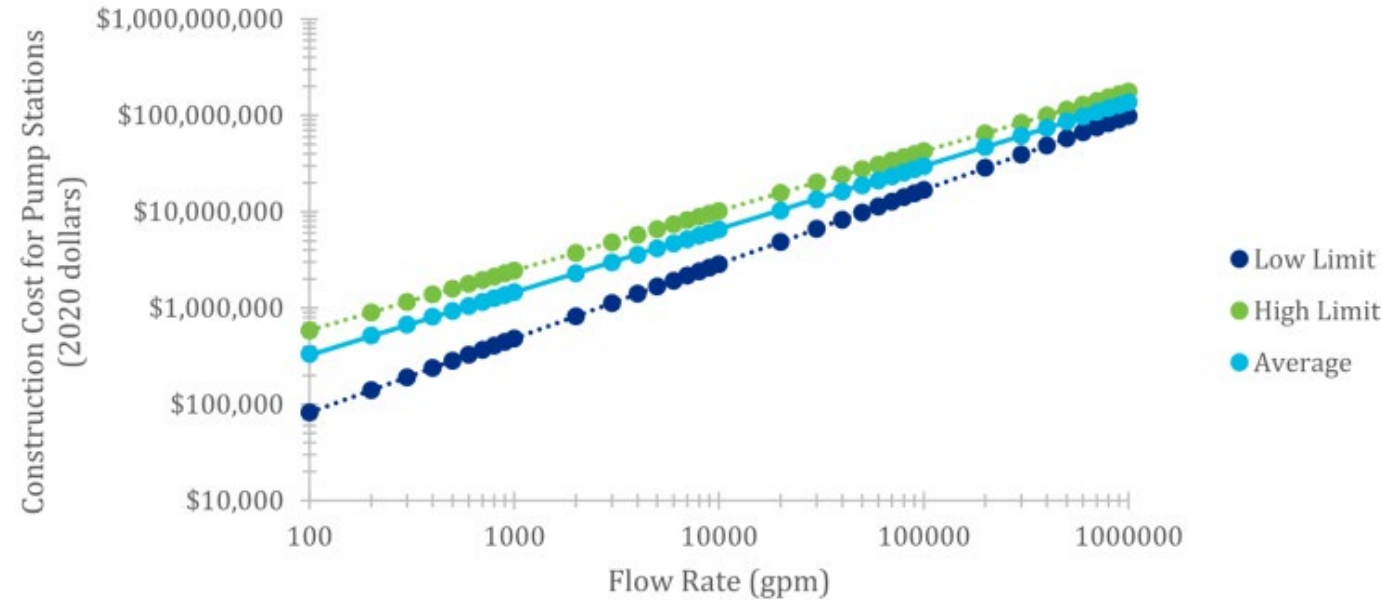
- Provides infrastructure to move water from Poudre Basin via GLIC#3 Ditch to GLIC system
- Replaces use of GLIC water for non-potable demands
 - Frees-up GLIC water for potable uses during droughts
 - Allows greater use of cheaper, non-treatable lower-Poudre sources
 - Increases Greeley's firm yield
- Reduces potable water use in the shoulder seasons.

Upper Equalizer Project

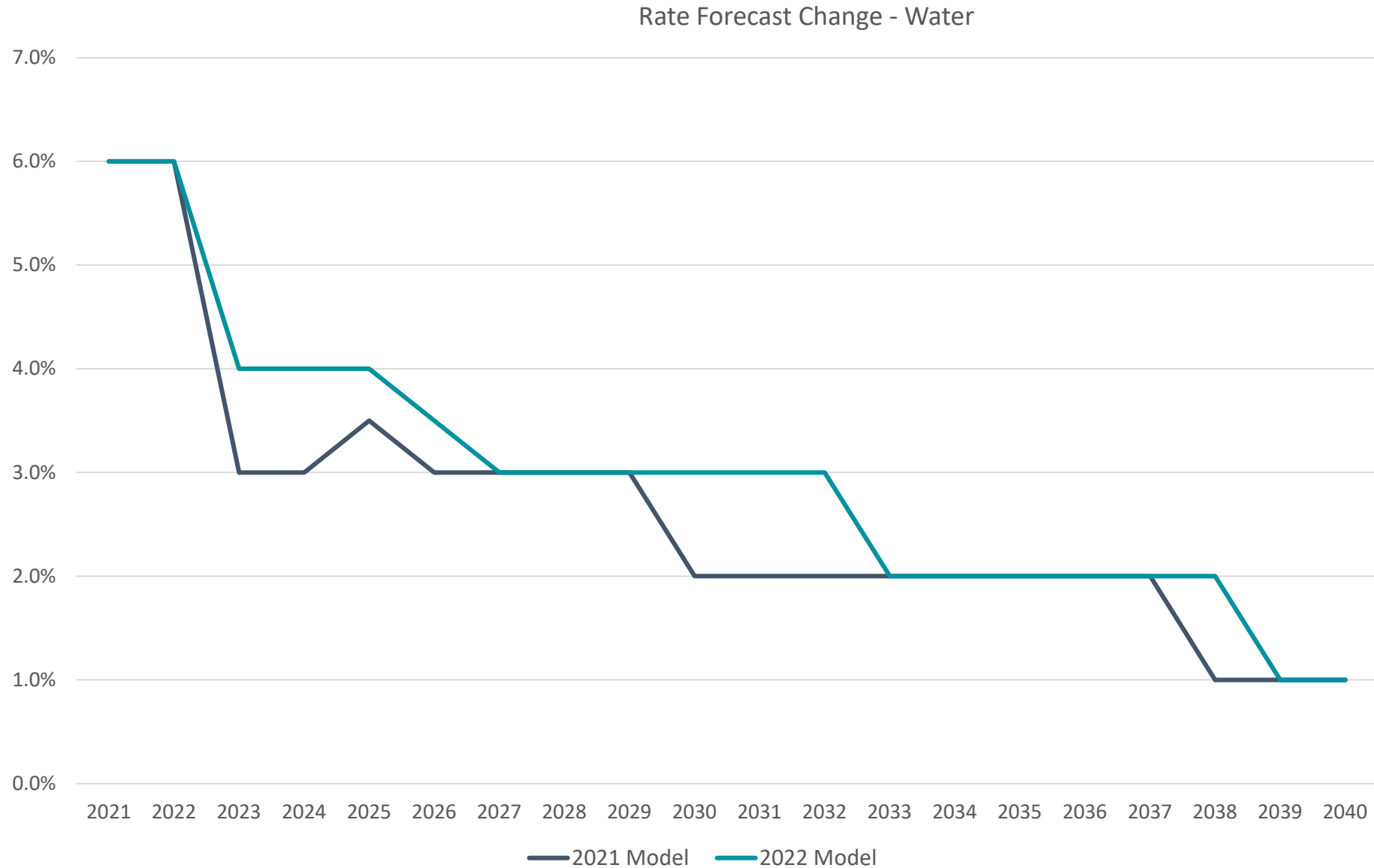


Non-Potable CIP

- 20 year projection - \$150 million
 - Not sustainable
- Backbone infrastructure and projected City contributions
- Proposed \$5 million per year for NP system expansion



Annual Water/NP Funding Projections





Finding and Recommendations



Key Findings

- Greeley has a unique and advanced NP irrigation system
- Data collection and record keeping should be improved
- NP demand varies significantly and is highly influenced by policy
- No critical infrastructure deficiencies identified in existing system

Key Recommendations

- Continue using a hub-and-spoke approach for future NP systems
- Require NP infrastructure even if a PS is not yet constructed
- Conduct detailed evaluations of demands and PS sizing during design
- Improve operational practices, such as lengthening watering windows
 - Allows expansion of system without infrastructure upgrades
- Require SCADA at all new or rebuilt pump stations
- Create plans for data collection and formal record-keeping
- Complete the recommended CIP projects
- Finalize NP policy to encourage adoption



Stakeholder/Community Engagement

Key Takeaways from Stakeholder Meetings

- Meetings held with other stakeholders:
 - Westminster
 - Denver Water
 - Evans
 - Windsor
- Greeley's non-potable system is unique and advanced (especially for raw water)
- Encouraging non-potable adoption is a challenge; most communities focus on larger users only
- Limited opportunities for collaboration with nearby communities
- Regional interest in non-potable is generally growing

Community Engagement

- Community engagement with engineers, planners, developers, and citizens
- Community engagement efforts included:
 - Virtual meeting to introduce MP and development work completed
 - Participants reviewed draft MP and provided comments
 - Follow up virtual meeting was held to discuss comments and responses
- Builders, Realtors, and Developers Roundtable on July 19th, 2021

Next Steps

- Recommendation & approval from Planning Commission – Sept. 24th
- City Council work session non-potable master plan overview – Sept. 28th
- City Council work session non-potable police update – Sept. 28th
- Finalize CIP project budgets
- Master plan acceptance by City Council – TBD



Questions?

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 10

TITLE: APPROVE AND RECOMMEND TO CITY
COUNCIL THE SECOND AMENDMENT TO
INTERGOVERNMENTAL AGREEMENT FOR
TREATED WATER SERVICE WITH THE
TOWN OF WINDSOR

RECOMMENDATION &
PROPOSED MOTION: APPROVE THE SECOND AMENDMENT TO
INTERGOVERNMENTAL AGREEMENT FOR
TREATED WATER SERVICE WITH THE
TOWN OF WINDSOR AND RECOMMEND
THAT CITY COUNCIL APPROVE THE SAME

ADDITIONAL INFORMATION:

The City of Greeley entered into an Intergovernmental Agreement (IGA) with the Town of Windsor in January of 1996 to set the terms by which Greeley would treat and deliver potable water to Windsor sourced from Windsor owned water resources. That outside city water service IGA was subsequently amended in the fall of 2017. A copy of the existing 2017 First Amendment IGA is enclosed for reference.

The Second Amendment to the IGA will provide Greeley with an annual payment for making up to 350 AF of municipal water available to Windsor in times of shortage. The terms allow Windsor access up to 350 AF of drought protection water supply available during times of shortage, which are defined by a CBT quota < 65% (less than .65 AF/unit). City of Greeley may at its sole discretion curtail lease deliveries if it imposes mandatory city-wide water use restrictions.

The price per acre foot (325,851 gallons) of Interim lease water is based upon Greeley's Non-Agricultural Water Rental Policy (2021). The Non-Ag CBT Rental for non-augmentation municipal type uses is = \$500/AF.
Establishes an annual payment to Greeley for making drought water available. Further, an annual payment for the Interim Water Lease availability is required; and in 2022, the annual payment is \$60,000 and shall increase by 3% per year
The initial Term of Sec. 22 is 10 years; maybe extended for one 5 year term



Second Amendment to IGA for Treated Water Service With Town of Windsor

August 18, 2021

Presented to the Greeley Water & Sewer Board

Sean Chambers, Director



Windsor IGA Background

Outside City Water Treatment and Delivery Service Intergovernmental Agreement

- Windsor does not operate its own water treatment plant, it partners with others including Greeley
- IGA provides ongoing commitment to treat and deliver a portion of Windsor's water supply
- Termination of contract with 7 years notice and ability to negotiate during termination
- System Development Charges (SDC) remain consistent with other outside water service IGAs
- Peaking factor in cost of service rate function will be calculated on the average of the previous five years, extending the number of years to modulate variations
- Second Amendment allows for an additional lease during drought



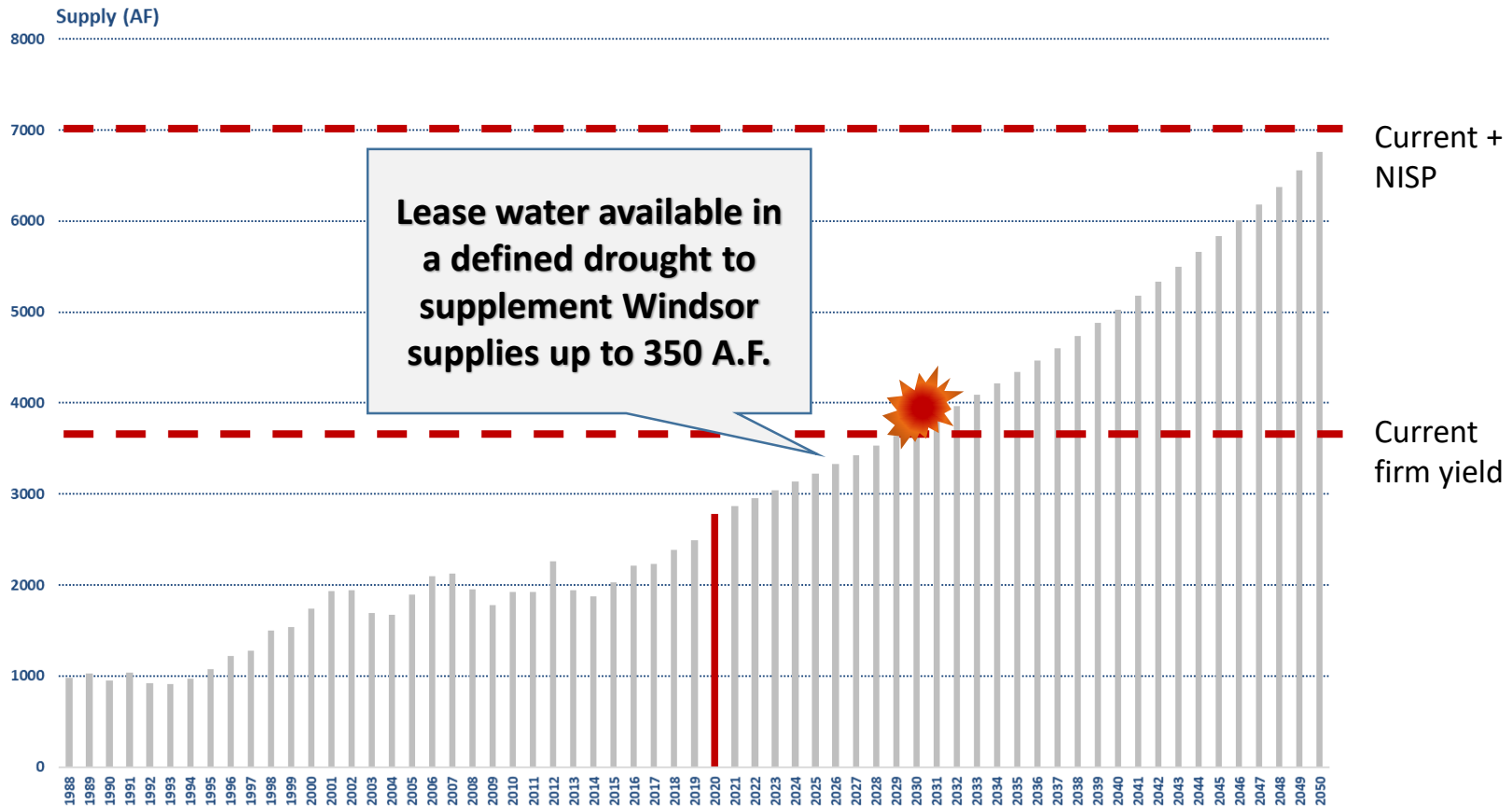
2nd Amendment - Section 22 Terms Interim Drought Water Supply Lease

- Provides for up to 350 AF of drought protection supply available during times of shortage
- Shortage defined by a CBT quota < 65% (less than .65 AF/unit)
- Greeley may curtail lease deliveries if it imposes mandatory city-wide water use restrictions
- Price per AF of lease is based upon Greeley's Non-Agricultural Water Rental Policy (2021)
 - Non-Ag CBT Rental for non-augmentation municipal type uses is = \$500/AF
- Establishes an annual payment to Greeley for making drought water available
 - Annual Payment for Interim Water Lease availability is \$60,000 in 2022
 - Annual Payment shall increase by 3% per year
- Initial Term of 10 years; maybe extended for one 5 year term





Why Windsor Needs Drought Protection





Staff Recommendation

**Water & Sewer Department Staff
Recommend the Board Approve the 2nd
Amendment to the IGA for Treated Water
Service with the Town of Windsor and
Recommend that City Council Approve the
Same.**





Questions



THE CITY OF GREELEY, COLORADO

RESOLUTION 95, 2017

A RESOLUTION OF THE GREELEY CITY COUNCIL AUTHORIZING
ENTRY INTO THE FIRST AMENDMENT TO THE INTERGOVERNMENTAL
AGREEMENT FOR TREATED WATER SERVICE BETWEEN THE CITY OF GREELEY
AND THE TOWN OF WINDSOR

WHEREAS, pursuant to C.R.S. §29-1-203, governments may cooperate or contract with one another to provide any function, service or facility lawfully authorized to each of the following cooperating units of government; and

WHEREAS, Greeley and Windsor previously entered into that certain Intergovernmental Agreement for Treated Water Service on January 4, 1996 ("the 1996 IGA"); and

WHEREAS, authorized representatives of Greeley and Milliken have met on numerous occasions to review the 1996 IGA and discuss the possible modification of that agreement; and

WHEREAS, Greeley and Windsor have a continuing common interest in obtaining high-quality treated water in sufficient quantities to meet the present and future needs of their citizens and service areas; and

WHEREAS, Greeley and Windsor have reached agreement regarding the modification and continuation of the 1996 IGA, by the terms and conditions of the First Amendment to Intergovernmental Agreement for Treated Water Service, Between the City of Greeley, Colorado and the Town of Windsor attached hereto and incorporated herein as Exhibit A; and

WHEREAS, the Greeley Water and Sewer Board reviewed the First Amendment to Intergovernmental Agreement for Treated Water Service, Between the City of Greeley, Colorado and the Town of Windsor, Colorado at its October 18, 2017 meeting, approved the agreement, and recommended approval by City Council of the same; and

WHEREAS, it is in the best interests of the citizens of the City of Greeley that the City Council authorize entry into this agreement.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF GREELEY, COLORADO:

Section 1. The City Council hereby authorizes the City to enter into the First Amendment to Intergovernmental Agreement for Treated Water Service, Between the City of Greeley, Colorado and the Town of Windsor, Colorado, attached hereto and incorporated herein

as Exhibit A.

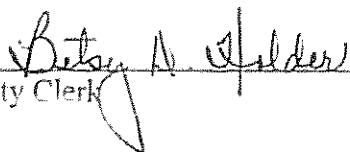
Section 2. City staff and legal counsel are hereby authorized to make minor changes and modifications to the First Amendment to Intergovernmental Agreement for Treated Water Service prior to final execution of the instrument, so long as the substance of the agreement remains substantially unchanged.

Section 3. This Resolution shall become effective immediately upon its passage.

PASSED AND ADOPTED, SIGNED AND APPROVED THIS 7th day of November, 2017.

ATTEST:

THE CITY OF GREELEY, COLORADO



City Clerk



Mayor

FIRST AMENDMENT TO
INTERGOVERNMENTAL AGREEMENT FOR
TREATED WATER SERVICE

BETWEEN THE CITY OF GREELEY, COLORADO
AND THE TOWN OF WINDSOR, COLORADO

This FIRST AMENDMENT TO INTERGOVERNMENTAL AGREEMENT FOR TREATED WATER SERVICE ("First Amendment") is entered into this 13th day of November, 2017, by and between **THE CITY OF GREELEY**, Colorado, a home rule municipality ("Greeley") and **THE TOWN OF WINDSOR**, Colorado, a home rule municipality acting as the governing board of the Windsor Water Utilities Enterprise ("Windsor"), to set forth the terms and conditions by which Greeley will use its supply and treatment facilities to provide the treatment and delivery of potable water to Windsor.

WHEREAS, pursuant to C.R.S. §29-1-203, governments may cooperate or contract with one another to provide any function, service or facility lawfully authorized to each of the following cooperating units of government; and

WHEREAS, Greeley and Windsor previously entered into that certain Intergovernmental Agreement for Treated Water Service on January 4, 1996 ("the 1996 IGA"); and

WHEREAS, authorized representatives of Greeley and Windsor have met on numerous occasions to review the 1996 IGA and discuss the possible modification of that agreement; and

WHEREAS, Greeley and Windsor have a continuing common interest in obtaining high-quality treated water in sufficient quantities to meet the present and future needs of their citizens and service areas; and

WHEREAS, Greeley and Windsor are agreeable to modifying the 1996 IGA under the terms and conditions of this First Amendment; and

WHEREAS, Greeley and Windsor desire to reduce their understandings, and the terms and conditions of this First Amendment, to writing;

NOW THEREFORE, for good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, and in further consideration of the mutual covenants, undertakings, terms, and conditions contained herein, Greeley and Windsor agree as follows:

1. **OTHER TERMS IN FULL FORCE AND EFFECT.** Except as explicitly modified in this First Amendment, all terms and conditions of the 1996 IGA remain in full force and effect.
2. **AMENDMENTS.** The 1996 IGA is hereby amended as follows.
 - a. **Section 1.8 and 1.9 are incorporated as follows.**

1.8 "Peaking Error" means a discrete operational incident experienced by Windsor that causes a measured peaking factor increase, which incident is agreed by both Greeley and

Windsor, in their sole respective discretions, to be a one-time event that is not anticipated to occur again in the future.

1.9 “Peaking Error Fee” means a one-time fee assessed to Windsor by Greeley in the event that an agreed upon Peaking Error occurs, in lieu of utilizing the increased measured peaking factor attributable to a Peaking Error in the calculation of rates under this agreement.

b. Section 12 of the 1996 IGA is amended in its entirety as follows.

12. PEAK DEMAND MEASUREMENT AND DETERMINATION.

12.1 Each year either Windsor or Greeley or both may register and record peak daily demands. Windsor’s peak daily demand factor will either be a flow-weighted average of several master meters, or it shall be derived from simultaneous readings from the several master meters, whichever method generates the highest demand factor. Peak hourly demand factors will be determined by dividing the peak daily demand reading by 24 (hours in the day), and then dividing that result by the average hourly demand for that calendar year.

Peak Hourly Demand Factor Calculation: Peak Daily Demand / 24 / Average Annual Hourly Demand

To modulate variations in peaking factors from year to year, and to thereby modulate fluctuations in the cost-of-service rates, peaking factors will be calculated based upon the average of the previous two years actual recorded peak flows. Notwithstanding the provisions regarding Peaking Error below, in no case will past year’s or current year’s water bills be adjusted for changes in the current peak demand factors. If peak daily demands are not registered in any given year, then the measurements used in the prior year’s rate study will be assumed constant in the next rate study.

12.2 Unanticipated Operational Peaking. If Windsor experiences an operational incident that causes its measured peaking factor to increase, it may request from Greeley that such increased measured peaking factor be deemed an error, and that the increased factor not be included in the forthcoming rate calculation. If Greeley agrees that the incident was a one-time event that is not anticipated to occur again in the future, the increased peaking measurement may be termed a Peaking Error. Mutual agreement by Windsor and Greeley that the increased factor constitutes a Peaking Error shall result in the assessment to Windsor of a Peaking Error Fee, as described below, and the increased factor shall not be included in the forthcoming rate calculation. If a Peaking Error occurs, the peaking factor used in the rate calculation shall be from the last two years, as described above, without the Peaking Error.

12.3 Peaking Error Fee. Upon mutual agreement by Windsor and Greeley that a Peaking Error has occurred, Windsor shall remit to Greeley a Peaking Error Fee and Greeley shall not utilize the increased peaking factor in the calculation of Windsor’s rate. The Peaking Error Fee assessed to Windsor shall be in an amount equal to 20% of the total annual revenue

paid by Windsor to Greeley pursuant to this agreement during the calendar year in which the Peaking Error occurred.

12.4 Water usage pursuant to an agreed upon Peaking Error shall not result in an increase in System Development Charges, nor an increase to the base rate as calculated pursuant to Section 8 of this agreement.

c. Section 13 of the 1996 IGA is amended in its entirety as follows.

13. SYSTEM DEVELOPMENT CHARGES.

13.1 Windsor shall pay to Greeley a system development charge ("SDC") when the metered water delivered to Windsor in any year exceeds the acre-feet delivered in the base year. Payment of system development charges will create a new base year delivery. No system development charges will be due in subsequent years for metered delivery equal to or less than the new base year delivery. Payments of the system development charge will occur in twelve monthly increments following the calendar year in which the exceedance occurs. In no case shall system development charges be refunded. Windsor's current base year volume at the time this First Amendment is executed is 651.33 acre-feet.

13.2 The SDC due shall be a percentage of the then current Inside the City Greeley ¾-inch tap plant investment fee (expressed in \$/acre-feet), to be multiplied by Windsor's consumption in acre-feet of water metered in excess of the base year delivery. The SDC percentage is calculated as follows: The typical Windsor single-family customer benefits from 75% of Greeley Water System. To express Greeley's plant investment fee in terms of \$/acre-feet, the average annual inside-the-City residential demand, as used in the annual update of the Greeley rate model, is divided into the plant investment fee.

13.3 *THE FOLLOWING CALCULATION UTILIZES 2016 DATA TO DERIVE EXAMPLE FIGURES FOR THE SOLE PURPOSE OF DEMONSTRATING THE SDC METHODOLOGY. ANY ACTUAL SDC BORNE BY WINDSOR WILL VARY ANNUALLY, IN ACCORDANCE WITH THE METHODOLOGY DESCRIBED IN THIS SECTION 13.*

Example Conversion and Calculation of SDC Rate

Average Annual Demand:	135,000 gallons (0.414 acre-feet per ¾-inch tap)
Current Inside the City Greeley PIF:	\$10,800

Conversion of Greeley PIF: $(\$10,800) / (0.414 \text{ AF/year}) = \$26,087 \text{ per AF/year}$

Windsor SDC: $(75\%) * (\$26,087 \text{ per AF/year}) = \$19,565 \text{ per AF/year}$

Example Base Year and SDC Calculation

Windsor Base Year Volume: 651.33 acre-feet
Windsor Actual Metered Flow: 660 acre-feet (8.67 AF in excess of Base Year Volume)

Calculation of Total SDC Due: $(660-651.33) * (\$19,565) = \$169,628.55$

Windsor's Base Year Volume would then increase to become 660 AF.

d. Section 16 of the 1996 IGA is amended in its entirety as follows.

16. INTEGRATION, MERGER, AND SUPERSESSION. This First Amendment incorporates and renews the terms and conditions of the 1996 IGA not explicitly modified herein, and supersedes all terms and conditions of any other agreements regarding water supply previously existing between Greeley and Windsor. This First Amendment contains all agreements and understandings, whether written or oral, between Greeley and Windsor regarding the subject matter herein.

e. Section 17 of the 1996 IGA is amended in its entirety as follows.

17. TERM. In the interest of reliability and security, this First Amendment shall be for an initial term of twenty-five years from the date of execution set forth above. At the expiration of this initial term, this agreement shall automatically renew for successive ten-year terms, unless terminated in accordance with Section 18 below.

f. Section 18 of the 1996 IGA is amended in its entirety as follows.

18. DEFAULT AND TERMINATION. In the event either party fails to meet the terms and conditions of this agreement, such failure shall constitute a default of this agreement and the non-defaulting party may immediately terminate this agreement, the effective day of termination being thirty days after the receipt of written notice of default by the defaulting party. Notice shall be given either to the Windsor Town Manager or the Greeley City Manager. Either party may cure the default during the aforesaid 30-day cure period. Upon cure of any default, this agreement shall remain in full force and effect. Nothing herein shall limit either party from collecting damages and amounts due from the other party upon termination of this agreement by default. Notwithstanding the above, this agreement may otherwise be terminated at will by either Greeley or Windsor by giving an advance written notice to the other party of no less than ten (10) years. Nothing herein shall preclude the parties from negotiating modifications of this agreement during the ten-year notification of termination window, in which case an amended agreement may modify or supplant this agreement.

IN WITNESS WHEREOF, the City of Greeley and the Town of Windsor have authorized and executed this First Amendment to Intergovernmental Agreement for Treated Water Service on the date first written above.

TOWN OF WINDSOR, COLORADO

By: Kristie Melendez
Kristie Melendez, Mayor

ATTEST:

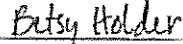
By: Patti Garcia
Patti Garcia, Town Clerk



THE CITY OF GREELEY, COLORADO

ATTEST:

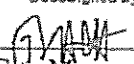
By: 
Mayor

By: 
City Clerk

WATER AND SEWER BOARD:

AS TO SUBSTANCE:

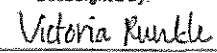
By: 
Chairman

By: 
City Manager

AS TO LEGAL FORM:

AS TO AVAILABILITY OF FUNDS:

By: 
City Attorney

By: 
Director of Finance

**INTERGOVERNMENTAL AGREEMENT FOR
TREATED WATER SERVICE
BETWEEN THE CITY OF GREELEY, COLORADO
AND THE TOWN OF WINDSOR, COLORADO**

THIS AGREEMENT is made this 4th day of January, 1998⁶, by and between **THE CITY OF GREELEY**, Colorado, a home rule municipality ("Greeley") and **THE TOWN OF WINDSOR**, a Colorado statutory town acting as the governing board of the Windsor Water Utilities Enterprise ("Windsor"), for the treatment and delivery of potable water to the Town of Windsor by and through the treatment facilities and transmission lines of the City of Greeley, Colorado.

WHEREAS, pursuant to § 29-1-203, C.R.S., governments may cooperate or contract with one another to provide any function, service or facility lawfully authorized to each of the cooperating or contracting units of government; and

WHEREAS, the Town of Windsor and the City of Greeley are neighboring municipalities which have a common interest in obtaining high-quality water in sufficient quantity to meet present and future needs; and

WHEREAS, the citizens of Windsor are desirous of long-term reliability in treated water; and

WHEREAS, Windsor and Greeley can cost-effectively combine their demand for treated water through one system of treatment, transmission and treated water storage thereby achieving economies of scale; and

WHEREAS, in addition to its own needs and demand, Greeley has the capacity and the facilities to meet the needs of Windsor for water treatment and transmission as are more fully set forth herein; and

WHEREAS, Windsor and Greeley shall and will continue to own their water rights individually and separately, each municipality relying upon the yield of its own water rights to provide the raw water necessary for treatment proposed under this agreement; and

WHEREAS, Greeley and Windsor are agreeable to entering into a long-term contract for the treatment and delivery of potable water to Windsor through an intergovernmental agreement; and

WHEREAS, the parties are desirous of reducing the understandings, terms and conditions of said agreement to writing.

NOW THEREFORE, IN CONSIDERATION of the mutual covenants, undertakings, terms and conditions contained herein, the parties agree as follows:

1. DEFINITIONS. The terms used herein are defined as follows:

1.1 "Greeley" shall refer to the City of Greeley and any authorized representative thereof.

1.2 "Greeley water system" or "Greeley water system enterprise" shall refer to Greeley's raw water and water rights, raw water storage and conveyance systems, water treatment plants, treated water conveyance and storage systems, pump stations and related appurtenances for the collection, distribution and measurement of water.

1.3 "Peak daily demand" means the greatest rate of treated water delivered by Greeley to Windsor over a twenty-four hour period, beginning at midnight, in a given calendar year.

1.4 "Peak hourly demand" means the greatest rate of treated water delivered by Greeley to Windsor over a one-hour period for any given day of the calendar year.

1.5 "Windsor" shall refer to the Town of Windsor as the governing board of the Windsor Water Utilities Enterprise and any authorized representative thereof.

1.6 "Windsor system" or "Windsor water system" shall refer to the pipes, pump stations, treated water storage reservoirs, and related appurtenances for the distribution of water (a) inside the Windsor town limits (b) downstream of master meters gauging Greeley's delivery to Windsor.

1.7 "Year" means a calendar year beginning on January 1.

2. USE. Pursuant to the terms of this intergovernmental agreement, Greeley agrees to treat water for Windsor in the manner and in such amounts as are more fully set forth herein.

It is understood and agreed that in reliance upon providing water to Windsor, the Town has appropriated certain funds for the construction of transmission lines capable of receiving and transporting such water. The parties acknowledge that the construction of these transmission lines is a condition precedent to delivery of water to Windsor. Water shall be made available to Windsor upon the completion of the transmission lines. Commencing with the first full year that this agreement is in effect and continuing annually for the term of this agreement Greeley shall make available not less than 600 acre feet of treated water. During each full year that this agreement is in effect Windsor shall take a minimum of 400 acre feet of treated water. If in any year treated water is available to Windsor and Windsor fails to take and use 400 acre feet of treated water Windsor shall nonetheless pay for this minimum allotment of treated water.

The parties further acknowledge that the initial year of this agreement will likely not be a full year. In this event, Windsor will be relieved of the 400 acre feet minimum requirement and will be required to pay only for the treated water actually delivered in this first year.

Nothing herein shall limit Windsor from taking treated water in excess of 600 acre feet subject to the availability thereof. All treated water in excess of 600 acre feet shall be expressly conditioned upon Greeley having the excess capacity to provide such water, and Windsor shall pay for the same.

3. POINT OF DELIVERY.

3.1 Treated water from Greeley's transmission and distribution system shall be delivered to Windsor through multiple master meters, the location of which will be mutually established and agreed upon by both municipalities.

3.2 Unless otherwise agreed upon between the parties, Greeley shall construct, own and maintain treated water meter vaults, meters, back-flow prevention devices and all associated facilities located at the delivery points. All of the costs of the metering facilities attributable to service to Windsor shall be paid by Windsor by and through inclusion in the Windsor rate base charged by Greeley and more fully described in paragraph eight of this agreement. Greeley agrees to design, construct and maintain all metering facilities in a prudent and cost effective manner. Each water meter shall be operated and maintained so as to record both cumulative flow and, as needed, maximum hourly and maximum daily flow within the accuracy prescribed by current American Water Works Standards. Each municipality will give the other seven calendar days notice prior to any routine or independent meter test. Windsor shall have the ability to valve the line downstream of a master meter for operation, maintenance and repair purposes.

4. **ALTERNATE SOURCES.** It is understood and agreed that as of the date of this agreement Windsor is receiving treated water from Greeley, the North Weld County Water District and the Fort Collins Loveland Water District. Nothing in this agreement shall be construed as limiting Windsor from continuing to receive treated water from sources other than Greeley during the term of this agreement, in whatever amounts Windsor deems appropriate.

5. **POTABLE WATER PROJECTION REQUIREMENTS.** No later than March 1 of each year, Windsor shall provide written notice to Greeley of its projected treated water requirements for the current calendar year and the five consecutive years following the year in which such notice is given. The projections in the notice shall include, at a minimum, both total annual consumption and maximum day and maximum hourly usage. Any actual usage in excess of projected peak demands which has a cost impact, excepting fire flow and other emergencies, shall result in supplemental demand charges as determined by the cost-of-service rate study and approved by the Greeley Water and Sewer Board.

6. **WATER RIGHTS.** Windsor shall acquire sufficient water rights which shall be usable in the Greeley water system and approved for municipal use in the Greeley water system under Colorado law in order to satisfy the treated water requirements of Windsor, expressly subject to the following conditions:

(a) On or before April 1 of each year, Windsor shall make raw water available to Greeley's water treatment plants equal to 130% of Windsor's projected potable water use for that calendar year.

(b) Windsor shall pay all assessment costs on any of the water provided for treatment by Greeley under this agreement.

(c) Windsor shall be responsible for meeting all return flow requirements of the raw water provided to Greeley for treatment, or other requirements of State or Federal law.

7. WATER SHORTAGE. In the event of a shortage of treated water, caused by the inability of a component of the Greeley water system to function, Windsor and Greeley shall share proportionally in water use reductions. Windsor and Greeley staff shall meet and mutually agree to a schedule and method of reducing water demand, with initial emphasis on reducing all nonessential uses such as lawn and parks irrigation. If a shortage persists, Windsor and Greeley agree to impose emergency rates which may be different for each customer category and which are intended to reduce discretionary consumption of treated water. The impact of the emergency rates shall be fairly and equally distributed among both Windsor and Greeley water customers. In a prolonged shortage, Windsor and Greeley agree to adopt a uniform set of enforcement tools and penalties to curtail usage. In any event, Greeley will make every effort feasible to continue to meet both Windsor's and Greeley's water demand, including obtaining treated water from other providers. In the event of a shortage, nothing shall prevent Windsor from independently using an alternate source of treated water in whatever amount Windsor deems necessary, until Greeley can again bring its facilities on line. In the event of a shortage caused by the inability of the Greeley water system to function, Windsor is relieved of the 400 acre-feet take-or-pay requirement specified in paragraph 2.

8. RATES. The initial rates for treated water delivered to Windsor shall be based upon the 1995 water rate cost-of-service model approved by the Greeley Water and Sewer Board. The Windsor rates shall be cost-of-service plus ten percent. The cost-of-service rates shall be reviewed annually and adjusted as needed by the Greeley Water and Sewer Board in accordance with section 17-4 of the Greeley City Charter.

9. BILLING. Bills shall be paid within thirty days of receipt, after which time interest penalties shall begin to accrue at the rate of one percent per month, or fraction thereof, during the period in which the bill remains unpaid.

10. NO ACQUIRED RIGHTS OR VESTING IN WATER RIGHTS OR IN WATER SYSTEM. As contained in section 17-1 of the Greeley City Charter, the Greeley water system is an Enterprise, as that term is defined pursuant to article X, section 20 of the Colorado Constitution. The Greeley water system Enterprise is owned by the citizens of Greeley.

Windsor Water Utilities Enterprise has been designated by Windsor as an Enterprise Fund as that term is defined pursuant to article X, section 20 of the Colorado Constitution.

Windsor specifically acknowledges and agrees that no rights or ownership of the Greeley water system shall become vested as a result of such service. Neither Greeley nor Windsor shall, by reason of any provision of this agreement or the use of water hereunder or otherwise, acquire any vested or adverse right, in law or in equity, in the water rights or water system owned by the other municipality. Neither the assignment, use, rental, or license of water or water rights nor the payment of system development charges shall be deemed to initiate, create, or vest any rights or ownership by either Greeley or Windsor in the other's water rights or water system. Further, Windsor shall not assert or claim any vested rights to continued service other than as established by the terms and conditions of this agreement.

11. POTABLE WATER. The treated water delivered by Greeley to the Windsor master meters shall be potable water which complies with applicable potable water law.

12. PEAK DEMAND MEASUREMENTS AND DETERMINATION. Each year either Windsor or Greeley or both may register and record peak daily and peak hourly demands. Windsor's peak daily and peak hourly demand factors will either be flow-weighted averages of the several master meters, or it shall be derived from simultaneous readings from the several master meters, whichever method generates the highest demand factor. To modulate variations in peaking factors year to year, and to thereby modulate fluctuations in the cost-of-service rates, peaking factors will be calculated based upon the average of the previous two years actual recorded peak flows. If the average of the peak hourly or the peak daily demand factors in the two immediately preceding years averages more than the factors used in the most current water rate study, then the next rate study will use the highest recorded peak daily or peak hourly factor from those two preceding years. If the average of the peak hourly or the peak daily demand factors in the two immediately preceding years averages less than the factors used in the most current water rate study, then the next rate study will use the highest recorded peak daily or peak hourly factor from those two preceding years. In no case will past year's or current year's water bills be adjusted for changes in current peak demand factors.

If peak daily or peak hourly demands are not registered in any given year, then the measurements used in the prior year's rate study will be assumed constant into the next rate study.

13. SYSTEM DEVELOPMENT CHARGES. This agreement allows Windsor's demand in any year to grow to an initial allowance of 600 acre-feet without payment of a system development charge. Water which is demanded by Windsor and delivered by Greeley to Windsor in any given calendar year which exceeds 600 acre-feet shall incur payment by Windsor to Greeley of a system development charge. This charge will be calculated as the current inside-Greeley plant 3/4-inch tap investment fee multiplied by every acre-foot of water consumed in excess of 600 acre-feet. Payments of this system development charge will occur in twelve monthly increments following the calendar year in which the excess occurs. The excess resulting in payment of a system development charge will create a new allowance. System development charges will not be refunded. No system development charges will be

paid in subsequent years for consumption equal to or less than the new allowance. Increased demand and delivery above the new maximum allowance in subsequent years will again cause payment of system development charges as calculated in this paragraph.

14. RELEASE, HOLD HARMLESS, INDEMNIFICATION. Both Windsor and Greeley are public entities, as that term is defined pursuant to the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, *et seq.* The parties to this agreement have the benefits and responsibility enumerated in the Colorado Governmental Immunity Act. Each party shall defend any and all claims for injuries or damages pursuant to and in accordance with the requirements and limitations of the Colorado Governmental Immunity Act occurring as a result of negligent or intentional acts or omissions of the parties, their agents, employees and assigns.

In addition, Greeley shall be responsible for any and all liability for injuries or damages caused by any negligent acts or omissions of Greeley, its officers, employees and agents, performing functions or activities upon the property of Windsor. Greeley shall provide adequate workmen's compensation insurance for all of its employees, agents and assigns engaged in activities and functions upon the property of Windsor.

Windsor shall be responsible for any and all liability for injuries or damages caused by any negligent acts or omissions of Windsor, its officers, employees and agents, performing functions or activities upon the property of Greeley. Windsor shall provide adequate workmen's compensation insurance for all of its employees, agents and assigns engaged in activities and functions upon the property of Greeley.

Each party shall furnish the other party current certificates of insurance stating the coverages outlined above are in full force and effect.

15. NO PUBLIC UTILITIES COMMISSION CONTROL. The Town of Windsor, its employees and elected or appointed officials, agree neither to assert nor support any statement, policy, petition, rule making, or legislation attempting to place the Greeley water system under the rate making authority or jurisdiction of the Colorado Public Utilities Commission by virtue of this intergovernmental agreement or otherwise.

16. THIS AGREEMENT CONTROLS AND SUPERSEDES PREVIOUS AGREEMENTS. This agreement shall supersede any and all terms and conditions of water supply agreements previously existing between Greeley and Windsor.

17. TERM. In the interest of reliability and security, this agreement shall be for an initial term of twenty-five years from the date of its execution. After its initial term, this agreement shall be automatically renewed for successive ten-year terms, unless terminated as provided below.

18. DEFAULT AND TERMINATION. In the event either party fails to meet the terms and conditions of this agreement, such failure shall constitute a default of this agreement

and the non-defaulting party may immediately terminate this agreement, the effective day of termination being thirty days after the receipt of written notice of default by the defaulting party. Notice shall be either to the Windsor Town Administrator or the Greeley City Manager. Either party may cure any default during the aforesaid cure period. Upon cure of any default, this agreement shall remain in full force and effect. Nothing herein shall limit either party from collecting damages and amounts due from the other party upon termination of this agreement by default.

19. JURISDICTION AND VENUE. This agreement shall be interpreted pursuant to the laws of the State of Colorado. Venue to enforce this agreement shall be in Weld County.

20. AMENDMENT. This agreement shall be amended only in writing with the approval of the governing bodies of each municipality. No amendment or modification shall be effective unless in writing signed by the aforesaid persons. This agreement shall be governed by, construed and enforced in accordance with Colorado law.

21. DISPUTE RESOLUTION. Should disagreements arise regarding the interpretation of any portion of this agreement the parties agree to make efforts to resolve such disputes through negotiation; first, at the staff level; and second, with the respective Water Boards and/or City Councils. Procedures for such negotiations shall be established by mutual agreement at the time and may, with the concurrence of the parties, involve the use of qualified outside mediators. Any negotiations and resolution agreements reached therefrom must be within the legal authority granted to the parties by appropriate City Charters and/or State statutes, or shall be null and void. Notwithstanding anything to the contrary in this agreement, it is expressly agreed between the parties that this provision for dispute resolution does not apply to the authority granted the Greeley Water and Sewer Board pursuant to § 17-4 of the Greeley City Charter, including but not limited to, the establishment of minimum water rates.

IN WITNESS WHEREOF, the parties have executed this agreement the day and year first above written.

ATTEST:

THE CITY OF GREELEY, COLORADO

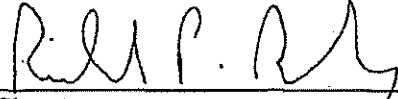
By: Betsy D. Felder
City Clerk

By: Steven Carlson
Mayor

Approved as to Substance:

By: 
City Manager

Approved as to Legal Form:

By: 
City Attorney

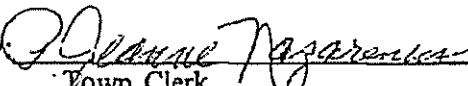
As to Availability of Funds:

By: 
Director of Finance

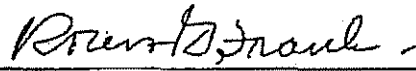
GREELEY WATER AND SEWER BOARD

By: 
Chairman

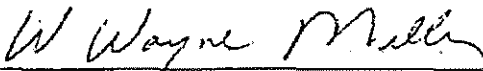
ATTEST:

By: 
Town Clerk

THE TOWN OF WINDSOR, COLORADO

By: 
Mayor

WINDSOR WATER BOARD

By: 
Chairman

njw:120695

SECOND AMENDMENT TO
INTERGOVERNMENTAL AGREEMENT FOR
TREATED WATER SERVICE

BETWEEN THE CITY OF GREELEY, COLORADO
AND THE TOWN OF WINDSOR, COLORADO

This SECOND AMENDMENT TO INTERGOVERNMENTAL AGREEMENT FOR TREATED WATER SERVICE ("Second Amendment") is entered into this ____ day of _____ 2021, by and between THE CITY OF GREELEY, COLORADO, a home rule municipality ("Greeley") and THE TOWN OF WINDSOR, COLORADO, a home rule municipality acting as the governing board of the Windsor Water Utilities Enterprise ("Windsor"), to set forth the terms and conditions by which Greeley will use its supply and treatment facilities to provide the treatment of potable water and provision of leased water to Windsor.

WHEREAS, pursuant to C.R.S. § 29-1-203, governments may cooperate or contract with one another to provide any function, service or facility lawfully authorized to each of the following cooperating units of government; and

WHEREAS, Greeley and Windsor previously entered into that certain Intergovernmental Agreement for Treated Water Service dated January 4, 1996 ("1996 IGA"), which was amended by that certain First Amendment to Intergovernmental Agreement for Treated Water Service, dated November 13, 2017 and attached hereto as Exhibit A ("First Amendment"); and

WHEREAS, Greeley and Windsor have a continuing common interest in obtaining high-quality treated water in sufficient quantities to meet the present and future needs of their citizens and service areas; and

WHEREAS, Greeley and Windsor are agreeable to further amending the 1996 IGA under the terms and conditions of this Second Amendment; and

WHEREAS, Greeley and Windsor desire to reduce their understandings, and the terms and conditions of this Second Amendment, to writing;

NOW THEREFORE, for good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, and in further consideration of the mutual covenants, undertakings, terms, and conditions contained herein, Greeley and Windsor agree as follows:

1. OTHER TERMS IN FULL FORCE AND EFFECT. Except as explicitly modified in this Second Amendment, all terms and conditions of the 1996 IGA, as amended by the First Amendment, remain in full force and effect.

2. AMENDMENTS. The 1996 IGA, as amended, is hereby further amended as follows.

a. Section 6 of the 1996 IGA is amended and replaced in its entirety as follows.

6. WATER RIGHTS. Windsor shall make available to Greeley for treatment water attributable to water rights that are decreed or otherwise approved for municipal use under Colorado

law and usable in the Greeley water system. Windsor shall remain responsible for all assessments due on the water rights made available to Greeley for treatment pursuant to this agreement. Windsor shall remain responsible for compliance with all requirements of local, State, or Federal law associated with the water rights made available to Greeley for treatment pursuant to this agreement, including, without limitation, for meeting the return flow obligations associated with changed water rights.

Windsor shall make such water available to Greeley in sufficient quantities to meet the potable water use projections described in Section 5 above, including sufficient quantities beyond its projections to cover the shrinkage associated with the delivery of such water. Greeley and Windsor will cooperate in the calculation and assessment of shrinkage based on agreed shrinkage factors for the sources of supply provided by Windsor and the treatment plant at which the water is treated.

b. Section 12.1 of the 1996 IGA is amended and replaced in its entirety as follows.

12.1 Each year either Windsor or Greeley or both may register and record peak daily and peak hourly demands. Windsor's peak daily and peak hourly demand factors will either be flow-weighted averages of several master meters, or shall be derived from simultaneous readings from the several master meters, whichever method generates the highest demand factors.

To modulate variations in peaking factors from year to year, and to thereby modulate fluctuations in the cost-of-service rates, peaking factors will be calculated based upon the average of the previous five years' actual recorded peak flows. Notwithstanding the provisions regarding Peaking Error set forth in Sections 12.2, 12.3, and 12.4, in no case will past year's or current year's water bills be adjusted for changes in the current peak demand factors. If peak daily or peak hourly demands are not registered in any given year, then the measurements used in the prior year's rate study will be assumed constant in the next rate study.

c. Section 13.1 of the 1996 IGA is amended and replaced in its entirety as follows.

13.1 Windsor shall pay to Greeley a system development charge ("SDC") when the metered water delivered to Windsor in any year, excluding Interim Water delivered pursuant to Section 22 below, exceeds the acre-feet delivered in the base year. Payment of system development charges will create a new base year delivery. No system development charges will be due in subsequent years for metered delivery equal to or less than the new base year delivery. Payments of the system development charge will occur in twelve monthly increments following the calendar year in which the exceedance occurs. In no case shall system development charges be refunded. Windsor's current base year volume at the time this Second Amendment is executed is 651.33 acre-feet.

d. The 1996 IGA is amended by the addition of a new Section 22 as follows.

22. INTERIM WATER SUPPLY LEASE. In addition to the treated water service provided pursuant to the 1996 IGA, as amended, Greeley will also provide to Windsor an interim supplemental supply of raw water during certain times of water shortage more particularly

described in Paragraph 22.2 below that Windsor may (but shall not be required to) itself treat and deliver to its customers (“Interim Water”), pursuant to the terms of this Section 22 (“Interim Water Supply Lease”). Though this Section 22 may expire or be terminated independent of the 1996 IGA, as amended, in its entirety, all other terms and conditions of the 1996 IGA, as amended, not explicitly superseded in this Section 22 remain applicable to the conduct of the parties under the Interim Water Supply Lease.

22.1 Term. The initial term of the Interim Water Supply Lease commences on November 1, 2021 and expires after a period of ten (10) years. Upon the mutual agreement in writing of Greeley and Windsor, the Interim Water Supply Lease may be extended for one (1) subsequent term of five (5) years.

22.2 Amount of Interim Water and Projection Schedule. For purposes of this Interim Water Supply Lease, a Water Year shall run from November 1 through October 31 of the following calendar year. In the event that the Board of Directors for the Northern Colorado Water Conservancy District (“Northern Water”) sets a C-BT Quota of less than sixty-five percent (65%) in any Water Year during the term of this Interim Water Supply Lease, Greeley agrees to provide up to three hundred and fifty (350) acre-feet of Interim Water to Windsor for that Water Year. In such an event, Windsor shall provide to Greeley a projection schedule within thirty (30) days after the date that Northern Water sets a C-BT Quota of less than sixty-five percent (65%), detailing the amount of Interim Water in acre-feet needed per month for the remainder of that Water Year (“Projection Schedule”). Notwithstanding the total maximum amount of three hundred and fifty (350) acre-feet of Interim Water per Water Year set forth above, Greeley shall not be obligated under any circumstances to provide more than one hundred and twenty-five (125) acre-feet of Interim Water to Windsor in any calendar month, or more than one million, five hundred thousand (1,500,000) gallons of Interim Water to Windsor on any calendar day.

22.3 Payment for Interim Water. Windsor shall pay to Greeley an annual payment on or before March 1 of each Water Year during the term of this Interim Water Supply Lease, regardless of whether the obligation described in Paragraph 22.2 above is triggered, as consideration for making its water resources available (“Annual Payment”). The Annual Payment shall be sixty thousand dollars (\$60,000.00) for Water Year 2022. Each Water Year thereafter, the Annual Payment shall increase by three percent (3%). Windsor shall also pay to Greeley the Greeley non-agricultural water rental rate in effect on the first day of then-current Water Year, as established by the Greeley Water and Sewer Board according to its Non-Agricultural Water Rental Policy, per acre-foot of Interim Water provided to Windsor during each Water Year this Interim Water Supply Lease is triggered (“Lease Payment”). Windsor shall remit Lease Payments to Greeley within thirty (30) days of receiving an invoice from Greeley, and in no event shall Windsor be entitled to a refund of either Annual Payments or Lease Payments.

22.4 Sources of Interim Water Supply. Greeley may, in its sole discretion, allocate any of its sources of water supply that are available and decreed for municipal use to meet its

obligations under this Interim Water Supply Lease. Windsor shall be solely responsible for all accounting and administration of the Interim Water applicable to its use in the Windsor water system, after such water is made available by Greeley. Windsor shall be solely responsible for any transit losses assessed on the Interim Water. Greeley shall remain entitled to the use of any return flows attributable to Interim Water provided to Windsor under this Interim Water Supply Lease.

22.5 Limitations on Obligation to Provide Interim Water. Greeley may curtail deliveries of Interim Water to Windsor if Greeley imposes, in Greeley's sole discretion, mandatory city-wide water use restrictions to address drought conditions, infrastructure failure, or other catastrophic circumstance limiting the ability of Greeley to satisfy the indoor water usage needs of its citizens, so long as, and to the extent that, deliveries under this Agreement are prevented or delayed by such cause. Greeley also may curtail deliveries of Interim Water to Windsor if an accident, act of war, natural catastrophe, fire, explosion, or other cause beyond the reasonable control of Greeley prevents or delays its ability to deliver Interim Water, so long as, and to the extent that, deliveries under this Interim Water Supply Lease are prevented or delayed by such cause.

22.6 Restriction on Assignment. Windsor shall not rent, sublet, or otherwise convey in any manner the right to use the Interim Water. Neither Greeley nor Windsor shall assign any of their rights or delegate any of their obligations under this Interim Water Supply Lease.

22.7 Default and Termination of Interim Water Supply Lease. This Interim Water Supply Lease may expire, or be terminated in accordance with the provisions of this Section, without terminating the 1996 IGA, as amended, in its entirety. If either Greeley or Windsor fails to comply with a term or condition of this Section 22, including, without limitation, the obligation to timely make the Annual Payment, such failure constitutes a default of the Interim Water Supply Lease only. The non-defaulting party may declare the default by providing written notice to the Greeley Water Resources Operations Manager or the Windsor Community Development Director. Upon receipt of this notice of default, the defaulting party will have fifteen days within which to cure the default. If, in the sole discretion of the non-defaulting party, the default remains uncured after the aforementioned fifteen-day cure period, or after any written extension thereof mutually agreed upon by Greeley and Windsor, the non-defaulting party may declare the Interim Water Supply Lease terminated. The failure of either Greeley or Windsor to declare a default of this Section 22 does not establish a precedent nor constitute an implied waiver of any subsequent breach of the Interim Water Supply Lease. This Interim Water Supply Lease shall automatically terminate in the event either Greeley or Windsor terminates the 1996 IGA, as amended, in accordance with Section 18 above.

e. The 1996 IGA is amended by the addition of a new Section 23 as follows.

23. VESTED CONTRACTUAL RIGHTS. The contract rights created pursuant to the 1996 IGA, as amended, are intended by Greeley and Windsor to be presently vested and fully

enforceable according to their terms. The provisions of the 1996 IGA, as amended, were negotiated as, and constitute, parts of an integrated whole, and the inability of either party to enforce any of such provisions or to consummate any of the transactions contemplated hereby due to changes in law, whether by amendment of the State or federal constitutions, the respective charters or municipal codes of either municipality, or of any other applicable statute or regulation, or by other regulatory or judicial action, would result in substantial and irreparable harm to both parties and constitute an impairment of their vested contractual rights.

IN WITNESS WHEREOF, the City of Greeley and the Town of Windsor have authorized and executed this Second Amendment to Intergovernmental Agreement for Treated Water Service on the date first written above.

THE TOWN OF WINDSOR, COLORADO

ATTEST:

By: _____
Paul Rennemeyer, Mayor

By: _____
Karen Frawley, Town Clerk

[Seal]

THE CITY OF GREELEY, COLORADO

ATTEST:

By: _____
John Gates, Mayor

By: _____
Anissa Hollingshead, City Clerk

AS TO SUBSTANCE:

AS TO AVAILABILITY OF FUNDS:

By: _____
Raymond Lee, Acting City Manager

By: _____
John Karner, Director of Finance

AS TO LEGAL FORM:

By: _____
Doug Marek, City Attorney

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 11

TITLE: LEGAL REPORT

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

Legal Report
Greeley Water and Sewer Board Meeting
August 18, 2021

Statement of Opposition: Based on our review of the June, 2021 Water Court Resume, staff and water counsel recommend that the Water and Sewer Board file a statement of opposition to the following water court application:

1. **Case number 21CW3093**, Application of Town of Windsor for change of 42.25 shares of New Cache la Poudre Irrigating Company, 27.5 shares of Cache la Poudre Reservoir Company and 1 preferred right of Fossil Creek Reservoir to municipal, commercial and industrial use, as well as change in location of storage to Kyger and Kern Reservoirs. Greeley owns New Cache shares and has other water rights that could be affected without adequate terms and conditions governing the proposed changes.

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE _____ NO ENCLOSURE X

ITEM NUMBER: 12

TITLE: EXECUTIVE SESSION

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

- WATER MARKET UPDATE

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 13

TITLE: RESOLUTION RECOGNIZING ROY OTTO AS
EXOFICIO BOARD MEMBER

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

**CITY OF GREELEY, COLORADO
ACTING BY AND THROUGH ITS WATER AND SEWER BOARD**

RESOLUTION _____, 2021

A RESOLUTION OF APPRECIATION TO ROY H. OTTO FOR DEDICATED YEARS OF SERVICE

WHEREAS, Mr. Roy H. Otto has served as the City Manager, and as an ex officio member on the Water and Sewer Board since 9/13/1999; and during the course of his dedicated service, the city's population has grown from approximately 75,000 residents in 1999 to approximately 111,000 residents today; and

WHEREAS, Mr. Otto regularly provided leadership, wisdom and guidance at each monthly Board meeting, contributing to numerous strategic water and sewer decisions in the areas of utility financial planning, water supply planning, water storage, master planning efforts, water conservation, the development of non-potable irrigation water systems and the improvements to the city's wastewater collections and treatment systems; and

WHEREAS, Mr. Otto has demonstrated his passion and leadership for water supply and thoughtful planning for the future of the Greeley community. His continuous commitment to the city's water utility and its role in the sustainability and growth of Greeley has been unparalleled; and

WHEREAS, during Mr. Otto's tenure on the Board, Greeley's water rights portfolio has continued to expand and to be protected from outside challenges; significant additions have included substantial acquisition of shares in the Water Supply and Storage Company, the New Cache Irrigation Company, and the Larimer and Weld Irrigation Company, Windsor Reservoir and Canal Co., the Leprino Produced Water Decree, the Terry Ranch Aquifer Storage and Recovery Project and the Windy Gap Firming project and its Chimney Hollow Reservoir; and

WHEREAS, in the Policy Area the establishment of the Industrial Water Bank and the transition from raw water dedication to cash-in-lieu to meet water dedication requirements are notable. During the term of Mr. Otto's service, a number of data driven policy refinements have occurred that refine the yield per share of dedicated water; and development code policy updates to raw water dedication requirements for single family residential development, for commercial and multifamily development, and to the policy that allows development to buy water from the city in lieu of dedication, known as the cash-in-lieu of raw water dedication policy; and

WHEREAS, during Mr. Otto's tenure Greeley's raw water storage capacity was upgraded and added to by, the Seaman Reservoir Spillway Replacement, the rehabilitation of the High Mountain Reservoirs, the multi-year permitting effort to enlarge Seaman Reservoir, the construction of the Poudre Ponds for non-portable storage, the development of the Taft Hill Gravel Pits, the aquifer storage associated with the Terry Ranch project, and the final approval for the Construction of the Chimney Hollow Reservoir as part of the Windy Gap Firming Project; and

WHEREAS, during Mr. Otto's tenure there was significant long range planning happening including the 2003 Water Master Plan, 2004 Non-Potable Master Plan, the 2019 Wastewater Master Plan, the 2021 Wastewater Collection Plan, Water Distribution Plan and the Updated Non-Potable Plan, initiating an integrated water resource plan; and

WHEREAS, during Mr. Otto's tenure the Water Department and the City invested in the utilization of Non-Potable irrigation systems for the Parks, Golf Courses, Schools, and other large turf areas, along with the adoption of increased use of Non-Potable water was a major effort in water conservation including the adoption of a State of Colorado approved Water Conservation Plan for the City, the creation and implementation of a City wide Residential Water Budget program, the start of the conversion of all water meters to Smart Water Meters, and a turf replacement program called Life After Lawn; and

WHEREAS, during Mr. Otto's tenure the City navigated numerous Natural Disasters that the Department responded to, including the 2002-2003 Drought, the High Park and Hewlett Gulch wildfires in the Poudre watershed, the Flood of 2013, COVID-19 Pandemic; and the record size Cameron Peak Fire and the East Troublesome Fires of 2020 which impact all four of Greeley's watersheds; and

WHEREAS, during Mr. Otto's tenure Greeley's Water Treatment and Reclamation Facility received numerous awards from the Environmental Protection Agency for Excellence in Waste Water Treatment. In 2017 Greeley's water operations won American Water Works award for Best Tasting Water in the United States by the American Water Works Association at their annual meeting; and

WHEREAS, Mr. Otto was essential in the startup and growth of the Northern Colorado Water Literate Leaders program through Colorado State University that is raising water literacy throughout our region; and where he became a true advocate in the water space, connecting with water leaders across the state, becoming a "Water Buffalo", in support of the staff and Board; and understanding the long term strategic importance of securing the Terry Ranch acquisition creating a stable future for Greeley.

WHEREAS, MR. Otto initiated and led a strategic conversation about regional water issues, developing the regional water Strat Op, bringing together Northern Colorado's municipal water agencies to work on issues of critical importance.

WHEREAS, Mr. Otto consistently and passionately dedicated his time, energy and applied wisdom for the betterment of Greeley, Colorado. His intentional investment in water utility matters, his leadership on regional water issues, his commitment to the Board and the Water and Sewer Department is appreciated beyond the capacity of words.

NOW THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF GREELEY, COLORADO:

Section 1. The Water and Sewer Board hereby acknowledges, and wishes to express its sincere gratitude for, the dedication and contributions of Roy H. Otto to the Water and Sewer Department, Water and Sewer Board, and the citizens of the City of Greeley.

Section 2. This resolution shall take effect on the fifth (5th) day following its final publication, as set forth in Section 3-16 of the Greeley City Charter.

PASSED AND ADOPTED, SIGNED AND APPROVED ON THIS ____ DAY OF _____ 2021.

ATTEST:

THE CITY OF GREELEY, COLORADO

City Clerk

Mayor

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE X NO ENCLOSURE

ITEM NUMBER: 14

TITLE: DIRECTOR'S REPORT

RECOMMENDATION: INFORMATIONAL ONLY

ADDITIONAL INFORMATION:

- Cameron Peak Fire recovery and mitigation funding update
 - Secured \$3M CWCB Watershed Restoration Grant to keep recovery work and mulching activities ongoing.
 - Submitting application for an additional \$6M grant from the same CWCB program that is distributing funds from SB-240
 - See attached CPRW report on mitigation work through Aug. 6th
- City Clerk's analysis of Petitions to Amend Greeley Charter
 - Ongoing analysis of the citizen petitions that propose to amend the City Charter sections 17-9 and 17-10
 - Impact info at: <https://greeleygov.com/services/ws/water-ballot>
- South Platte Basin Roundtable Colorado River Demand Management
 - See: <https://cwcb.colorado.gov/focus-areas/supply/demand-management> and;
 - <https://www.youtube.com/watch?v=RXifgk4ojz0> for additional background the Colorado River Drought Contingency Plan and potential Upper Colorado Basin Demand Management Program
- Board & Council Tour
 - All day bus tour to the following destinations:
 - Greeley Wastewater Treatment and Reclamation Facility undergoing a major regulatory driven treatment process upgrade
 - Poudre Ponds Non-Potable Water Storage Facility Expansion
 - 60" Potable Transmission Line and Terry Ranch interconnect
 - Cameron Peak Wildfire Burn Area impacts and Mitigation
 - Watershed Impacts and Mitigation
 - Flash Flooding Impacts and Mitigation
 - High Mountain Reservoir Storage Impacts and Mitigation
 - Collaborative Partnerships in Burn Area Recovery



Memo

TO: Petition Representatives
CC: City Manager Roy Otto and Honorable Mayor and City Council of the City of Greeley
FROM: City Clerk Anissa Hollingshead
DATE: August 2, 2021

Two Charter petitions were filed with the Clerk's Office on Monday, August 2, 2021, at 4:45 p.m. The petition sections submitted were preliminarily reviewed by members of the City Clerk's Office and the petition representatives are being provided with the attached petition receipts documenting the number of petition sections, pages of signatures, and total signatures turned in.

Timelines are driven both by the statutory provisions for proposed charter amendments and timing associated with the November General Election.

- May 4, 2021: Statements of intent submitted with petition forms
- May 6, 2021: Approval issued by City Clerk of petitions forms
- August 2, 2021: Deadline for circulating the petition & filing with the City Clerk (90 days from the filing of the statement of intent)
- August 4, 2021: Last possible date a petition must be filed for the Nov. 2 General Election
- September 3, 2021: Deadline for the City Clerk to certify ballot content to Weld County
- November 2, 2021: Municipal General Election

The statements of intent for the two Charter petitions were filed on May 4, 2021. As of that date, Greeley had 62,019 registered voters. That means each petition must include at least 3,101 signatures to reach the 5% threshold for a valid petition.

The petitions were filed in a timely manner and the total number of signatures submitted, prior to any review of their validity, does meet the required threshold to constitute a valid petition for each petition submitted. Since it appears valid petitions have been submitted, on their face meeting the base parameters for further evaluation of the sufficiency of the signatures contained, the process of verifying signatures will begin.

Next Steps:

With the submission of the petitions, time clocks start for two processes:

1. Pursuant to CRS §31-2-220 (4), the Clerk shall inspect the petitions and attached affidavits to ensure compliance with the statute, including examining the information on signature lines for patent defects. Under the provisions of CRS §31-2-210 (3), the Clerk must certify to the Council as the validity and sufficiency of each petition within 15 working days. That deadline is Monday, August 23, 2021.
2. CRS §31-2-223 outlines provisions allowing the submission of a protest in writing under oath to be filed with the Clerk by any registered voter in the City, setting forth the specific grounds for protest and specific names protested. Protests must be filed within 30 calendar days after the petitions are filed, which will be Wednesday, September 1, 2021.

Staff in the City Clerk's Office will begin the review of all petition sections on Tuesday, August 3. Provisions have been designed to ensure that all petition materials are fully secure, kept in locked cabinets within secured space. In further compliance with best practices for such matters, petition sections will be under the direct control of the Clerk or the Clerk's direct designee at all times, and when handled for review, will always be in the custody of at least two people at a time, starting at the point of their receipt this afternoon, ensuring redundancy for security and verification of all work performed.

Once this review is completed, the Clerk will issue a certification to the City Council of the petitions' sufficiency or insufficiency. Due to the timelines associated with the November General Election, if the either or both petitions are found insufficient, there is not a window to file an amended petition and action on a potential charter amendment will end at this time.

If either or both petitions are certified as sufficient, the City Council must set a ballot title for the petition(s) at its next meeting. It is likely a special meeting will need to be called for this purpose because of the deadline to certify ballot content for the November 2, 2021, General Election. A notice of election must be published for any sufficient petitions within 30 days of its filing, so by September 1, 2021. This notice must contain the full text of the amendment as contained in the petition.

Protest Provisions

Colorado Revised Statutes include provisions allowing any registered voter to file a protest regarding a petition. As noted above, the timeline for filing such a protest begins at the point a petition is filed.

A protest must be filed in writing and under oath with the City Clerk by any registered voter in Greeley. It must be filed within 30 calendar days of when the petition is filed. The deadline for a protest of the petition filed August 2, 2021, is September 1, 2021.

A written protest must set forth the specific grounds for the protest, including identifying by section and line number any signature being challenged.

In order to ensure Greeley voters are able to exercise this right to protest, petition sections will be scanned as reviewed each day along with a log documenting the results of the review and made available on the City website, on the City Clerk's section at [City Clerk | City of Greeley \(greeleygov.com\)](https://www.greeleygov.com/city-clerk).

City of Greeley, Colorado
OFFICE OF THE CITY CLERK
1000 10th Street
Greeley, CO 80631
Phone 970-350-9740 **Fax** 970-350-9828
www.greeleygov.com



Petition Receipt

I, Anissa N. Hollingshead, City Clerk for the City of Greeley, Colorado, did on the 2nd day of August, 2021 receive a petition to amend Greeley's Home Rule Charter, specifically, the following Section:

Section 17-9 Procedures for Sale of Water and/or Water Supply and Treatment Facilities

Said petition is represented by:

1. Mary Gauthiere, 2157 Buena Vista Drive, Greeley, CO 80634
2. John Gauthiere, 2157 Buena Vista Drive, Greeley, CO 80634
3. William J. Schneider, 2137 21st Avenue, Greeley, CO 80631
4. Robin Howard, 1638 29th Avenue, Greeley, CO 80634
5. Sandra Cummings, 4626 West 1st Street Road, Greeley, CO 80634

This petition contained 96 petition sections.

This petition contained 608 pages of signatures.

This petition contained 4282 total signatures before verification of any kind.

A handwritten signature in black ink, appearing to read "Anissa N. Hollingshead".



Anissa N. Hollingshead, City Clerk

City of Greeley, Colorado
OFFICE OF THE CITY CLERK
1000 10th Street
Greeley, CO 80631
Phone 970-350-9740 **Fax** 970-350-9828
www.greeleygov.com



Petition Receipt

I, Anissa N. Hollingshead, City Clerk for the City of Greeley, Colorado, did on the 2nd day of August, 2021 receive a petition to amend Greeley's Home Rule Charter, specifically, the following Section:

Section 17-10 Procedures for Acquisition and Provision of Ground Water and/or Recycled Wastewater

Said petition is represented by:

1. Mary Gauthiere, 2157 Buena Vista Drive, Greeley, CO 80634
2. John Gauthiere, 2157 Buena Vista Drive, Greeley, CO 80634
3. William J. Schneider, 2137 21st Avenue, Greeley, CO 80631
4. Robin Howard, 1638 29th Avenue, Greeley, CO 80634
5. Sandra Cummings, 4626 West 1st Street Road, Greeley, CO 80634

This petition contained 96 petition sections.

This petition contained 589 pages of signatures.

This petition contained 4,237 total signatures before verification of any kind.

A handwritten signature in black ink, appearing to read "Anissa N. Hollingshead".



Anissa N. Hollingshead, City Clerk

South Platte Basin Roundtable

Demand Management Committee

Final Work Plan – 8/10/21

I. Demand Management Overview

- a. The State of Colorado Department of Natural Resources (DNR) and its Colorado Water Conservation Board (CWCB) and the Interbasin Compact Committee (IBCC) have undertaken an exploration of Demand Management (DM) as a potential program or tool that could be used to help Colorado's water users avoid or mitigate the impacts of a mandatory Colorado River Compact administration scenario. In 2019, the seven Colorado River Basin States finalized the Drought Contingency Plan (DCP), agreements designed to provide more security to the Colorado River System. The Demand Management Storage Agreement was part of the DCP, through which the Upper Basin States committed to considering the feasibility of a potential DM program. The CWCB has authorized the Demand Management Feasibility Investigation, Step II Work Plan for 2021 to further evaluate potential program designs, cost issues, achievability of potential consumptive use savings, and the equitable proportionality of participation across the state.
- b. The State's DM investigation has considered a DM framework that could involve temporary, voluntary and compensated reductions in consumptive water use for the purpose of delivering water pursuant to the Demand Management Storage Agreement. The SP Basin Roundtable and its IBCC representatives have tracked the CWCB work and engaged in the DM work groups formed in 2019.

II. South Platte Volunteer Committee

- a. The SP Roundtable directed that a DM Committee be formed and comprised of volunteer Roundtable members and any public stakeholders having an interest or expertise.
- b. The following list of volunteers for the DM Committee was developed in the course of the July 13th SP Basin Roundtable discussion on the matter:
 - i. Garrett Varra (RT Chairman): gvarra@varracompanies.com;
Jim Yahn (SP Rep. to IBCC): jim@northsterling.org;
Sean Cronin (SP Rep. to IBCC): sean.cronin@svlhwcd.org;
Jim Hall: jhall@northernwater.org; Kirk Vincent: kvincent28@mac.com;
Sean Chambers: Sean.Chambers@greeleygov.com; Kevin Lusk klusk@csu.org;
Daylan Figgs: figgsdw@co.larimer.co.us; Donnie Dustin: DDUSTIN@fcgov.com;
Larry Rogstad: lrogstad@plcoutdoors.org; Lynda James: james.lynda2@gmail.com;
Kyle Whitaker: kwhitaker@northernwater.org; Josh Kuhn:
Josh@conservationco.org; Mary Gearhart mary.gearhart@greeleygov.com; and;
Robert Sakata: rtsakata@aol.com
Mary Gearhart will support keeping a record of the Committee's work.

III. Scope

The goal is to develop a statement and possibly a short set of key talking points that define the South Platte Basin's perspective on the DM Framework and the important work on the subject currently in process by the CWCB.

The Roundtable has expressed the belief that all water users, consumptive and non-consumptive, have something valuable to contribute to a constructive outcome. The SP Roundtable membership seeks to more clearly develop and define its collective view on Demand Management. The SP Roundtable may want to weigh on the fundamentals of a short term, voluntary, compensated, and equitable framework for Demand Management.

Key questions developed by the CWCB on the framework include:

Is an Upper Basin DM Achievable?

Is DM Advisable to Colorado and its many users?

Is DM worthwhile for Colorado to undertake?

The Roundtable expects that a statement will recognize the value and importance that Colorado River water plays in our communities, economies, agriculture and ecology. The Roundtable also believes the statement should honor Colorado's approach to the law of the river, to prior appropriations, and to the importance of working collaboratively on solutions that benefit all of Colorado. The Roundtable further expects that through this work, its membership will become better informed on the vocabulary and key issues of a DM program, and develop knowledge on the hydrology, technical issues, and concepts that define this complex resource challenge.

IV. Work Plan

The Roundtable supported the recommendation of a 60-90 day work plan, that would include 1-3 meetings for the South Platte Basin to focus on the importance of Colorado River water to the basin and its many users; and 1-2 meetings between the SP Basin DM Committee and the yet to be formed Metro Basin RT DM Committee to further discuss and identify alignment in principles and messaging. The SPBRT DM committee will convene and prepare a statement for consideration by the voting members of the SPBRT.

After consideration and discussion among the South Platte Basin Roundtable, the SPBRT DM committee intends to share the draft DM statement or talking points with the Metro Basin RT DM committee for further discussion and consideration of areas of alignment. The SPBRT DM Committee may find value in discussing its insights and statement other roundtables and the state of Colorado, and will do so if that becomes the consensus of the SPBRT.

The SPBRT and this subcommittee hold open meetings and interested persons are welcome to attend and contribute to the dialogue. The proposed meeting schedule is here below.

Proposed SP Basin Committee Work Plan Schedule:

Update for South Platte Basin Roundtable	August 10 th – 4:00 PM
DM Committee Kick off and Discussion of Core Issues Mtg.	August 17 th – 10:00 AM
SP Refining Concepts and Proposed Talking Points	Wk. of Aug. 23 rd
Final SP Committee (meeting as needed)	Wk. of Aug. 30 th or after
SP Basin RT – Metro Basin RT joint DM Committee Mtg. #1	Wk. of Sep. 13 th
South Platte Basin Roundtable September Meeting Update	Sept. 14 th – 4:00 PM
SP Basin RT – Metro Basin RT joint DM Committee Mgt. #2	Wk. of Sep. 20 th
SP Basin RT Committee potential discussion with Arkansas RT	Wk. of Sep. 27 th

Notes:

EDITOR'S PICKS (<https://cronkitenews.azpbs.org/category/editors-picks/>) SUSTAINABILITY
(<https://cronkitenews.azpbs.org/category/sustainability/>)

Colorado River Basin reservoirs begin emergency releases to prop up a troubled Lake Powell

By Luke Runyon/**KUNC** (<https://www.kunc.org/>)

July 16, 2021



Anchored houseboats gather at Hall's Crossing Marina on Lake Powell in southern Utah. (Photo by Luke Runyon/KUNC)

Emergency water releases from reservoirs upstream of Lake Powell are underway to preserve the ability of the nation's second-largest reservoir to generate hydroelectric power.

The Bureau of Reclamation started releasing additional water Thursday from Flaming Gorge Reservoir in Wyoming. Additional water releases from Blue Mesa Reservoir in Colorado and Navajo Reservoir in New Mexico are planned for later this year. Emergency releases could last until at least December.

Lake Powell is projected to hit a record low in July. It's situated on the Colorado River, a drinking and irrigation water source for more than 40 million people in the Southwest. Inflows to the enormous reservoir were the third lowest on record in 2021. That followed a meager runoff in 2020.

The releases are meant to maintain some level of hydroelectric power at Lake Powell's dam, which is under increasing threat due its low level. Glen Canyon Dam's minimum hydropower level is at 3,490 feet above sea level. It's currently at 3,557 feet and is forecast to drop to 3,515 feet by the end of April 2022.

Hydropower production might become unfeasible at elevations above 3,490 feet because of turbine cavitation, when small air bubbles form and damage the generators' inner workings.

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operation, which could in further harm and damage the generators under working.

Releases from Flaming Gorge Dam will increase by 50 cubic feet per second every day until July 23. Daily releases from Flaming Gorge will rise from 860 cubic feet per second to 1,310 cubic feet per second, “in response to basin-wide drought and storage concerns at Lake Powell,” reclamation staff told stakeholders this week.

The Upper Basin states of Colorado, Wyoming, New Mexico and Utah agreed to possible federal intervention, under emergency circumstances, to boost Lake Powell’s levels in the [2019 Drought Contingency Plan](https://www.usbr.gov/dcp/docs/final/Attachment-A1-Drought-Response%20Operations-Agreement-Final.pdf) (<https://www.usbr.gov/dcp/docs/final/Attachment-A1-Drought-Response%20Operations-Agreement-Final.pdf>). This is the first time this portion of the plan has been put into action.

“We are facing unprecedented dry conditions in the Colorado River Basin. More details about conditions as well as planning efforts are forthcoming,” said Rebecca Mitchell, Upper Colorado River commissioner for the state of Colorado. “What we do know is that the Upper Basin Drought Contingency Plan calls for increased coordination and planning in situations like this. And those agreements call for the Bureau of Reclamation to closely consult with the Upper Basin States, including Colorado. It has never been more critical to work together.”

A [federal shortage declaration](https://www.kunc.org/2021-07-07/after-decades-of-warming-and-drying-the-colorado-river-struggles-to-water-the-west) (<https://www.kunc.org/2021-07-07/after-decades-of-warming-and-drying-the-colorado-river-struggles-to-water-the-west>) in the river’s lower basin is expected next month due to record low levels at Lake Powell’s downstream sister reservoir, Lake Mead. The two are managed jointly by guidelines agreed to in 2007.

This story is part of ongoing coverage of the Colorado River, produced by KUNC and supported by the Walton Family Foundation.

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COLORADO WATER CONSERVATION BOARD

Protecting Colorado Water

DEMAND MANAGEMENT FEASIBILITY

General FAQs

JUNE 2021

Q. What is Demand Management?

- A. Demand Management is a potential program that could be used to protect Colorado's water users by helping to avoid or mitigate the impacts of a mandatory Colorado River Compact administration scenario. If such a program is established, it could provide compensation for water users to voluntarily conserve water on a temporary basis.

Q. What is the Colorado River Compact?

- A. The 1922 Colorado River Compact requires the Upper Division States of Colorado, New Mexico, Utah, and Wyoming to not deplete the flow of the river below 75,000,000 acre-feet over ten years to the Lower Division States. The Upper Division States have never violated the compact, and the purpose of any Demand Management program would be to maintain compliance with the compact.

Q. What agency has the authority to consider the feasibility of Demand Management and implement a program within Colorado?

- A. The Colorado Water Conservation Board (CWCB) has authority to consider and implement a Demand Management program within Colorado. The CWCB was established for the purpose of aiding in the protection and development of the waters of the state, for the benefit of the present and future inhabitants of the state. There are several agencies that operate as political subdivisions, but the CWCB is an agency of the state and its functions are governmental functions for the welfare and benefit of the state and its inhabitants.

Q. Why is Colorado considering the feasibility of a Demand Management program at this time?

- A. In 2019, the seven Colorado River Basin States finalized the Drought Contingency Plan (DCP), a suite of agreements designed to provide more security to the Colorado River System. The [Demand Management Storage Agreement](#) was part of the DCP, through which the Upper Division States committed to considering the feasibility of a potential Demand Management program.

Q. Why might Colorado benefit from a Demand Management program?

- A. The purpose of such a program would be to protect Colorado water users from mandatory curtailment in the event of a compact administration scenario by conserving and storing water as an insurance policy of sorts, to help ensure continued compact compliance in the future. Additionally, a Demand Management program would offer a tool to share the burden across water use sectors, as opposed to potential disproportionate impacts to one sector or subbasin. A Demand Management Program may provide environmental, recreational, and other benefits as well.

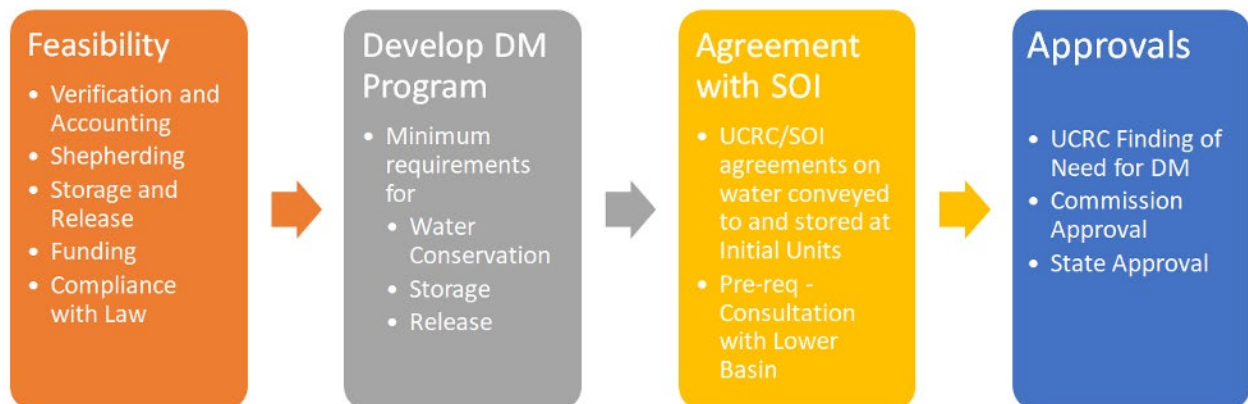
Q. How does Demand Management fit with other Colorado River issues?

- A. Demand Management is only one potential tool in the toolkit when it comes to maintaining compact compliance and protecting Colorado's water users. As part of its core mission of protecting Colorado's water, the Colorado Water Conservation Board (CWCB) is dedicated to protecting the very people that rely on Colorado's water (water users) for their livelihoods. It is therefore important to consider all potential mechanisms to increase water security as the CWCB considers the changing climate and uncertainty relating to future hydrologic conditions. Demand Management is one of those options that each of the Upper Basin States (Colorado, New Mexico, Utah, and Wyoming) agreed to investigate and are exploring to help face the future.

Q. Would all Upper Division States need to agree to move forward with a Demand Management program?

- A. Yes. To move forward with a Demand Management program as contemplated in the Demand Management Storage Agreement (DMSA) within the [Drought Contingency Plan](#) (DCP), key elements of the program would need to be approved by each one of the Upper Division States, the Upper Colorado River Commission (UCRC), and the Secretary of Interior (SOI) prior to its implementation. The Lower Division States would also need to be consulted. Below is a visual representation of the steps that must be taken before a potential program may be established.

Steps to developing a potential Demand Management Program



Q. How would a potential Demand Management program work?

- A. Demand Management would be a temporary, voluntary, and compensated program that would allow Colorado River water users to opt-in and temporarily reduce their consumptive use of water in order to assist with water storage for future Colorado River Compact requirements.

Q. Is there currently a Demand Management program set up in Colorado?

- A. At this time, there is no Demand Management program in Colorado. Rather, the feasibility investigation into a potential Demand Management program is underway. It is not a foregone conclusion that a Demand Management program will be established. There are many questions that would need to be answered and steps that would need to be taken before one could be set up.

Q. Is the purpose of a Demand Management program to protect Colorado water users, or to provide surplus water to the Lower Division States of Arizona, California, and Nevada?

A. The purpose of a potential Demand Management program is to protect water users in Colorado and the other Upper Division States by assisting in maintaining compact compliance for the Upper Division States. It is not to provide surplus water to the Lower Division States. A potential Demand Management program would help the Upper Division States continue to meet their legal obligations and mitigate, prevent, or delay mandatory cutbacks or compact administration in Colorado and the other Upper Division States. It would only be implemented if it is determined to be achievable and worthwhile for Colorado and the Upper Division States.

Q. Would any of the saved water become available for the growing Front Range population?

A. Pursuant to the Drought Contingency Plan and the Demand Management Storage Agreement, all of the water conserved through a Demand Management program could only be used to meet the Upper Division States' obligations of the 1922 Colorado River Compact, rather than providing for any other uses, including Front Range urban uses. [Learn more](#) about the Colorado River Compact and "Law of the River."

Q. Is there a target of water conservation that a Demand Management program would be required to meet?

A. The size of a Demand Management program would be determined by the number of water users who voluntarily decide they want to participate, subject to the cap of 500,000 acre-feet of storage among the Upper Division States, pursuant to the [Demand Management Storage Agreement](#).

Q. How can unintended consequences of a Demand Management program be avoided or mitigated?

A. If a program is established, many factors would need to be considered in its design to adequately protect Colorado's water users, communities, and the state as a whole. That is why the Colorado Water Conservation Board is committed to working with stakeholders and others across the state to ensure that if a Demand Management program is established, it takes into account potential adverse consequences and includes mechanisms to mitigate or eliminate them, and is sufficiently adaptable to respond to unintended consequences as they arise.

Q. How would Demand Management avoid adversely impacting the economies of communities in which water users participate?

A. The Colorado Water Conservation Board (CWCB) is analyzing potential economic impacts—both positive and negative—so that any negative impacts may be identified and mitigated or avoided if a program is established. Water users may choose to participate if they determine it is beneficial for them to do so. The CWCB is also dedicated to considering mitigation measures if there are secondary impacts to communities. Throughout the feasibility investigation, community leaders, stakeholders, and others will continue to have opportunities to help the CWCB consider potential program designs that could benefit communities and avoid adverse impacts.

Q. Are there any Demand Management pilot programs available?

A. At this time, there are no specific Demand Management pilot programs. There are, however, many conservation-based grant programs available through the Colorado Water Conservation Board, including [Water Supply Reserve Funds](#) and [Alternative Transfer Methods](#). These programs are not directly related to Demand Management but could help to inform the Demand Management feasibility investigation.

Q. Should a Demand Management program be established, how could it ensure all sectors reliant on Colorado River water be given equal opportunity to participate?

A. Equity is one of the most important factors in determining the feasibility of such a program. There is broad recognition that equity may be defined in different ways, including not only equitable opportunity to participate but also equity in terms of avoiding adverse impacts to a particular sector or area of the state. That's why the Colorado Water Conservation Board remains dedicated to fully understanding what equity looks like across the state, and also remains committed to ensuring it is a key consideration in the feasibility investigation, and in a potential program.

Q. What is the next step in determining if Colorado should set up a Demand Management program?

A. On November 18, 2020, the Colorado Water Conservation Board (CWCB) adopted the [Demand Management Feasibility Investigation Step II Work Plan](#). The goal throughout this Step will be to build on work completed pursuant to the 2019 Work Plan. Through development of a framework incorporating various potential program designs, issues such as program cost, on-the-ground achievability of potential projects, proportionality of participation across the state, and other key issues will be analyzed.



COLORADO

**Colorado Water
Conservation Board**

Department of Natural Resources

Colorado Water Conservation Board's mission is to conserve, develop, protect and manage Colorado's water for present and future generations.

WATER & SEWER BOARD AGENDA AUGUST 18, 2021

ENCLOSURE _____

NO ENCLOSURE X

ITEM NUMBER: 15

TITLE: SUCH OTHER BUSINESS THAT MAY BE
 BROUGHT BEFORE THE BOARD AND
 ADDED TO THIS AGENDA BY MOTION OF
 THE BOARD

RECOMMENDATION: TO BE DETERMINED

ADDITIONAL INFORMATION: