

**DESIGN CRITERIA
AND
CONSTRUCTION SPECIFICATIONS**

VOLUME III

POTABLE WATER DISTRIBUTION,
SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS,
AND LANDSCAPE & IRRIGATION



January 2023

DEPARTMENT OF WATER & SEWER

CITY OF GREELEY, COLORADO



FORWARD

The City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, Non-Potable Irrigation Systems, and Landscape Irrigation* documents are intended to provide guidance for the design, review, and construction of those public utility improvements pertaining to water in or under the public right-of-way or dedicated easements.

This document represents an attempt to assist those in the design, review, and construction industry to provide quality and long-lasting public utility improvements and facilities. The document also provides for consistency in the areas of design, review, and construction.

This document is not intended to replace or restrict the function of the design engineer or the innovativeness and expertise of developers and contractors. Users of this document are encouraged to submit their ideas and methods of improving this document.

Sean Chambers
Water and Sewer Director

Effective: January 31, 2023

CITY OF GREELEY, COLORADO
DEPARTMENT OF WATER & SEWER

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**POTABLE WATER DISTRIBUTION, SANITARY SEWER COLLECTION,
NON-POTABLE IRRIGATION SYSTEMS, AND LANDSCAPE & IRRIGATION
DESIGN CRITERIA**

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SECTION 1

GENERAL REQUIREMENTS

1.01 SCOPE

The purpose of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems and Landscape and Irrigation*, hereafter referred to as the “Criteria”, is to present the minimum design and technical criteria for the analysis and design of potable water distribution, sanitary sewer collection, and non-potable irrigation systems for which City of Greeley acceptance is required. The Criteria may be amended as new technology is developed or a need for revision is demonstrated and proven through experience and use. The Design Engineer shall be responsible for compliance with these Criteria as well as other applicable design and construction standards in the preparation of engineering reports, construction drawings, and specifications for City review and acceptance.

1.02 DEFINITIONS AND ABBREVIATIONS

Wherever the following words, phrases, and abbreviations appear in these specifications they shall have the following meaning:

- A. ac – acre
- B. ac-ft – acre-feet
- C. ANSI – American National Standards Institute
- D. APPROVED PLAN – The latest revised Construction Drawing(s) accepted by the City of Greeley.
- E. APWA – American Public Works Association
- F. AS-CONSTRUCTED DRAWINGS – Drawings reflecting actual conditions and information for the project after construction is completed.
- G. ASME – American Society of Mechanical Engineers
- H. ASTM – American Society for Testing Materials
- I. AWWA – American Water Works Association
- J. CDOT – Colorado Department of Transportation
- K. CDPHE – Colorado Department of Public Health and Environment
- L. cfs – cubic feet per second
- M. CITY – City of Greeley
- N. CONSTRUCTION DRAWINGS – Engineered working drawings including plan, profile, and detail sheets of proposed development and utility improvements accepted by the City.

- O. CONTRACTOR – The individual, firm, partnership, corporation, or combination thereof, private, municipal, or public including joint ventures, which, as an independent contractor, has entered into a contract with the Developer/Owner.
- P. CRITERIA – City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*.
- Q. DESIGN ENGINEER – The partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, who is hired by the Developer/Owner to conduct engineering design services and may be empowered by the Developer/Owner to act as his agent for the project.
- R. DEVELOPER – The owner, corporation, association, partnership, agency, or individual who or which shall participate in development, has entered into a development agreement with the City and has entered into an agreement with the Design Engineer and Contractor to perform the development work.
- S. DEVELOPMENT – Any construction or activity which changes the basic characteristic or use of land on which construction or activity occurs, including but not limited to, any non-natural change to improved or unimproved real estate, substantial improvements to buildings or other structures, installation of utilities, mining, dredging, filling, grading, paving, extraction, or drilling operations.
- T. DEVELOPMENT CODE – A section of the City Municipal Code prepared by the City of Greeley Community Development Department which sets forth requirements and standards for land development, land use, and the *Subdivision Regulations*.
- U. DIP – Ductile-iron pipe.
- V. EASEMENT – A right granted by the property owner permitting a designated part or interest of the property to be used by others for specific use or purpose.
- W. EPA – Environmental Protection Agency
- X. ft² – square feet
- Y. ft/s – feet per second
- Z. GEOTECHNICAL ENGINEER – A partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, proficient in the area of soil mechanics, and who is hired by the Developer/Owner to conduct subsurface soils investigations and evaluations, ground water assessments, and other related engineering services.
- AA. gpcd – gallons per capita per day
- BB. gpd – gallons per day
- CC. gpm – gallons per minute
- DD. HP - horsepower

- EE. INSPECTOR – Representative of the City of Greeley designated to conduct construction/field observation.
- FF. LAND SURVEYOR – A registered Professional Land Surveyor, according to State of Colorado statutes, who is hired by the Developer/Owner to determine the boundaries and elevations of land and/or a structures and other related surveying services.
- GG. LIVING UNIT - one or more connected rooms, constituting a separate, independent housekeeping establishment for owner occupancy, or rental or lease as a single unit on a monthly basis or longer, physically separated from any other room or dwelling units which may be in the same structure and served by no more than one gas meter and one electric meter.
- HH. MAY – A permissive condition. Where the word “may” is used, no requirement for design or application is intended.
- II. NEC – National Electric Code
- JJ. NFRWQPA – North Front Range Water Quality Planning Association (regional 208 agency)
- KK. NON-POTABLE – Water that is not treated to approved drinking water standards and is not suitable or intended for human consumption, but is produced and delivered for irrigation use.
- LL. OSHA – Occupational Safety and Health Administration
- MM. OWNER – Any person having title or right of ownership in the surface estate of real property or leasehold interest within.
- NN. PGI – PVC Geomembrane Institute
- OO. PLANNING COMMISSION – Appointed members to advise the City Council on land use planning and development and to make decisions on land use matters.
- PP. PLANS – See CONSTRUCTION DRAWINGS.
- QQ. PLC – Programmable Logic Controller
- RR. PROFESSIONAL ENGINEER – An engineer registered with the State of Colorado according to State of Colorado statutes.
- SS. PROFESSIONAL LAND SURVEYOR – A land surveyor registered with the State of Colorado according to State of Colorado statutes.
- TT. psi – pounds per square inch
- UU. PVC – Polyvinyl chloride
- VV. SDC – City of Greeley *Design Criteria and Construction Specifications, Volume I, Streets.*
- WW. SDDC – City of Greeley *Design Criteria and Construction Specifications, Volume II, Storm Drainage.*

- XX. SDR – Standard Dimension Ratio (pipe outside diameter over minimum pipe wall thickness).
- YY. SHALL – A mandatory condition. Where certain requirements in the design or application are described with the “shall” stipulation, it is mandatory that these requirements be met.
- ZZ. SHOULD – An advisory condition. Where the word “should” is used, it is considered to be advisable usage, but not mandatory. Deviations may be allowed when reasons are given which show that the intent of the standard is met.
- AAA. SPECIFICATIONS – The construction specifications portion of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*.
- BBB. STRUCTURE - Anything constructed or erected on or in the ground, the use of which requires a more or less permanent location on or in the ground, and, including, but not limited to, walls, retaining walls, fences, parking lots, parking slabs and oil and gas production facilities.
- CCC. STANDARDS – The design criteria portion of the City of Greeley *Design Criteria and Construction Specifications, Volume III, Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation Systems*.
- DDD. SUBCONTRACTOR – Any person, firm or corporation, other than the employees of the Contractor, who enters into contract with the Contractor, to furnish labor, materials, or labor and materials.
- EEE. SUBDIVISION REGULATIONS – A section of the Development Code prepared by the City of Greeley Community Development Department, which contains requirements for various land use, land development, and subdivision processes.
- FFF. UNCC – Utility Notification Center of Colorado.
- GGG. UNDERDRAINS – Private line or system that controls or managing any subsurface water on individual foundation lot or lots. No private underdrain systems shall be allow in Water & Sewer easements.
- HHH. UTILITY – City of Greeley Water and Sewer Department.
- III. UTILITIES – Shall mean all utilities, wet and dry, on site prior to the time of any design and development and all utilities proposed with design. Wet utilities shall include, but are not limited to potable water lines, sanitary sewer lines, non-potable irrigation lines, transmission gas lines, storm water lines, ditches and other runoff conveyance elements. Dry utilities shall include, but are not limited to electric lines, telephone lines, gas service lines, fiber optic lines, and cable television lines.
- JJJ. VFD – Variable Frequency Drive
- KKK. WATER AND SEWER DIRECTOR – Shall mean the Director of the City of Greeley Water and Sewer Department or their designated representative.

1.03 MINIMUM STANDARDS

- A. The City of Greeley’s Community Development Department has Development Code documents that can help define the various processes required for projects within the City.
- B. The City’s review and acceptance will only be to determine if the plans and specifications conform to the City’s requirements. The City’s review and acceptance will not relieve the Developer, Design Engineer and Contractor from responsibility for any variation from the City requirements or adequate design standards. The City’s review and acceptance shall not constitute any assumption of responsibility or liability for the design or construction. It is the intent and purpose of these standards and specifications to obtain high quality construction throughout, with the completed work complying with the City standards and specifications.
- C. All vertical and horizontal control shall be based on the currently adopted City of Greeley vertical and horizontal monumentation. Proposed reference monumentation shall be approved by the City prior to survey. A list of approved monuments may be obtained from the City.

1.04 RELATIONSHIP TO OTHER STANDARDS

- A. Whenever a provision of these Criteria and any other provision in any law, ordinance, resolution, rule, policy, or regulation of any kind contain any restrictions covering any subject matter within these Criteria, the most restrictive standard shall apply.
- B. The provisions of these Criteria and standards are minimum requirements that do not preclude the use of more restrictive standards by the Design Engineer or City.
- C. Adherence to these Criteria does not remove the Developer’s responsibility to investigate and obtain any other regulatory permits or approvals, from either local, regional, state, or federal agencies, that may be required for a particular project.

1.05 REVIEW AND ACCEPTANCE

- A. All potable water, sanitary sewer, and non-potable irrigation construction plans and specifications submitted to the City for review preliminary and final, comment, and acceptance shall be prepared by, or under the direct supervision of a Professional Engineer. Said Professional Engineer shall be responsible for the design, preparation of the construction drawings and reports, determining material specifications, and reviewing the field survey for accuracy.
- B. The construction plan review process for all development as outlined in the *Development Code* shall be followed.
 - 1. The preliminary plan set shall be reviewed by the City for general compliance with these Criteria and the City shall provide comments to the Developer or their agents regarding corrections, additions, and omissions.
 - 2. All submittals to the City shall be done in accordance with the city Development Code.

3. It is the responsibility of the Design Engineer to confirm that submittals are in conformance with these current standards. Any preliminary or final submittal not meeting these criteria may be rejected without review.
 4. After final corrections are made and the plans are accepted, the plans set shall be signed by the Water and Sewer Director or designated representative(s). The signing of the plans will constitute acceptance. The acceptance is qualified in that: ***The plans are reviewed and accepted for concept only and the plan acceptance does not imply responsibility by the Water and Sewer Department or the City of Greeley for accuracy and correctness. The plans acceptance does not imply that quantities of items indicated on the plans are the final quantities required. The plans acceptance shall not be construed for any reason as acceptance of financial responsibility by the Water and Sewer Department or City of Greeley for additional items not shown that may be required during the planning or engineering phase and the construction phase.***
- C. See Section 6 *Landscape and Irrigation Design Criteria* to determine if additional review and supervision by a registered Landscape Architect is required.
 - D. If the Design Engineer responsible for the plans disagrees with any requested changes to the submitted plans that may be required by the City for acceptance, such disagreement shall be brought to the attention of the City, and if required by the City, in writing.
 - E. The Seal of the Design Engineer on plans so corrected and accepted for construction will signify that the Professional Engineer has reviewed, approved, and authorized said corrected plans for construction.
 - F. No construction shall be undertaken without a City accepted and signed set of Construction Drawings and a recorded plat or required potable water, sanitary sewer, and/or non-potable irrigation easements.

SECTION 2

SUBMITTAL REQUIREMENTS

2.01 GENERAL

Requirements discussed in this section are the minimum for potable water distribution, sanitary sewer collection, and non-potable irrigation systems and are not meant to be all-inclusive. Other requirements may be needed for a complete design. The Design Engineer shall consider the maintenance and operational aspects of the potable water distribution, sanitary sewer collection, and non-potable irrigation systems' infrastructure, as well as constructability in their design.

- A. All construction drawings shall be legible and submitted on PDF 22" x 34" or 24" x 36" sheets. Additional sizes may be accepted with prior approval.
- B. A legend describing all line types, symbols, and abbreviations shall be shown either on the cover sheet or each individual sheet.
- C. Each sheet in the Construction Drawings shall be marked "PRELIMINARY, NOT FOR CONSTRUCTION" with the date of submittal. This statement shall be removed on the final City accepted Construction Drawings.
- D. City accepted and signed construction plans are required prior to the City's issuance of construction permits.

2.02 PRELIMINARY CONSTRUCTION PLAN REQUIREMENTS

For Preliminary subdivisions, plans shall be submitted to the City for review and acceptance prior to the preparation of final Construction Drawings. Acceptance of the preliminary submittal shall constitute only a conceptual acceptance and shall not be construed as acceptance of specific design details. The preliminary plans' submittal requirements are outlined below and in the City of Greeley Community Development Department's Construction Plan checklist.

- A. Utility Sheet
 - 1. A general overview of the entire project including, but not limited to, streets (complete with names), alleys, lot and block numbers, all proposed and existing utilities on and within 100 feet of the project site, all existing and proposed easement, rights-of-way on and adjacent to the project site, and storm water facilities.
 - 2. The entire project shall be shown on one (1) sheet unless the project is too large to show sufficient detail. City acceptance must be granted to show the project on more than one sheet and a key map to aid in drawing orientation and locating the sheet construction in relation to the overall project will be required on each sheet.
 - 3. Proposed project phasing for utilities and structures.
 - 4. Proposed point(s) of connection for potable water, sanitary sewer, or non-potable irrigation mains to the existing system(s). All existing potable and non-potable water lines shall be labeled with the pipe diameter, type of material, and year of installation

(available from the City). All existing sanitary sewer lines shall show existing manholes, complete with rim and invert elevations, and pipe diameter.

5. Geotechnical bore locations shall be shown in plan view within the utility plans.
6. Any other information deemed necessary by the Design Engineer or City.

2.03 FINAL CONSTRUCTION PLAN REQUIREMENTS

- A. Final Construction Plans shall contain the same information as indicated in the Preliminary Construction Plan Requirements section 2.02 of these Criteria with additional requirements as outlined below and in the City of Greeley Community Development Department's Final Construction Plan checklist. After one (1) year from the original acceptance date, the City may require resubmittal of the plans for review and acceptance due to revised or updated City design criteria or construction specifications.
- B. City accepted easements or a City accepted final plat must be executed before final Construction Plan acceptance.
- C. One set of 22" x 34" or 24" x 36" plans shall be submitted to the City for acceptance signatures when all known issues have been addressed to the satisfaction of the City. Additional sizes may be accepted with prior approval. Once the plans receive City signatures, the Developer or their agents shall make copies of the signed plans and provide them to the City.
- D. An electronic version, in a format acceptable to the City, of the final Construction Drawings shall be provided to the City at the time of plan signatures.
- E. Potable water, sanitary sewer, and non-potable irrigation main designs shall be provided on separate plan and profile sheets specific to potable water, sanitary sewer, and non-potable irrigation.
- F. The Cover Sheet shall contain a signature line for all Ditch Companies, or end user(s) if the ditch is not controlled by a Ditch Company, that have their facilities impacted or modified by the project.
- G. All utility verifications shall be in compliance with Colorado Revised Statute 9-1.5 as updated.
- H. "Call Utility Notification Center of Colorado (UNCC) at 1-800-922-1987 or dial 811 for utility locates 72 hours prior to any excavation work" shall be put on all drawing sheets.
- I. Conduit Plan
 1. The conduit plan serves to show all proposed utility conduits crossing public rights-of-way and easements. ***The conduit plan may be a separate sheet from the utility plan as requested by the City.***
 2. Provide a general overview of the project including but not limited to street names, street rights-of-way, all proposed and existing utilities, all proposed and existing easements, and lot and block numbers.

3. Show all utility conduits crossing the public rights-of-way and easements and indicate the utility conduit diameter, number of conduits, depth of installation, and name of utility using the conduit.
4. Add the following note to the conduit plan: “All utility conduit crossings of potable water, sanitary sewer and non-potable irrigation lines shall be encased in High Density Polyethylene (HDPE) or fusible C900-16 PVC Pipe, with minimum Standard Dimension Ratio (SDR) 11 across the entire easement or right-of-way width. The encasement joint shall be butt fused. Flexible joints are not allowed.”

J. Construction Plan View

1. Clear distance between utilities shall be outside wall to outside wall.
2. Show and label proposed and existing easements, rights-of-way, and property lines.
3. Indicate the proposed method of connection to existing potable water distribution, sanitary sewer collection, and non-potable irrigation systems.
4. Show all proposed and existing potable water, sanitary sewer, and non-potable irrigation services. Indicate the station of service locations on the potable water, sanitary sewer, and non-potable irrigation mains or include a tabular list of stations.
5. Where the minimum cover over sanitary sewer mains provides less than 10 feet of elevation difference between the top of foundation grade and the top of the sewer main, a note shall indicate the lot is served by a “shallow sewer” and appropriate elevation information shall be provided. Shallow sewer is defined in *Section 4* of these Criteria.

- K. Pothole information of all water or sewer mainlines and impacted services. At critical locations and as determined by City, with date including month and year, elevation, depth and datum.

L. Construction Profile View

1. Show all existing and proposed utility crossings in compliance with Colorado Revised Statute 9-1.5 as updated. Existing utility crossing locations and elevations shall be obtained from the current project design field survey. Existing utilities shall be potholed as required to perform complete and accurate design prior to construction plan acceptance. Field obtained elevations shall be provided on the Construction Drawings complete with when the field information was gathered, the exact location where it was collected, the Firm that performed the potholing and surveying, and the date the survey was conducted.
 - a. Clear distance between utilities shall be outside wall to outside wall.
2. Where the potable water and sanitary sewer mains are within two feet vertically of each other, all water and sewer services that cross a main shall be shown.
3. Provide all pertinent information for existing utilities, refer to checklist for details.
4. Provide pipe slope, manhole inverts in and inverts out (main and service line), and rim

elevations and manhole stationing for proposed sanitary sewer lines.

5. Any other information deemed necessary by the Design Engineer or City.

M. Standard Drawing (Detail) Sheets

1. Include all project applicable City of Greeley Standard Drawings as part of the construction plans set. Water and Sewer Department Standard Drawings are provided in these Criteria. Refer to the Department of Public Works' *SDC* and *SDDC*, latest revision, for other project related details.
2. All City of Greeley Standard Drawings shall contain the City logo in the bottom left corner. If any standard City detail is modified, the City logo shall be removed from the detail and placed on a separate sheet before standard details. All modified detail shall be stamped by design engineer.
3. Where Standard Drawings are not applicable to the work, provide project specific construction details. These shall include construction details of critical connections, atypical crossings, special fittings and appurtenances, and any other details deemed necessary by the Design Engineer or City.

N. Requirements for Changes to Final Accepted Plans

1. Should circumstances warrant changes from the City accepted Construction Plans, acceptance of the changes shall be obtained from the City prior to construction.
2. All modified drawings shall be on 22" x 34" or 24" x 36" sheets. Depending on the extent of the changes, the City will decide if revised plans are required.

O. Wastewater Pumping Station (Lift Station) Final Construction Plans

1. Lift station final construction plan requirements are specific to the design requirements of the lift station in addition to state and regional guidelines. Refer to *Section 4* for lift station requirements.

P. Geotechnical bore logs and groundwater data shall be shown in the Construction Plans.

2.04 FINAL PLAT AND REPLAT REQUIREMENTS

A. Final plats shall adhere to the requirements set forth in the City of Greeley Development Code Chapter 3: *Subdivision Regulations* and the Department of Public Works' *SDC*, latest revision. The following requirements shall also apply:

1. Clearly show, label, and dimension newly dedicated and existing potable water, sanitary sewer, and non-potable irrigation easements.
2. Clearly denote the allocation of any new or existing water dedication credits between the parcels included on the plat.
3. Where minimum cover over sanitary sewer provides less than 10 feet of elevation difference between the finished top of foundation elevation and the invert of the sewer

main, the plat shall indicate that the lot is served by a “shallow sewer”. Shallow sewer is defined in *Section 4* of these Criteria.

4. Where a single service is allowed for multiple buildings on a single lot the plat shall indicate that if the lot is ever subdivided the service and main configuration must be brought into alignment with the current City of Greeley Design Criteria.
 5. All platted lots shall be adjacent to a public potable water distribution and sanitary sewer collection main. No potable water or sanitary sewer services shall cross lot lines.
- B. For all replats where lot lines or street locations change, all existing potable water, sanitary sewer, and non-potable irrigation mains, services, fire hydrants, fire sprinkler lines, etc. shall be relocated to their appropriate location or abandoned. Potable water distribution, sanitary sewer collection, and non-potable irrigation system designs in this replatted area must conform to the current City of Greeley Design Criteria.

2.05 LANDSCAPE PLANS REQUIREMENTS

- A. No plant material with mature growth greater than three (3) feet in height shall be planted within potable water, sanitary sewer, or non-potable irrigation easements.
- B. No shrubs shall be planted within five (5) feet or trees within ten (10) feet of potable and non-potable water meters, fire hydrants, sanitary sewer manholes, or potable water, sanitary sewer, and non-potable irrigation mains and services.
- C. Clearly show and label all proposed and existing potable water and non-potable irrigation meter pits/vaults, mains and services, sanitary sewer mains and services, fire hydrants, and easements on the landscape plans.
- D. Show and label all proposed water taps that will be used for landscape irrigation.
- E. Provide a table summarizing irrigation water use by area per Section **20-254** of municipal code
- F. See Section 6: *Landscape and Irrigation Design Criteria* for additional landscape plan requirements that may apply.
- G. Add sections 2.05-A and 2.05-B of these Criteria as notes on the landscape plans.

2.06 EASEMENTS

- A. When it is not feasible for potable water, sanitary sewer, or non-potable irrigation main installation to be in a dedicated street right-of-way, the installation shall be made within a dedicated easement. The conditions for allowance of such an exception shall be determined for each individual case. The minimum easement width acceptable to the City is as follows:
 1. For a dedicated potable water, sanitary sewer, or non-potable irrigation main easement containing just one (1) main, the width shall be twenty (20) feet or twice the depth to the invert of the pipe, whichever is greater. This easement shall be for the exclusive use by City of Greeley potable water, sanitary sewer, or non-potable irrigation mains. The easement name, which shall be “PERMANENT POTABLE WATER EASEMENT”,

“PERMANENT SANITARY SEWER EASEMENT” or “PERMANENT NON-POTABLE WATER EASEMENT”, and the easement width shall be labeled on the Construction Drawings and plat.

2. For any combination with two utilities, potable water, sanitary sewer or non-potable irrigation main easements, the total width shall be thirty (30) feet or twice the maximum depth to the invert of each utility, whichever is greater. This easement shall be for the exclusive use by the City of Greeley. The easement name and the easement width shall be labeled on the Construction Drawings and plat.
 3. For any combination with three utilities, potable water, sanitary sewer or non-potable irrigation main easements, the total width shall be forty (40) feet or twice the maximum depth to the invert of each utility, whichever is greater. This easement shall be for the exclusive use by the City of Greeley. The easement name and the easement width shall be labeled on the Construction Drawings and plat.
 4. Where pipes of diameters greater than sixteen inches (16”) are installed additional easement width may be required to account for pipe width.
- B. The mains within the easement shall be located as centrally as feasible within the easement while maintaining required separation from other mains and accounting for the depths of mains where necessary.
- C. There shall be no detention ponds, berms greater than three (3) feet, permanent structures, fences, trees, shrubs with mature height greater than three (3) feet, or other obstructions that will impede the ability of the City to adequately maintain and service the main(s) located within the easement.
- D. Easements not dedicated with a plat, shall be dedicated by separate document and recorded prior to City acceptance of the Construction Drawings. Easement dedication by separate document shall include:
1. Easement Dedication Form. An easement dedication form shall be completed by the Developer. Standard easement dedication forms are available in the appendix. The completed easement dedication form must be signed by the property Owner and notarized.
 2. Exhibit Map. An exhibit map (8 ½” x 11”) with sufficient description information to establish the legal boundary of the easement shall be provided. The exhibit map shall show and label all existing easements, property lines, and public rights-of-way. The City may request additional information, not listed here, for the exhibit at the city's discretion.
 3. A Written Legal Description of the dedicated easement boundary.
 4. Funds for Recording. The Developer shall provide cash or a check made out to the **City of Greeley** for the easement recording fees. The City shall provide the recording fee sum once all easement documents are finalized. ***The City does not provide the funds for recording easement documents.***
 5. Once the easement dedication documents are accepted by the City and the recording fees

have been provided in the appropriate amount, the City shall have the easement documents recorded with Weld County.

2.07 HYDRAULIC REPORT – POTABLE WATER & SANITARY SEWER

A hydraulic analysis for the potable water distribution and sanitary sewer collection systems for a given project shall be submitted by the Design Engineer, as a report, to the City for review and acceptance. The report shall be accepted by the City prior to final Construction Drawing acceptance. The hydraulic analysis report will be reviewed by the City, along with the Construction Drawings, in the same review and acceptance process as outlined in *Section 1* of these Criteria. Projects that move forward to final design without a City accepted potable water distribution and sanitary sewer collection system hydraulic analysis report are subject to possible design changes, including but not limited to, pipe re-alignment, upsizing, extensions, and additional stubouts.

The objective of the hydraulic analysis report is to assist the Design Engineer with designing a project's potable water distribution and sanitary sewer collection systems to adequately serve peak demands while adhering to the design requirements set forth in these Criteria. For the potable water distribution system, the hydraulic analysis report serves as a tool for demonstrating the necessary number of connection points to the existing system for adequate water line looping, system reliability and required pipe sizing. For the sanitary sewer collection system, the hydraulic analysis report evaluates peak flow quantities, flow type, pipe capacity, and flow velocity and establishes appropriate pipe sizing.

Non-potable irrigation system hydraulic and design reports are also required for projects utilizing non-potable water for irrigation purposes; however, since non-potable irrigation systems are unique, the non-potable hydraulic and design report requirements have been provided in section 2.08 of these Criteria.

The written hydraulic report shall include the following information:

A. Title Page

1. Report title.
2. Project name and location.
3. The name, address, and phone number of the Owner, Developer and Design Engineer that prepared the report.
4. Report preparation date.

B. Engineer Certification Sheet

1. The report shall be prepared by or under the supervision of a Professional Engineer, licensed to practice in the State of Colorado, possessing adequate experience in the design of potable water distribution and sanitary sewer collection systems. The report shall contain a certification sheet with the following statement to be signed and sealed by the Design Engineer:

“I understand the City’s acceptance does not relieve the Design Engineer’s responsibility for errors, omissions, or design deficiencies for which the City is held harmless.

Registered Professional Engineer

(Affix Seal)

C. Table of Contents

D. Project Description and Location

1. Clearly state the location of the project. Provide a site vicinity map specifying the project's geographical location and the project area in acres. The project acreage shall be the same as on the project plat.
2. Clearly state the land use zoning, estimated number of residential lots or living units, commercial square footages, and the irrigated acreages.
3. Indicate if the project will be phased. Elaborate on the anticipated timing for each project phase and the phase's associated building and infrastructure construction.
4. For multifamily, commercial, or industrial developments, indicate if potable or non-potable water will be used for landscape irrigation.
5. Identify the locations of all potable water, sanitary sewer, and non-potable irrigation connection points to the existing systems.
6. Provide the pipe diameter, pipe material, and year of installation for the existing potable water, non-potable water, and sanitary sewer lines.

E. References and Appendices

1. Provide a page referencing all design criteria, resources, and modeling software used in preparing the hydraulic report.
2. Provide appendices as necessary to include modeling result printouts, copies of demand assumption data, and fire flow test results.
3. Hydrant flow tests results may be available from Greeley Fire Department (970-350-9511). Obtained fire flow test pressures will be evaluated for use by the City on a case by case basis.

F. Potable Water System Report Requirements and Assumptions

1. Provide all used equations, demand assumptions, and essential design requirements, parameters, and constraints.
2. Indicate the software package(s) and version used for the water system modeling.
3. Indicate in which City of Greeley potable water pressure zone the project is located.
4. Provide calculations for estimated population, design flows and velocities, irrigated acreage, irrigation application rates, peaking factors, and any other necessary design

calculations.

5. Provide hydrant fire flow and fire sprinkler system flow requirements.

G. Potable Water System Analysis and Modeling

1. Modeling Scenarios

- a. Static. The static scenario shall establish the available water pressure for the site with no demands on the system and serves to check that pressure requirements are maintained.
- b. Peak hour demand plus fire flow. This scenario shall include peak hour domestic water use¹ demands plus fire flow².
- c. Peak hour demand plus fire flow with one (1) water connection closed. While using the determined potable water demands for the peak hour plus fire flow scenario, each connection to the existing potable water system shall be closed, in turn, and modeled. Fire flow shall be placed at a hydrant nearest to the closed connection. This scenario represents a worst-case water demand condition and shall only serve to demonstrate how the potable water distribution system within the development functions during this condition. It is acceptable to have the potable water system velocity requirements violated in this scenario only. The system must maintain a minimum pressure of 20 psi with fire flow.
- d. Phasing. Water modeling shall be required for the incomplete potable water system as indicated per the planned phasing on the Construction Drawings, in order to demonstrate that peak hour demand plus fire flow can be met for the interim phased condition.

The hydraulic report shall verify that a proposed potable water system can provide the required water demands for a given development, at an acceptable pressure, and meet the overall potable water system design requirements set forth in these Criteria. At the City's discretion all ultimate connections to existing water mains may be required regardless of development phasing. Upsizing water mains within a development as a means to increase water system capacity in lieu of making a connection to another water source, is not permitted.

If the hydraulic water model demonstrates that a larger main is required to serve the phased condition than would be needed for the full build out condition, the Developer is required to install the larger pipe at their expense and is not eligible for pipe oversizing reimbursement from the City when the larger pipe is no longer needed.

- e. Additional scenarios. At the City's discretion, the City may require additional

¹ Domestic water use shall refer to all household and corresponding lot irrigation for single family and applicable multifamily residential potable water use. It shall also refer to all potable water use, including potable irrigation, for commercial and industrial uses.

² Fire flow shall be inclusive of fire hydrant and fire sprinkler flow. Residential, commercial, or industrial developments requiring fire sprinkler systems shall have fire sprinkler demands, in addition to hydrant fire flows, placed in the hydraulic water model at appropriate node locations.

scenarios, adjustments to the fire flow placement, reservoir elevations, and existing system connections, revisions to the pipe and node schematic layout, and other model modifications as necessary to verify that the proposed potable water system will meet the design requirements and potable water demands of the development and the City as a whole.

- f. At the City's discretion, the hydraulic analysis may be required to extend beyond the limits of the project boundary.
- g. Demands for undeveloped parcels shall be calculated based on the higher of the current or anticipated land use or zoning of the property.
- h. Model must be compatible and capable of being integrated with City's hydraulic model developed with InfoWater. Model must be provided to Water and Sewer upon request.

2. Modeling Procedure

- a. Connections to the existing potable water distribution system are typically denoted as reservoirs with the same hydraulic grade elevation. The City shall provide inflow pressure.
- b. Place estimated domestic water, fire sprinkler, and irrigation tap demands at appropriate node locations within the model as they relate within the project.
- c. Locate fire flow demands at hydrant locations according to the modeling scenarios in section 2.07-G of these Criteria. The maximum allowable fire flow provided from any one (1) hydrant shall be 1,500 gpm. If the required fire flow is in excess of 1,500 gpm, the next closest hydrant shall be used until the required fire flow is met.
- d. Depending on the location of the development, existing potable water system performance and reliability in the area, number of available potable water connections, and surrounding land uses, some of the project's proposed potable water connections may require modeling as a demand point or no connection instead of a water source. The City shall provide additional outflow demands for a development on a case by case basis.

H. Potable Water System Report Results

- 1. Provide a schematic layout of the potable water distribution system showing and labeling the reservoir connections, pipe network, and demand nodes as presented and analyzed for each water model scenario.
- 2. Provide a Reservoir Report for the static condition. The Reservoir Report shall include the following information:
 - a. Reservoir Identification Label
 - b. Elevation (ft) per City of Greeley datum
- 3. Provide Pipe Reports for all modeled scenarios. Pipe Reports shall include the following

information.

- a. Modeled Scenario Title
 - b. Pipe Identification Label
 - c. Pipe Length (ft)
 - d. Pipe Diameter (in)
 - e. Pipe Material
 - f. Hazen-Williams Coefficient
 - g. Pipe Control Status (open or closed)
 - h. Pipe Velocity (ft/s)
 - i. Upstream Calculated Pressure (psi)
 - j. Headloss (ft)
4. Provide Junction/Node Demand Reports for all modeled scenarios. Junction/Node Demand Reports shall include the following information:
 - a. Modeled Scenario Title
 - b. Node Identification Label
 - c. Node Elevation (ft) per City of Greeley datum
 - d. Node Demand (gpm)
 - e. Calculated Hydraulic Grade (ft)
 - f. Pressure (psi)

I. Potable Water System Design Conclusions

1. Discuss hydraulic analysis results for all modeled scenarios.
2. Confirm that the pipe velocity and pressure requirements during the peak hour demand plus fire flow operating condition are met per *Section 3* of these Criteria.
3. Confirm that the pressure requirements during the peak hour demands plus fire flow operating conditions, with one water connection closed, are met per *Section 3* of these Criteria.
4. Discuss any potable water line oversizing required by the City over and above what is necessary for the development's potable water needs.
5. For phased developments, discuss phased construction of the potable water distribution

system and confirm that potable water pipes are sized and looped appropriately to meet the peak hour, plus fire flow demand velocity and pressure requirements during the interim condition.

J. Sanitary Sewer System Design Requirements and Assumptions

1. Provide all used equations, demand assumptions, and essential design requirements, parameters, and constraints.
2. If a model is required, it must be compatible with the City's InfoSWMM model. Model must be provided to Water and Sewer upon request.
3. Provide calculations for estimated population, design flows, peaking factor(s), hydraulic design, infiltration, flow type, and any other necessary design calculations.

K. Sanitary Sewer Systems Analysis and Modeling

1. If the development is phased, the sanitary sewer system shall be analyzed for full build out. This evaluation shall include the development's sanitary sewer flows and anticipated offsite sanitary sewer flows impacting the sanitary sewer system within the development.
2. Evaluate the development's sanitary sewer sizing for capacity to convey offsite flows.
3. Undeveloped areas shall have sanitary sewer flows calculated based on the higher of the current or anticipated land use or zoning of the property.
4. The City may require additional analysis in order to further verify that the proposed sanitary sewer system will meet the design requirements and needs of the development and the City. The City will evaluate sanitary sewer system hydraulic evaluations on a case by case basis.

L. Sanitary Sewer System Report Results

1. Provide a schematic layout of the sanitary sewer collection system showing and labeling all manholes, design points used for analysis, pipe slopes, and pipe sections.
2. Provide written calculations or printouts of software analysis results for each pipe evaluation including the following information:
 - a. Pipe Diameter (in)
 - b. Material
 - c. Date of installation
 - d. Pipe Slope (%)
 - e. Sub and Super Critical Calculations, when a model is required
 - f. Manning's n Value

- g. Pipe Discharge-(gpm)
- h. Pipe Flow Velocity (ft/s)
- i. Pipe Flow Depth (in)
- j. d/D (depth of flow/diameter of pipe)
- k. Maximum Capacity at d/D of 50% and/or 80% – (gpm) dependent on date of installation

M. Sanitary Sewer System Conclusions

- 1. Discuss analysis results for all pipe evaluations.
- 2. Confirm that acceptable pipe velocities and flow depth criteria are met.
- 3. If design constraints arise and pipe velocity, flow depth, minimum allowable slope per pipe diameter, or any other Criteria requirements cannot be maintained, the Design Engineer shall provide the City written explanation as to why the Criteria is violated, why the non-standard sewer system design should be accepted, and request a variance to the Criteria. Water & Sewer Department acceptance is required for the variance.
- 4. Discuss any sanitary sewer main oversizing required by the City over and above what is necessary for the development needs.
- 5. Indicate if the development is served by “shallow sewer.” Shallow sewer is defined in *Section 4* of these Criteria.
- 6. Discuss potential impacts that future upstream developments may have on the sanitary sewer capacity through the proposed development. Explain the capacity issues within the development and the proposed solutions for resolving them.

N. Supplemental Engineering Calculations

- 1. These calculations shall include but are not limited to pipe restrained lengths, external pipe load analysis, traffic loadings, casing pipe wall thickness, and air and vacuum release valve sizing.
- 2. Any calculations deemed necessary by the Design Engineer or City.

O. Wastewater Pumping Stations (Lift Station) Design Report

- 1. Refer to *Section 4* of these Criteria and CDPHE for lift station design and approval guidelines and lift station design report requirements.

2.08 DESIGN REPORT – NON-POTABLE IRRIGATION SYSTEM

The objective of the non-potable irrigation system design report is to assist the Design Engineer with designing a non-potable irrigation system and storage facility to adequately serve peak season irrigation demands while adhering to the design requirements set forth in these Criteria. Refer to section 2.07 of these Criteria regarding report review and acceptance.

The non-potable irrigation system design report shall include, but is not limited to, the following information:

- A. Title Page, Engineer Certification Sheet, and Table of Contents requirements, refer to section 2.07 of these Criteria.
- B. Project Description and Location
 - 1. Clearly state the location of the project. Provide a site map identifying the project area and location of the non-potable storage facility (pond), pump station, discharges/fill lines, and overflow works.
 - 2. Indicate if the non-potable system will be phased. Elaborate on the anticipated timing of the project phasing and how it will affect the overall design and construction of the non-potable irrigation system.
 - 3. If connecting to an existing non-potable irrigation system, identify locations of pipe connections. Provide the pipe diameter, pipe material, and year of installation of the existing main.
- C. References and Appendices
 - 1. Provide a page referencing all design criteria, resources, and modeling software used in preparing the design report.
 - 2. Provide appendices as necessary to include supplementary information.
- D. Non-potable Irrigation System Report Requirements and Assumptions
 - 1. Provide all used equations, assumptions, design methodologies, essential requirements, parameters, and constraints.
 - 2. Indicate any software package(s) and version used for the non-potable pipe system modeling. The model should be compatible with Innovyze InfoWater for incorporation into the City's model.
 - 3. Provide calculations for determining irrigated acreage, required storage volume, pond design including high and low operating elevations, watering requirements, application rates, and design flow.
 - 4. Provide the number and type of pumps, motor horsepower, system head curves, head computations, discharge pressure, and any other pertinent information for the pump system design.
- E. Discussion Items
 - 1. Discuss specific design features of the non-potable irrigation system and their requirements, including but not limited to, non-potable/potable water sources and means of delivery into the system, the lining and aeration system, pond shoreline treatment, overflow works, and pond design.
 - 2. General design requirements for the pump station, including but not limited to, power

and electrical requirements, control and monitoring systems, and building requirements.

F. Non-Potable Irrigation System Analysis and Modeling

1. The non-potable irrigation system shall be modeled for the static scenario and the design irrigation demands scenario. Refer to section 2.07 of these Criteria for modeling procedures and report results requirement.

G. Non-potable Irrigation System Design Conclusions

1. Discuss hydraulic analysis results for all modeled scenarios.
2. Confirm that the pipe velocity and pressure requirements during irrigation demand are met per *Section 5* of these Criteria.

H. The City may require electronic copies of the hydraulic models be submitted.

2.09 GEOTECHNICAL SOILS REPORT

- A. A geotechnical soils evaluation, prepared by or under the supervision of a Geotechnical Engineer, licensed in the State of Colorado, shall be submitted to the City for review and shall be accepted by the City prior to final Construction Drawing acceptance. The geotechnical soils report shall describe the classifications and characteristics of the soils encountered on the project and include recommended methods of backfilling and compaction. Refer to the Department of Public Works' *SDC*, latest revision, for soils testing and geotechnical soils report requirements.
- B. The Geotechnical Engineer shall evaluate groundwater conditions for the site and provide recommendations for sanitary sewer main groundwater barriers.
- C. The geotechnical soils evaluations shall include information required to determine potential corrosive soils with pH and resistivity, refer to section 3.11 of these Criteria.

2.10 VERIFICATION SURVEY DRAWING REQUIREMENTS

- A. Prior to paving, the Design Engineer shall provide the City with a survey of the installed potable water, sanitary sewer, and non-potable irrigation systems. The purpose of this survey is to verify that the mains and appurtenances were installed per design and within allowable construction tolerances. Once the City has accepted the verification survey, the City shall give the Contractor written notice to proceed with paving construction. ***Verification Survey plans are not As-Constructed Record drawings.*** See section 2.11 of these Criteria for As-Constructed Record Drawing requirements.
- B. The Verification Survey drawing(s) shall be prepared for easy modification and transition to final As-Constructed Record drawings.
- C. The Verification Survey drawings shall be modified from the original construction plan and profile sheets showing the design information as well as the surveyed information. The original design information shall be shown as "lined through" if as constructed conditions differs from approved construction plans. The surveyed information shall be located in the same area as the design information and shall be either "clouded" or made with a heavier line weight than the design information for clear differentiation.

- D. Verifications Survey drawings shall be prepared by a Professional Engineer. Surveyed elevations for the Verification Survey shall be obtained by a Colorado Registered Land Surveyor. The Surveyor shall obtain horizontal locations, surveyed elevations and information for the following: To the same precision and datum as design drawings.
1. Potable and non-potable – Horizontal locations of valves, fire hydrants, blow-offs, air/vacuum release valves, and top of pipe elevations at all valves.
 2. Sanitary sewer – Horizontal locations of manholes, diameter of manholes, sizes of installed pipe, invert elevations of all mainline pipes and services entering and exiting a manhole, distances between manholes, pipe slopes based on the surveyed invert elevations, and proposed manhole rim elevations.
 3. Utilities – Provide horizontal and vertical location of all existing and proposed utility crossings.
 4. For potable and non-potable water lines, provide the proposed final ground elevations at all valve boxes. ***Surveyed top of valve nut and valve nut key extension elevations. This information must be used to calculate top of pipe elevation based on the height of the installed valve bonnet, which varies due to pipe diameter and valve manufacturer.***
 5. Any other surveyed information as required by the City.
- A. Construction tolerances shall be:
1. Water System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.30 feet
 2. Sanitary System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.02 feet
- B. Survey measurement accuracy shall be:
1. Horizontal locations: ± 0.10 feet
 2. Elevations: ± 0.01 feet

2.11 AS-CONSTRUCTED RECORD DRAWING REQUIREMENTS

- A. The Contractor and Design Engineer shall be responsible for recording As-Constructed information on a set of Record Drawings kept at the construction site. A representative of the Developer shall monitor construction to assure that changes in construction (as approved in writing) and other pertinent details, such as horizontal location of fittings and manholes, valves, top of pipe elevations, manhole inverts, service tap locations, pipe sizes, depths, etc. are kept current on the As-Constructed Record Drawings.
- B. Where the construction is phased with a more than 30-day lapse between phases, As-Constructed Record Drawings shall be submitted to the City after each completed phase. The Construction Drawings for all future phases shall also reflect the “As-Constructed” conditions of the previous phases.
- C. At a minimum, the As-Constructed Record Drawings set shall include the following sheets from the original accepted Construction Drawings:

1. Cover Sheet
 2. Utility Plan
 3. All potable water, sanitary sewer, and non-potable irrigation plan and profile sheets.
 4. All construction details and City of Greeley Standard Drawings that were used in the construction of the potable water distribution, sanitary sewer collection, and non-potable irrigation.
 5. Landscape plans.
- D. The As-Constructed Record Drawings shall show the original design information as well as the As-Constructed information. The original design information shall be shown as “lined through”. The As-Constructed information shall be located in the same areas as the design information and shall be either “clouded” and/or made with a heavier line weight as the design information for clear differentiation. The month and year of the construction shall also be noted.
- E. A Colorado Registered Land Surveyor shall certify the As-Constructed horizontal locations and surveyed elevations of all items listed in section 2.10 of these Criteria in addition to:
1. Final sanitary sewer manhole rim elevations and Inverts.
 2. Final top of water valve box elevations, top of pipe.
 3. Construction tolerances shall be evaluated based on original design and City design criteria.
 4. Measurement tolerances shall be:
 - i. Horizontal locations: ± 0.10 feet
 - ii. Elevations: ± 0.01 feet
- F. The project responsible Design Engineer and Land Surveyor shall observe construction, as required, in order to certify the conditions and information recorded on the As-Constructed Record drawings is true and correct.
- G. The General Contractor for the project shall sign each drawing sheet of the As-Constructed Record plans set with the following statement:
- I, _____, hereby state that this project was constructed to City of Greeley accepted Construction Drawings and standards, as designed by the project Design Engineer, and as field staked by the project Land Surveyor. All deviations to the approved Construction Drawings, standards, design, or survey were so noted on field drawings and these were provided to the project Design Engineer for acceptance and inclusion in the As-Constructed Record Drawings.

Construction Company

Address

Authorized Representative

Title

Date

- H. A Professional Land Surveyor shall perform or directly supervise all field survey data collection to verify the As-Constructed conditions and shall stamp and seal each drawing sheet in the As-Constructed Record Drawing set with the following statement:

I, _____, hereby state that this project was field staked for construction per City of Greeley accepted Construction Drawings and standards and in accordance with the project design. I certify that the field survey information obtained for the As-Constructed Drawings was obtained in accordance with City current standards and is accurately represented on these As-Constructed Record Drawings.

Registered Professional Land Surveyor

(Affix Seal)

- I. A Professional Engineer shall review all the As-Constructed information for compliance with the original approved design and standards and shall stamp and seal each drawing sheet in the As-Constructed Record plan set with the following statement:

I, _____, hereby state that I have reviewed the As-Constructed information provided by the project Contractor and project Land Surveyor. I certify that according to the information provided the As-Constructed Record Drawings are in compliance with the City of Greeley accepted Construction Drawings and standards and will function as designed.

Registered Professional Engineer

(Affix Seal)

- J. As-Constructed Record signed and sealed drawings shall be submitted to and accepted by the City prior to issuance of Substantial Completion, in the form of one electronic PDF version and one file package containing GIS spatial data compatible with ESRI ArcGIS using the coordinate system referenced in the most recent City of Greeley Control Points Datasheet. The two (2) year warranty period for the installed potable water, sanitary sewer, and non-potable irrigation systems will begin **after** the Certificate of Substantial Completion has been issued by the City. The request for the Substantial Completion Certificate may be initiated by the City or requested by the Developer, but in all cases is the sole responsibility of the Developer.
- K. The City will compare the certified As-Constructed Record Drawing information with the approved Construction Drawings, previously submitted Verification Survey, and information the City may be aware of during the construction process. Any corrections, additions, or omissions to the As-Constructed Record Drawings shall be provided to the Design Engineer who prepared the As-Constructed Drawings for changes.

- L. The Certificate of Substantial Completion, will NOT be granted until the As-Constructed Drawings for the potable water, sanitary sewer, and non-potable irrigation systems are accepted by the City. (Ordinance 44, 2002)
- M. The Certificate of Final Acceptance occurs at the end of the two year warranty period and final walk through of the project.

2.12 REIMBURSEMENT FOR PUBLIC INFRASTRUCTURE DESIGN AND INSTALLATION COSTS

- A. The City may require the Developer to install a potable water, sanitary sewer or lift station, non-potable irrigation main or non-potable pond and pump station larger than is needed to adequately serve development.
- B. For the installation of mains the City will reimburse the Developer for the materials costs above that required for the development. The difference in materials costs shall only include the difference in pipe materials, manhole materials, valve materials, and fitting materials. Additional materials costs, if any, shall be agreed upon in writing, prior to commencement of construction.
- C. For sanitary sewer collection main oversizing, the City may reimburse the Developer for additional costs due to sanitary sewer main installation excavation depth or width beyond that required for the development.
- D. If the City requested oversizing results in significant change to horizontal or vertical alignment, additional reimbursement may be agreed to prior to construction.
- E. For the installation of sanitary sewer lift stations and non-potable ponds and pump stations the City will reimburse the Developer for the materials costs above those required by the development on a pro rata basis using the portion of the lift or pump station capacity that is not required for the development. The scope of the reimbursement and the reimbursement ratio shall be agreed upon in writing prior to the commencement of construction.
- F. For non-potable pond oversizing, the City may reimburse the Developer for extra excavation and materials costs due to additional depth above that required size for the development.
- G. The Developer shall submit a materials list with unit prices, quantities, and, if appropriate, a cost comparison between the two pipe sizes under consideration. Reimbursement will only be paid after the As-Constructed Record Drawings have been accepted by the City. Copies of material invoices for materials delivered to the development site and used in construction shall be provided along with the Developer's request for reimbursement.
- H. If the Developer is required to design and construct off site potable water, sanitary sewer, or non-potable irrigation mains in order to serve the development, the Developer may be eligible for design and construction cost reimbursements from other developments that connect to that main. Conversely, if the Developer connects to potable water, sanitary sewer, or non-potable irrigation mains constructed by another Developer or the City, the Developer may be required to participate in the design and construction costs of those lines. Refer to the *City of Greeley Charter and Code, Title 20: Public Services*, sections 20-159, 20-160, 20-161, 20-322, 20-323, and 20-324 for additional reimbursement requirements.

2.13 Subsurface Utility Engineering

- A. All new underground facilities, including laterals up to the structure or building being served shall be electronically locatable when installed as required by Colorado Revised Statute 9-1.5-103 as amended
- B. All services including potable water, non-potable irrigation water, and sanitary sewer must be locatable up to the structure using tracer wire. See Water & Sewer standard details for the required tracer wire specifications.
- C. Potable and non-potable irrigation water mains shall be locatable using tracer wire. See Water & Sewer standard details for the required tracer wire specifications.
- D. Sanitary sewer mains do not require tracer wire as they are electronically locatable by other means, including. robots, sonde, and camera systems.

SECTION 3

POTABLE WATER DISTRIBUTION SYSTEM DESIGN CRITERIA

3.01 GENERAL

The purpose of this section is to provide information for the design and layout of a potable water distribution system. Potable water distribution system design shall be in accordance with the City of Greeley *Water Master Plan*, latest revision, and these Criteria.

This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance. **This Design Criteria typically applies to potable water mains sixteen inches (16”) in diameter and smaller.** The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

3.02 DEFINITIONS

A. Potable Water Distribution Mains

1. A potable water distribution main is a water pipe that primarily serves as a delivery conduit to transport potable water from transmission mains or reservoirs directly to individual water services.
2. Potable water distribution mains within the City are eight inches (8”), twelve-inches (12”), and sixteen-inches (16”) in diameter.

B. Potable Water Transmission Mains

1. A potable water transmission main is a water pipe that primarily serves as a delivery conduit to transport potable water directly to the distribution reservoirs and mains.
2. Potable water transmission mains are generally larger than sixteen inches (16”) in diameter.

C. Potable Water Services

1. Potable water services include all piping, fittings, and appurtenances used to convey potable water from the distribution main to the customer.

3.03 DESIGN FLOW

- A. The potable water distribution system shall be designed to transport peak hour plus fire flow demands in accordance with these Criteria.
- B. All water demands used in the design of potable water distribution systems are subject to approval by the City.

C. Design Flow

1. The water demand criteria presented in the following table are minimum criteria and the City reserves the right to modify the Criteria, at any time, for the design of specific projects. Potable water demand criteria for uses not provided in the table shall be determined during system design.

TABLE 3-1: Potable Water Design Flow

Residential			
Zoning based on <i>City of Greeley Charter and Code, Chapter 24.401, Zoning</i>			
Use	Units Per Acre*	Occupancy	Peak Hour Demand
R-E	3	3.1 persons	1.9 gpm/unit
R-L	5	3.1 persons	1.9 gpm/unit
R-M	10	2.7 persons	1.7 gpm/unit
R-H	20	1.7 persons	1.1 gpm/unit
R-MH	15	1.7 persons	1.1 gpm/unit
*Use these unit per acre values unless specific unit counts are known			
Commercial			
Where uses are known, use the specific demand values. Commercial demands based on 1000 ft ² of building area unless noted otherwise. Otherwise use the appropriate zoning demand values.			
Use	Average Day Demand without Irrigation		
C-L	1500 gpd per acre		
C-H	3000 gpd per acre		
I-L & I-M	1500 gpd per acre		
I-H	3000 gpd per acre		
Use	Average Day Demand		
Restaurant	500 gpd		
Retail/Office	200 gpd		
Grocery	430 gpd		
Laundry, Dry Cleaning	1000 gpd		
Auto Dealer, Repair/Service	115 gpd		
Car Wash with Water	1500 gpd		
Hospital	380 gpd		
Hotel/Motel	350 gpd		
Retirement & Nursing	350 gpd		
School	12 gpd/student without showers 36 gpd/student with showers		
Religious Building	300 gpd		

Warehouse (Non-industrial)	25 gpd
Irrigation	25 gpm per acre

- Irrigation is included in the residential water demand, but not included in the commercial water demand. Irrigation demands for commercial uses shall be determined using the provided irrigation demand criteria and the commercial development's estimated irrigated acreage.
- For residential demands without irrigation flows, a base flow of 60 gallons per capita per day shall be used.
- Treat Mixed-Use High Intensity Zoning as 50% R-H and 50% C-H and Mixed-Use Low Intensity Zoning as 50% R-H and 50% C-L unless a more detailed breakdown is known.
- Due to the extreme variation in water consumption amongst the different types of industry, industrial water demands shall be determined during system design when the industrial use is known.

D. Peaking Factor

- The peaking factor for indoor water use should align with the peaking factor for sanitary sewer in most situations. Instances where the two peaking factors do not align will require approval by the City of Greeley.
- A domestic peaking factor shall be obtained from ASCE Peak Flow Curve G¹:

$$P_f = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where P = Population in thousands (example: P = 2 for population of 2,000)

$$P_f = \frac{18 + \sqrt{\frac{F}{60000}}}{4 + \sqrt{\frac{F}{60000}}}$$

Where F = Flow in gallons per day (based on 60 gpcd in Table 4-1)

E. Fire Flows

- Contact City of Greeley Fire/Rescue Department (970-350-9510) for the latest adopted fire code and to confirm project fire flow requirements.
- For design purposes, the maximum allowable fire flow provided from any one (1)

¹ American Society of Civil Engineers (ASCE). 1982. *Gravity Sanitary Sewer Design and Construction. Manuals and Reports on Engineering Practice – No. 60*. Reston, VA: American Society of Civil Engineers.

hydrant is 1,500 gpm. Fire flow may be obtained from more than one (1) fire hydrant providing the additional hydrants are accessible to any possible fire location and meet the spacing requirements and distances from structures as specified in section 3.19 of these Criteria and by the City of Greeley Fire Department.

3.04 PRESSURE REQUIREMENTS

Potable water distribution systems must be designed to provide minimum and maximum system pressures as discussed in the following sections. Water system pressure information for the City's existing system shall be verified by the City.

- A. The potable water distribution system in all areas shall be designed for a maximum pressure of 125 psi and a minimum pressure of 40 psi at peak hour demands without fire flow.
- B. Twenty (20) psi residual pressure is required at any one (1) hydrant with peak hour demand plus fire flow with one (1) water connection closed.
- C. Pressure zones shall conform to existing City of Greeley pressure zones as provided in the *Water Master Plan*, latest revision. Specific information on the pressure zones or to confirm which pressure zone a development or site is actually located may only be obtained from the City. See Table 3.2 for ground elevation ranges for each pressure zone.
- D. Pressure regulating valves (PRV) or control valves will be required between pressure zones. The final PRV location shall be determined by the City.

TABLE 3-2: Pressure Zone Elevation Ranges

Zone1: 4740' – 4500'
Zone 2: 4840' – 4740'
Zone 3: 4940' – 4840'
Zone 4: 5060 – 4940'

3.05 HYDRAULIC DESIGN

- A. Friction Coefficient
 - 1. Potable distribution mains shall be designed using a Hazen-Williams friction coefficient "C" equal to 120.
- B. Velocity
 - 1. All pipes shall be sized for a maximum water velocity of no greater than five (5) feet per second (fps) at peak hour demand and seven (7) fps at peak hour demand plus fire flow.

3.06 POTABLE WATER MAIN SIZE

- A. Unless specifically indicated in the *Water Master Plan*, sixteen-inch (16") mains are required every mile and twelve-inch (12") mains are required every half-mile. Other distribution mains shall have a minimum diameter of eight inches (8").
- B. Hydrant leads connecting to the potable distribution system shall be six inches (6") in diameter. Other pipe diameters for hydrant leads are prohibited.

3.07 DEPTH OF BURY

- A. The minimum depth of cover shall be five (5) feet and the maximum depth of cover should generally not exceed six (6) feet. Design preference is to minimize lowering which can be challenging to locate and maintain.
- B. When design or constructability constraints are present, deeper or shallower water main installation may be permitted only with acceptance from the City. Additional design and installation considerations may be required by the City depending on the situation. Design considerations should minimize additional fittings and elevation changes where feasible.

3.08 CONNECTIONS TO THE EXISTING POTABLE WATER SYSTEM

- A. Main connections to the existing potable water distribution system shall be made by wet tap or cut in tee. All wet taps and all cut-in tees on mains smaller than 16" diameter shall be made by the Contractor under the direct supervision of the City. It is the Contractor's responsibility to provide all approved tapping materials (tapping sleeves, tapping valves, insulator kit, etc.). Taps for new 8" and 12" main connections to existing 16" or larger mains shall be performed by the City unless otherwise directed.
- B. Connections to the existing transmission mains or distribution mains larger than sixteen-inch (16") shall be limited and must be approved by City.
- C. For wet taps on existing transmission mains or sixteen-inch (16") and larger distribution mains, manufacturer's shop drawings and specifications for the proposed tapping sleeve shall be submitted to the City for review and acceptance prior to installation of the tapping sleeve by the Contractor.
- D. Taps on existing transmission mains or sixteen-inch (16") and larger distribution mains shall require the installation of an insulator kit between the tapping sleeve and tapping valve.
- E. Connection to cast iron mains constructed prior to 1950 may require replacement or non-standard fittings which must be reviewed and approved by City of Greeley Water & Sewer department.
- F. Construction documents shall include a note for all wet taps: "Contractor to reference specifications for approved tapping materials and prior to installation shall contact Distribution for direct supervision of installation by the City."

3.09 LOCATION AND LOOPING OF POTABLE WATER MAINS

- A. Potable water mains shall be located in the center of a dedicated street right-of-way, where feasible, or within a dedicated exclusive easement of appropriate width. If narrow street

sections do not allow the water line to be located in the center of the street right-of-way while maintaining clearances from other utilities and the lip of street gutter, the City may allow the potable water main to be located five (5) feet offset from centerline of the street right-of-way. City approval is required for all other proposed potable water main locations.

- B. The centerline of potable water mains shall not be placed closer than five (5) feet to the lip of street gutter without prior acceptance by the City. Preferred location is to maximize distance from lip of gutter.
- C. Potable water mains serving a cul-de-sac shall be extended to within ten (10) feet of the lip of street gutter at the end of the cul-de-sac and shall have a hydrant assembly placed on the line.
- D. A potable water main serving one (1) lot shall extend all the way across the frontage for that lot.
- E. Where non-compliant or private water mains or service lines exist within or adjacent to a new development, replacement of lines or additional connections to those lines may be required.
- F. Permanent dead-ends are prohibited without prior approval by Water & Sewer. City preference is no dead-end lines and may require additional infrastructure to meet water quality requirements.
- G. Temporary dead-ends with services shall have a fire hydrant or a flushing station with an acceptable discharge point at the end of the line.
- H. Temporary dead-ends with no services shall have a closed valve at the point of connection with the active distributions system and will not require a hydrant or flushing station after the valve.
- I. For temporary phasing, an adequate number of connections to the existing potable water distribution system as determined through hydraulic modeling and approved by the Water & Sewer shall be provided.
 - 1. Potable water mains shall extend to the extremities of the property or the subdivision served. Extensions shall be in appropriate locations to provide adequate water connections and to maintain looping requirements for adjacent, future developments and to facilitate the completion of the grid described in section 3.06 of these Criteria.
 - 2. Water mains shall be extended offsite when required to tie into the existing distribution system for additional water source connections. Appropriately sized easements shall be provided.
- J. In all instances, the City shall determine the potable water system looping, connections, and valving in order to maintain overall water system performance. Ultimately, the required source connections to the existing potable water system shall be solely determined by the Water & Sewer Department.
 - 1. New developments shall have at minimum two separate and distinct connections to the existing system to provide reliability for maximum fire flows in case of pipe failure and

better system circulation to maintain acceptable water quality. Source connections shall be made on opposite sides of the development.

3.10 POTABLE WATER SYSTEM PHASED INSTALLATION AND STUBOUTS

- A. Potable water distribution system phasing, if proposed by the Developer, shall be clearly identified on the overall utility plan. Water plan and profile sheets shall clearly show and label the phasing transitions in the potable water line design.
- B. The proposed potable water system phasing shall maintain looping integrity within the system as described in section 3.09 of these Criteria.
- C. The phased potable water system design shall meet the phased water demands for the development and adhere to all potable water system and hydraulic design requirements provided in these Criteria.
- D. Locate line valves and temporary fire hydrant and flushing station at the end of each phase or stub out, as described in section 3.09 of this criteria. The stubout shall be shown on the potable water plan and profile sheets.
- E. Phased water line or stubout construction shall be extended a minimum ten (10) feet beyond phased street paving to avoid asphalt removal during excavation for future connections.
- F. Phased potable water mains or stubouts intended for future connections shall be valved such that only one (1) valve needs to be closed when the main is extended and no customers are without water service when the line is extended. The valve must be appropriately restrained so it will not “blow off” when the water line is exposed and all thrust blocking is removed for the extension. See section 3.14 of these Criteria regarding pipe restraint.
- G. The maximum length of a stubout shall be fifty (50) feet unless otherwise approved by the City.
- H. Potable water main stubouts not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

3.11 PIPE MATERIAL

- A. Potable water pipes less than or equal to sixteen-inches (16”) in diameter shall be AWWA C151 cement-lined ductile iron pipe or AWWA C900-16 polyvinyl chloride (PVC) pressure pipe.
 - 1. HDPE pipe and fused PVC may be used with City approval for specifically identified purposes, location and uses such as horizontally bored crossings.
- B. The Design Engineer shall specify the pipe material and class, as required for specific project conditions. The pipe material and class shall be called out on the Construction Drawings.

- C. All ductile iron pipe shall be protected against soil corrosion based on the corrosion level determined from pH and Resistivity levels in accordance with the following table. If the corrosion level is found to be Medium or lower, the pipe shall be wrapped with 8-mils of V-Bio Enhanced Polyethylene Encasement in accordance with AWWA C105. If the Corrosion level is Medium-High or High, then additional Zinc coating of the pipe shall be required.

TABLE 3-3: Corrosive Soil Function of pH and Resistivity

pH	Resistivity (Ohms-cm)	Corrosion
<3.5	Any	High
3.5-4	<4,500	High
	>4,500	Medium-High
4.5-5.5	<4,500	High
	4,500-5,000	Medium-High
	>5,000	Medium
5.5-6.0	<1,000	High
	1,000-5,000	Medium-High
	5,000-10,000	Medium
	>10,000	Medium-Low
6.0-9.0	<1,000	High
	1,000-3,000	Medium-High
	3,000-10,000	Medium
	10,000-20,000	Medium-Low
	>20,000	Low

3.12 VALVES

- A. All valves shall be located in dedicated street right-of-way or within a dedicated exclusive easement of appropriate width. City approval is required for all other proposed valve locations.
- B. Gate Valves
- Gate valves are assigned in the potable water distribution system so that no single accident, break, or repair necessitates shutting down a length of pipe greater than 1,000 feet in all directions or no more than one hundred fifty (150) people are out of service at any one time.
 - At street intersections, gate valves shall be located at the extension of property lines, wherever possible.
 - Gate valves shall be located a minimum five (5) feet away from the edge of concrete cross pans or cutters and away from intersection. This requirement has precedence over section 3.12-B. of these Criteria.
 - Fire hydrant and fire sprinkler line gate valves shall be placed at the main. These gate

valves shall be mechanical joint valves and fasten to a mechanical joint anchor tee (swivel tee) on the main.

5. All potable water line valves shall have a concrete collar around the valve box in accordance with *SDC* Standard Drawings.
6. City may require additional valves to allow for maintenance and control and minimizing service outages. Final valve locations shall be solely determined by the City.
7. Valves shall be provided at both ends of water pipelines where the potential of inaccessibility for repairs may exist, this may include; rivers, ponds, ditches, railroads and highways. Where looping is required, valves shall be located at easement lines or ROW to maintain potable service.

C. Combination Air Valves

1. Sixteen-inch (16") diameter mains shall have combination air valves installed at high points along the main and shall be properly sized by the Design Engineer in accordance with the manufacturer's recommendation. The City shall have final determination on valve size, placement, and type of valve to install.

D. Pressure Regulating Valves

1. Pressure regulating valves (PRVs) control pressures between potable water distribution system and shall be placed at pressure zone boundary. The final installation location shall be determined by City.
2. The standard PRV size is eight inches (8") for all 8" mains unless otherwise approved by the City. For all mains larger than 8", duplex PRVs are required and shall be sized according to hydraulic calculations unless otherwise approved by the City.

E. Blowoffs

1. Any required blowoff location shall utilize a city approved fire hydrant or flushing station.

3.13 PIPE ALIGNMENT

- A. Potable water mains may have a change in alignment or grade to avoid obstructions, within the limits of the pipe joints. If joint deflections is not feasible or permitted by the City, an appropriate bend fitting shall be used.
- B. Allowable Joint Offset for PVC Pipe

TABLE 3-4: Maximum PVC Pipe Joint Deflection or per manufacturers limits whichever is more restrictive

Pipe Diameter (in)	Maximum Joint Deflection (°)
8"	1 °

12"	1 °
16"	1 °

- C. PVC pipe can be joined with High Deflection (HD) Couplings which allow five degrees (5°) of pipe joint deflection per coupling. HD couplings can be used in the place of small bends or where it is undesirable or impossible to joint deflect the pipe.
- D. Allowable Joint Deflection for DIP Pipe

TABLE 3-5: Maximum DIP Pipe Joint Deflection or per manufacturers limits whichever is more restrictive

Pipe Diameter (in)	Maximum Joint Deflection (°)
6"	4.0°
8"	4.0°
12"	4.0°
16"	2.5°

3.14 THRUST BLOCKING AND PIPE RESTRAINT

- A. Concrete thrust blocks or pipe restraints shall be constructed at all mainline bends, tees, dead ends, and valves as shown in the City of Greeley Standard Drawings.
- B. Thrust Blocks
 - 1. The thrust block details, as shown in the City of Greeley Standard Drawings, are to be used as minimums only. The Design Engineer shall determine the required size of thrust blocks to use.
 - 2. If for any reason (i.e. temporary dead end line), concrete thrust blocks cannot be used, restrained push-on or mechanical joint restraints shall be required.
- C. Pipe Restraint
 - 1. The pipe restraint details, as shown in the City of Greeley Standard Drawings, are to be used as minimums only. The Design Engineer shall determine the required size of thrust blocks to use.
 - 2. For transmission mains, the Design Engineer shall determine the length of required pipe restraint, for the pipe material being used, PVC or DIP, in accordance with AWWA M41 *Ductile-Iron Pipe and Fittings* or AWWA M23 *PVC Pipe – Design and Installation*, latest revision.
- D. In some instances (i.e. fire hydrants, large diameter fire lines, water line lowering's, etc.) thrust blocks may be required in addition to pipe restraint. The design engineer or City shall make such determinations on a case-by-case basis.

3.15 POTABLE WATER MAIN AND SERVICE ENCASEMENTS FOR WET UTILITIES

Wet utilities should be defined as any pipeline that could contaminate the potable water system.

- A. No general statement can be made to cover all encasement conditions, therefore only typical encasement situations are addressed in this section. Encasement requirements shall ultimately be determined by the City on a case-by-case basis.
- B. Refer to construction specification *Section 02445, Casing Pipe – Borings and Encasements* for encasement pipe material, diameter, and wall thickness (if applicable), casing spacers, and standard detail end seals, and installation requirements. No encasements shall be constructed from poured concrete.
- C. The use of “line” or “lines” in this section shall refer to both mains and services.
 - 1. Where sanitary sewer lines cross beneath potable water lines with less than eighteen inches (18”) clearance or any sanitary sewer lines cross above potable water lines, or the ten (10) feet horizontal clearance between potable water lines and sanitary sewer lines cannot be maintained, pipe encasement shall be designed and constructed so as to protect the potable water line.
 - 2. Where non-potable Distribution lines cross above or below potable water lines with less than eighteen inches (18”) clearance, pipe to be center on potable water Main or Fused and shall be designed and constructed so as to protect the potable water line.
 - 3. Pipe encasement shall be placed on the sanitary sewer line or non-potable irrigation line except in situations where the sanitary sewer or non-potable irrigation line is existing. Where the sanitary sewer or non-potable irrigation line is already constructed, the pipe encasement shall be placed on the potable water line. Priority shall be given to encase service lines before main lines.
 - 4. The encasement pipe shall extend a minimum ten (10) feet on either side of the crossing measured from the outside diameter of the crossed pipe. Longer casing pipes may be required depending on the encasement situation.
 - 5. For any atypical encasement sizing situations, the Design Engineer shall size the encasement pipe such that the inside clearance is at least one inch (1”) greater than the maximum outside diameter of the casing spacer runners.
 - 6. Where storm water lines cross above potable water mains, storm water pipe joints shall utilize rubber gaskets and exterior joint wrap a minimum ten (10) feet on either side of the crossed potable water main, measured from the outside diameter of the pipe.
- D. Potable water main crossings under any open irrigation ditch shall have a minimum five (5) feet of cover and shall be encased.
- E. Bored utility crossings shall have a minimum twenty-four inches (24”) of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses above the potable water line and a minimum thirty-six inches (36”) of vertical clearance from the outside diameter of the utility casing to the outside diameter of the potable water line if the bored utility crosses below the water line.

- F. If there are horizontal or vertical clearance conflicts between the potable water line and gravity utilities, the City may require that the potable water main be lowered, raised, or realigned in order to maintain the required clearances.

3.16 POTABLE WATER MAIN BORINGS & ENCASEMENTS REQUIRED BY OTHER AGENCIES

- A. Installation of potable water mains through City of Greeley or another agency's right-of-way, easement, or other, may require a bored casing pipe to facilitate main installation. The type of bored casing material and its properties will be specified by the agency granting permission to cross. Such crossings shall be subject to approval by the City to avoid conflicts in requirements or standards between the City and the agency granting permission to cross.
 - 1. A letter, permit, or approved crossing application from the agency granting permission to cross, must be provided to the City prior to the boring.
 - 2. The City shall not accept any bored crossings imposed with an annual user or crossing fee from the agency granting permission to cross. All bored crossing fees, if applicable, shall be paid by the Developer prior to the boring.
- B. The minimum requirements for bored casings within the City shall be in accordance with construction specification *Section 02445, Casing Pipe – Borings and Encasements. & standard drawings*
 - 1. The required bore length of casing pipe shall be determined by the Design Engineer and must be accepted by the City.
 - 2. All bored casing shall have a minimum of twenty-four inches (24") of vertical clearance from the outside diameter of the casing pipe to the outside diameter of the utility line if the bored casing crosses above the utility and a minimum thirty-six inches (36") of vertical clearance from the outside diameter of the casing pipe to the outside diameter of the utility line if the bored casing crosses below the utility, unless more stringent requirements by other utility.

3.17 POTABLE WATER SERVICES AND FIRE SPRINKLER LINES

- A. General
 - 1. Potable water service lines shall not be installed in trenches with other wet or dry conduits/utilities. A service line shall be separated from other conduits a minimum ten (10) feet horizontally and eighteen inches (18") vertically. The only exception will be a fire sprinkler line. In this instance, the horizontal separation may be a minimum of five (5) feet, from outside diameter of the pipe and final determination. This shall be evaluated by the City on a case-by-case basis.
 - 2. Potable water services and fire sprinkler lines for a given lot must be tapped on the potable water main within the confines of the extended property lines. Certain lots and cul-de-sacs may have the potable water service line or fire sprinkler line located anywhere along the lot frontage but shall be a minimum three (3) feet and preferred location is five (5) feet inside the property line being served.

3. No potable water service taps shall be made on fire sprinkler lines.
4. All taps shall require a tapping saddle or tapping sleeve and valve as shown in standard detail. No direct taps are allowed.
5. Potable water services and fire sprinkler lines not intended to be utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Water Services

1. Refer to construction specification *Section 02514, Water Service Lines, Meters, and Appurtenances*, for service pipe materials and installation requirement.
2. A separate potable water service line and meter must serve each building with individual owners.
3. No potable water service lines shall cross property lines, including irrigation systems, unless otherwise approved by the City for irrigating multiple outlots. Irrigation systems from a single potable water service shall only be allowed for use on that single property. Refer to appendix section A2 – *Compound Tap Exemption Policy for Irrigation of Multiple Outlots*.
4. No compound potable water taps are allowed. Refer to *City of Greeley Charter and Code, Title 20: Public Services*, Section 20-253.
5. Where one or more master meters are allowed for residential units, meters shall be configured to serve contiguous groups of units on one lot with no more than an estimated twenty-five residents served by a single master meter. The master metered system shall also be designed and constructed such that the property owner does not become a public water provider under state or federal regulations.
6. Pressure boosters are prohibited without adequate backflow protection.
7. Potable water services shall be located a minimum five (5) feet inside the property being served.
8. Under no condition is a potable water service to be located under driveways, trees, or other permanent structures.
9. Potable water service taps shall be separated by at least five (5) feet, measured along the potable water main length, including when taps are on opposite sides of the potable water main. Potable water service taps shall also be a minimum five (5) feet from all joints, fittings, or valves.
10. The corporation stop, curbstop, meter, that portion of the service line between the corporation stop and the meter, and five (5) feet past the meter shall all be the same internal diameter.
11. Potable water service curb stops shall be located $\pm$ one (1) foot from the property line or easement boundary and preferred inside the row. Potable water service meter

pits/vaults shall be located as close as possible beyond the curb stop. See City of Greeley Standard Drawings for additional service and meter installation requirements.

12. Potable water service meter pits/vaults shall normally be located after the curbstop in a landscaped area or streetscape. Meter pits/vaults shall not be installed in any street, parking area, driveway, or sidewalk unless otherwise approved by the City. If a meter pit/vault is permitted by the Water & Sewer Department to be located in any traffic area, the pit/vault shall be designed to withstand HS-20 traffic loadings. Curbstops with tracer wire test stations shall be in a valve box.
13. There shall be no major landscaping (trees, boulders, or shrubs with mature growth greater than three (3) feet), buildings, or other permanent structures within ten (10) feet of the meter pit/vault.
14. The maximum allowable number of living units on a single tap may be determined using a fixture analysis per the process outlined in the most recent edition of AWWA Manual of Water Supply Practices M22 – Sizing Water Service Lines and Meters. If no analysis is provided, the maximum values are shown below: Any residential project requesting a domestic tap larger than three inches (3”) shall be reviewed on a case-by-case basis.

TABLE 3-6: Living Units Allowed Per Tap Size

Tap Size (inch)	Maximum Allowable Living Units
3/4”	2
1”	4
1 1/2”	10
2”	25
3”	45

15. Commercial and industrial developments may provide potable water service stubouts, if the end user is known.

C. Fire Sprinkler Lines

1. Fire sprinkler lines two-inch (2”) or smaller shall be type “K” copper. Fire sprinkler lines larger than two-inch (2”) shall be restrained DIP. Restrained DIP fire sprinkler lines require concrete thrust blocking at the main and a gate valve at the main. Fire sprinkler lines are not metered.
2. Fire sprinkler lines must be connected to the potable water distribution system. Connections to non-potable irrigation system are prohibited.

3.18 POTABLE WATER MAINS AND SERVICES IN RELATION TO DRY UTILITIES

Dry utilities shall be defined as any utility pipeline that could not contaminate the potable water system.

- A. Potable water services and distribution mains shall have a minimum ten (10) feet horizontal and eighteen inches (18”) vertical separation from all utilities measured from outside

diameter.

- B. Dry utility crossings shall be encased in high density polyethylene pipe (HDPE), Standard Dimension Ratio (SDR) 11 or approved equal from edge to edge of the easement or right-of-way, or ten (10) feet on either side of the potable water main, whichever is greater. Final determination shall be accepted only by the City
- C. Right angle utility crossings are only permitted above and below the potable water main with adequate clearance. Non-right-angle crossings shall be approved by the City. Parallel installation of other utilities in exclusive water easements are not permitted.
- D. For a potable water line crossing situation not specifically mentioned in this section, the crossing requirements provided in these Criteria shall be applied to that particular situation to the best extent possible.

3.19 FIRE PROTECTION AND HYDRANT SPACING

- A. All fire protection, fire flow, and hydrant requirements are subject to approval by the Greeley Fire Department.
- B. Hydrant Spacing
 - 1. Residential structures shall be no further than 250 feet, fire access distance², from a fire hydrant.
 - 2. In R-L zoned areas, fire hydrant spacing shall be no further than 600 feet measured along the street curb line.
 - 3. In R-M and R-H zoned areas, fire hydrants shall be spaced equal to or less than 500 feet apart, measured along the street curb line. Structures shall be 250 feet or closer, fire access distance, from a fire hydrant.
- C. In commercial and industrial areas, structures shall be 250 feet or closer, fire access distance, from a fire hydrant.
- D. Where potable water mains are extended along streets where hydrants are not needed for the protection of structures, hydrants shall be provided at spacing not to exceed 1,000 feet.
- E. Hydrants shall be located at intersections whenever possible. Hydrants located mid-block shall be aligned with the extension of a property line.
- F. Fire hydrants shall be installed in accordance with construction specification *Section 02516, Water Utility Distribution Fire Hydrants* and City of Greeley Standard Drawings.
- G. A three (3) foot radius in all directions around the hydrant shall be clear of obstructions.
 - 1. Where hydrants are vulnerable to vehicular damage, crash posts shall be provided outside of the three (3) foot radius clearance in all directions from the hydrant and a

² Fire access distance is the distance a fire pumper must travel to lay a standard hose line from a hydrant to the primary access point of a structure. The hose lay distance is not measured over unimproved areas that may be impassable due to weather conditions, obstructions, etc.

minimum of one foot from edge of sidewalk.

2. When hydrants are located less than 4 feet from a vehicular travel path, or not protected by curb and gutter then crash posts shall be provided. Crash posts shall be concrete filled pipes that are four-inches (4") in diameter and a minimum of four (4) feet in height above the finished ground surface with two (2) feet of post below the finished ground surface.
- H. All hydrants must be within dedicated exclusive easements or public rights-of-way. Refer to *Section 2* of these Criteria for easement requirements.

3.20 CROSS CONNECTION AND BACKFLOW PREVENTION

- A. Potable water service lines on any property or inside any building shall have NO physical connection with any pipes, pumps, hydrants, tanks or non-potable irrigation systems that could draw or discharge any unsafe or contaminated water (including steam condensation or cooling water) into the potable water distribution system.
- B. For additional information on cross connection or backflow prevention requirements, refer to appendix section *A1 – Cross Connection and Backflow Prevention Policy*.

SECTION 4

SANITARY SEWER COLLECTION SYSTEM DESIGN CRITERIA

4.01 GENERAL

- A. The purpose of this section is to provide information for the design and layout of a sanitary sewer collection system. Sanitary sewer collection system design shall be in accordance with the City of Greeley Sanitary Sewer Master Plan, latest revision, and these Criteria.
- B. This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance. **This Design Criteria typically applies to sanitary sewer mains twelve inches (12”) in diameter and smaller.** The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

4.02 DEFINITIONS

- A. Sanitary Sewer Collection Mains
 - 1. A sanitary sewer collection main is a sanitary sewer pipe that gathers wastewater flows directly from individual sanitary sewer services or private sewer mains and transports.
- B. Sanitary Sewer Interceptor Lines
 - 1. Sanitary sewer interceptors within the City are fifteen inches (15”), eighteen inches (18”), or twenty one inches (21”) in diameter.
- C. Sanitary Sewer Trunk Lines
 - 1. A sanitary sewer trunk line is a sanitary sewer pipe that collects sewage flows from the collection mains and interceptors and carries those flows to the wastewater treatment facility.
 - 2. Sanitary sewer trunk lines are larger than twenty-one inches (21”) in diameter.
 - 3. All sanitary sewer trunk lines require additional approval through the Colorado Department of Public Health and Environment (CDPHE), and all permitting shall be completed by Developer and Design Engineer and must be approved and signed by City.
- D. Sanitary Sewer Services
 - 1. Sanitary sewer services include all piping, fittings, and appurtenances used to convey sanitary sewage from the plumbing system of a structure to a sanitary sewer collection main.
 - 2. Sanitary sewer services are typically four inches (4”) or six inches (6”) in diameter.

4.03 DESIGN FLOW

- A. The sanitary sewer collection system shall be designed to carry peak wastewater flows plus infiltration/inflow in accordance with these Criteria.
1. Depending on a development's location, consideration of upstream and offsite flow contributions may be required by the City to ensure proper sizing of the sanitary sewer collection mains within the development. This will be determined by the City on a case by case basis.
 2. Depending on the existing capacity of the downstream sanitary sewer collection system, the City may require verification that the downstream sewer system can convey the development's peak flows. If the downstream capacity is inadequate, the Developer may be required to make appropriate downstream sewer system upgrades. This will be determined by the City on a case by case basis.
 3. Any infill or redevelopment project that is an intensification of use shall require the Developer to verify that the downstream sewer system can convey the development's peak flows. If the downstream capacity is inadequate, the Developer may be required to make appropriate downstream sewer system upgrades.
- B. Design Flow
1. The wastewater flows presented in the following table are minimum criteria and the City reserves the right to modify the Criteria, at any time, for the design of specific projects. Wastewater flows for uses not provided in the table shall be determined during system design.

TABLE 4-1: Sanitary Sewer Design Flow

Residential			
<i>Zoning based on City of Greeley Charter and Code, Chapter 24.401, Zoning District Development Standards</i>			
Use	Units Per Acre	Occupancy	Average Day Wastewater Flows*
R-E	3	3.1 persons	0.13 gpm/unit
R-L	5	3.1 persons	0.13 gpm/unit
R-M	10	2.7 persons	0.11 gpm/unit
R-H	20	1.7 persons	0.07 gpm/unit
Commercial			
Use	Average Day Wastewater Flows*		
C-L (not specified)	1,500 gpd/acre (minimum)		
C-H (not specified)	3,000 gpd/acre (minimum)		
Retail/Offices	200 gpd/1,000 SF		
Hotels/Motels	350 gpd/1,000 SF		
Restaurants	500 gpd/1,000 SF		

Bars and Lounges	300 gpd/1,000 SF
Neighborhood Stores	200 gpd/1,000 SF
Department Stores	200 gpd/1,000 SF
Laundry and Dry Cleaning	1,000 gpd/1,000 SF
Banks	300 gpd/1,000 SF
Nursing Homes	350 gpd/1,000 SF
Warehouses	25 gpd/1,000 SF
Car Washes with Water Reuse	1,500 gpd/1,000 SF
Auto Dealer/Repair/Service	115 gpd/1,000 SF
Grocery Store	430 gpd/1,000 SF
Religious Buildings	300 gpd/1,000 SF
Factories	800 gpd/1,000 SF
Hospitals	380 gpd/1,000 SF
Schools (without showers)	12 gpd/student
Schools (with showers)	36 gpd/student
Industrial	
Use	Average Day Wastewater Flows*
I-L (not specified)	1,500 gpd/acre
I-M (not specified)	1,500 gpd/acre
I-H (not specified)	3,000 gpd/acre
*1cfs = 448.33 gpm Average day wastewater flow per capita = 60 gpcd	

- All flows used in the design of sanitary sewer collection systems are subject to approval by the City.

C. Peaking Factor

- A domestic peaking factor shall be obtained from ASCE Peak Flow Curve G¹:

$$P_f = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where P = Population in thousands (example: P = 2 for population of 2,000)

¹ American Society of Civil Engineers (ASCE). 1982. *Gravity Sanitary Sewer Design and Construction. Manuals and Reports on Engineering Practice – No. 60*. Reston, VA: American Society of Civil Engineers.

$$P_f = \frac{18 + \sqrt{\frac{F}{60000}}}{4 + \sqrt{\frac{F}{60000}}}$$

Where F = Flow in gallons per day (based on 60 gpcd in Table 4-1)

4.04 INFILTRATION AND INFLOW (I/I)

- A. Infiltration and inflow (I/I) is extraneous water flow that enters the sanitary sewer collection system.
 - 1. Infiltration is water entering the sanitary sewer collection system from the ground through service connections, defective pipes, pipe joints, and manhole connections.
 - 2. Inflow is unintentional water entering the sanitary sewer collection system from roof drains, underdrains, surface stormwater runoff, and natural drainage. Any direct connections to the sanitary sewer system shall be removed and directed to the appropriate locations.
- B. 200 gallons per day per inch-diameter per mile of pipe shall be added to the peak design wastewater flow as the allowance for I/I.
- C. 500 gallons per day per inch-diameter per mile of pipe located in groundwater shall be added to the peak design wastewater flow as the allowance for I/I.
- D. I/I flows are not subject to a peaking factor.

4.05 HYDRAULIC DESIGN

- A. The required pipe size shall be computed by Manning's Equation below:

$$Q = \frac{1.49}{n} AR^{2/3} \sqrt{S}$$

Where:

Q = Flow (cfs)

n = Manning's Coefficient of 0.013

A = Area of Flow (ft²)

R = Hydraulic Radius (A/P)

Where: P = Wetted Perimeter

S = Slope of pipe (ft/ft)

- B. All sanitary sewer collection mains shall be designed to a maximum depth of flow, depending on age.
1. Half full ($d/D=0.5$) for all mains constructed prior to 2022 due to historical tap locations on the mark.
 2. 4/5 full ($d/D=0.8$) for all new development.

Where:

d = Depth of Flow

D = Diameter of Pipe

- C. Minimum design velocity at peak flow shall not be less than two (2) ft/s or greater than seven (7) ft/s. Where 2 ft/s is not feasible, the minimum slope shall be 1% slope for 8" pipe.
1. Sewer shall be designed for velocities less than seven (7) ft/s whenever possible and for subcritical flows whenever possible.
 2. When conditions require velocity to be greater than seven (7) feet per second, special provisions shall be made to avoid scour and protect against displacement caused by erosion or impact.
- D. When lines are 10" and larger, Developer shall analyze flows for hydraulic jumps and special provisions shall be made to avoid H₂S and protect against its effects.

4.06 SANITARY SEWER MAIN SIZE AND SLOPE

- A. The following table shows the minimum allowable slopes per sanitary sewer main diameter. These minimum slopes may be used provided that the hydraulic design requirements in 4.05 of these Criteria are met.

TABLE 4-2: Minimum Sanitary Sewer Main Slopes (ASCE)

Pipe Diameter (in)	Minimum Slope (%)
8"	0.40%
10"	0.28%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%

- B. The maximum slope for any sanitary sewer collection main shall be 5%
- C. The City requires sanitary sewers to maintain a consistent slope throughout the sewer alignment in order to maintain capacity.
- D. All proposed sanitary sewers shall maintain the same inner diameter (ID) pipe size to match the existing City collection system; no downsizing shall be allowed.
- E. The City may require the Developer to install a sanitary sewer collection main larger than is needed to adequately service the development. Refer to *Section 2* of these Criteria for oversizing reimbursement.

4.07 **DEPTH OF BURY**

- A. Sanitary sewer collection mains shall have four (4) feet minimum depth of cover from the top of pipe to finished ground surface.
- B. Where grading, existing field conditions, or service constraints demonstrate that a sanitary sewer main must have less than four (4) feet of cover or when sewer main installation is deeper than twenty (20) feet at the invert, refer to section 4.10.
- C. Installation of sanitary sewer mains with depths greater than twenty (20) feet at the invert shall require written approval from Water & Sewer after all reasonable effort is made to keep depths to less than twenty feet.
- D. Where the elevation difference between the top of foundation and the top of the sanitary sewer collection main is less than ten (10) feet, the Construction Drawings and the plat shall indicate the lot is served by a “shallow sewer” and appropriate elevation information shall be given.

4.08 **LOCATION OF SANITARY SEWER COLLECTION MAINS**

- A. All sanitary sewer collection mains shall be located in dedicated street right-of-ways. Any other sanitary sewer collection mains shall be in a dedicated easement of appropriate width (refer to section 2.06). City approval is required for all proposed locations.
- B. The centerline of sanitary sewer collection mains shall not be placed closer than five (5) feet to the lip of the street gutter without prior acceptance by the City. The sewer collection mains centerline should avoid traffic wheel paths where feasible.
- C. Sanitary sewer collection mains shall extend to the upstream extremities of the property or subdivision being served. Main extensions shall be in appropriate locations to provide adequate sanitary sewer system connections for adjacent, future developments.
 - 1. A sanitary sewer collection main serving one (1) lot shall extend all the way across the frontage for that lot.
 - 2. The City may grant exceptions to sanitary sewer collection main extensions if development of an adjacent property is located in a different sewer basin, or if the

property can currently connect to the sanitary sewer system. This will be determined by the City on a case by case basis.

- 3. Sanitary sewer mains shall be extended offsite when required to tie into the existing collection system.
- D. Sanitary sewer collection mains shall be straight between manholes, both in alignment and slope.
- E. Stormwater and underdrain piping shall be distinguishable by color from sanitary sewer collection mains.

4.09 **SANITARY SEWER COLLECTION SYSTEM PHASED INSTALLATION AND STUBOUTS**

- A. Sanitary sewer collection system phasing, if proposed by the Developer, shall be clearly identified on the master utility plan. Sewer plan and profile sheets shall clearly show and label the phasing transitions in the sanitary sewer main design.
- B. The phased sanitary sewer collection system shall be designed for full build out of the development being served including any additional offsite flows that must be passed through the development. Stub-out shall be designed for future development flows.
- C. Phased sanitary sewer main or stub-out construction shall be extended a minimum ten (10) feet beyond phased street paving to avoid asphalt removal during excavation for future connections.
- D. A stub-out for future connection shall be provided for an adjoining phase or adjacent future developments.
- E. The stub-out design and installation shall maintain both vertical and horizontal alignment in accordance with these Criteria. The stub-out shall be shown on the sanitary sewer plan and profile sheets with the length and end of pipe invert labeled.
- F. The end of the stub-out shall be sealed with a removable watertight plug restrained by half (1/2) a cubic yard of concrete behind the plug until the time of future connection.
- G. The maximum length of a stub-out shall be forty (40) feet unless otherwise approved by the City. If the maximum stub-out length must be exceeded, the sewer main installation shall end at a terminal manhole or be extended to the next upstream manhole.
- H. Sanitary sewer main stub-outs not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

4.10 **PIPE MATERIAL**

- A. Sanitary sewer collection mains shall be polyvinyl chloride (PVC) SDR 35 pipe suitable for sanitary sewer flows.
- B. Alternative pipe materials shall only be used in the following situations:
 - 1. Where sanitary sewer collection mains are installed less than four (4) feet from the finished ground elevation to the top of pipe, approval by Water & Sewer Department is required.
 - a. The pipe material shall be PVC SDR 26 with flow fill from bottom of trench to one (1) foot above top of pipe, and the full trench width, and manhole to manhole.
 - 2. Where sanitary sewer collection mains are installed deeper than twenty (20) feet at the invert, polyvinyl chloride (PVC) SDR 26 shall be used.
 - a. For alternative pipe material installation situations, external load (earth and live load) analysis is required to verify the minimum alternative pipe material is suitable for the specific project conditions. If the alternative pipe material is unsuitable, the Design Engineer shall specify an acceptable pipe material. External pipe load calculations shall be submitted to the City for review and acceptance.
 - b. The length of alternative pipe material to install shall be called out on the Construction Drawings.
- C. Changes between pipe materials are not permitted along a continuous sewer main. The alternative pipe material shall be installed from manhole to manhole.
- D. To allow new connections to mains that are damaged, the main shall be replaced or rehabilitated per specifications from the upstream to downstream manhole.

4.11 MANHOLE LOCATION AND SIZE

- A. General
 - 1. Manholes shall be installed at every change in direction, slope, or connection with other sanitary sewer collections mains.
 - 2. There shall be no more than three (3) lines designed to discharge into any one manhole. This includes both main and service lines.
 - 3. The Design Engineer shall determine if conditions require an interior protection on the manhole from microbial induced corrosion. Acceptable protections for new construction are polymer concrete, concrete with Xypex Bio-San C500 admixture, or approved HDPE manhole liner systems. Acceptable protections for existing manholes are polymer concrete liner systems or coatings. Water & Sewer Department reserves the right to require additional locations where interior coatings may be required. Locations that require interior manhole protections may include, but are not limited to:
 - a. Locations where hydraulic jump may occur and the next downstream manhole.
 - b. Every drop manhole and the next adjacent downstream manhole.

- c. Any manhole where invert slope exceeds 5% or velocities exceed 5 ft/s or where flows change from supercritical to subcritical.
- 4. Buoyancy calculations shall be provided for manholes and pipes where groundwater may be encountered, has been identified in the geotechnical report, is located in the floodplain or other water sources are present. The manhole shall be sealed from the outside with an approved seal wrap, where groundwater or other water sources are present.
- 5. Connection and modifications of existing manholes that are constructed of bricks or show signs of damage shall be replaced or rehabilitated and coated per specifications.

B. Manhole Location

- 1. All manholes shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width (refer to section 2.06). City approval is required for all other proposed manhole locations.
- 2. The center of manholes shall not be placed closer than eight (8) feet to the lip of the street gutter without prior acceptance by the City.
- 3. The edge of the manhole cover shall be located a minimum five (5) feet from the edge of cross pans, wherever feasible.
- 4. Manholes located outside of the street section shall be located in areas not subject to flooding, stormwater conveyance, ponding or detention.
 - a. If locating manholes in stormwater conveyance areas cannot be avoided, a solid, watertight, bolt down manhole cover with an integral rubber gasket, shall be used.
 - b. Manholes located within the 100-year flood plain shall have a solid, watertight, rubber gasket, bolt down manhole cover. The manhole cover and grade ring shall be bolted to the manhole cone, and all manhole joints and grade rings shall be sealed from the outside with an approved seal wrap.
 - c. Manholes located within groundwater or where other water sources are present, shall have all manhole joints and grade rings sealed from the outside with an approved seal wrap.
- 5. Manholes outside of road rights-of-way shall be provided with direct access by means of an all-weather road. All-weather road requirements are as follows:
 - a. All-weather roads shall be designed to support City maintenance vehicles up to thirty-five (35) tons with a minimum turning radius of sixty (60) feet.
 - b. At a minimum, all-weather roads shall be ten (10) feet wide with eight (8) inches of compacted aggregate base course. Subgrade preparation, compaction, and aggregate base course shall be in accordance with *SDC* construction specifications.
 - c. If the all-weather road is longer than fifty (50) feet and does not have a public road access from both ends, an appropriately sized turn around shall be provided.

- d. The Design Engineer shall verify that these minimum requirements for the all-weather road are suitable for the specific project conditions.
- e. The all-weather road shall be located in a dedicated sanitary sewer or access easement.

C. Manhole Size and Spacing

1. The following table displays the diameter of standard manholes and the maximum manhole spacing for each sanitary sewer pipe diameter:

TABLE 4-3: Standard Manhole Diameter and Spacing

Sewer Pipe Diameter (in)	Manhole Diameter (ft)	Manhole Spacing (ft)
8"	4 ft	450 ft
10"	4 ft	450 ft
12"	4 ft	550 ft
15"	5 ft	550 ft
18"	5 ft	550 ft
21"	5 ft	550 ft

2. The following table displays the diameter of inside drop manholes. Use standard manhole spacing from Table 4-3 for inside drop manhole spacing. Inside drop manhole shall only be allowed for utility conflicts and pipe sizes up to eight inches (8"). City approval is required for all other proposed inside drops.

TABLE 4-4: Inside Drop Manhole Diameter

Inside Drop Pipe Diameter (in)	Manhole Diameter (ft)
4" or 6"	4 ft
8"	5 ft

4.12 MANHOLE INVERTS

- A. The minimum elevation drop across a manhole shall be one-tenth of a foot (0.1 ft) except where cast-in-place manholes are to be installed over existing sanitary sewer mains. In such cases, the existing sanitary sewer pipe grade determines the elevation drop across the manhole, by constructing the cast-in-place manhole over the existing, straight sewer main and removing the upper half of the pipe.
- B. Where a smaller sanitary sewer main joins a larger one, the smaller sanitary sewer main crown elevation shall match the crown elevation of the larger sanitary sewer main. This includes sanitary sewer service lines.
- C. Where the invert elevation difference between the invert in and invert out is twenty four inches (24") or more and eight inches (8") or smaller pipe size, an inside drop apparatus

shall be constructed. Refer to City of Greeley Standard Drawings for drop manhole construction.

- D. Sanitary sewer mains and services entering a manhole with less than twenty four inches (24”) but greater than six inches (6”) of elevation difference between the invert in and invert out shall be avoided. If unavoidable, the invert shall have a sloping bench to prevent solids deposition.

4.13 GROUNDWATER BARRIERS

- A. Groundwater barriers shall be installed across the sanitary sewer collection main, ten (10) feet upstream of every manhole, in areas where sanitary sewer collection mains are below groundwater.
- B. Refer to the Standard Drawings and construction specification *Section 02315, Excavation and Fill* for additional information and installation requirements for groundwater barriers.

4.14 SANITARY SEWER MAIN AND SERVICE ENCASEMENTS

- A. Refer to 3.15 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for typical sanitary sewer main and service encasement requirements.

4.15 SANITARY SEWER MAIN BORINGS

- A. Refer to 3.16 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for sanitary sewer main boring requirements.

4.16 SANITARY SEWER SERVICES

A. General

1. Sanitary sewer service lines shall not be installed in trenches with dry conduits/utilities. A service line shall be separated from other conduits a minimum of five (5) feet horizontally and eighteen inches (18") vertically.
2. Sanitary sewer service lines shall not be installed in trenches with wet conduits/utilities. A service line shall be separated from other conduits a minimum of ten (10) feet horizontally and eighteen inches (18") vertically.
3. Sanitary sewer services for a given lot must be tapped on the sanitary sewer collection main within the confines of the extended property lines. The sanitary sewer service line shall be located a minimum five (5) feet inside the property being served.
4. Sanitary sewer services not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Sewer Services

1. Sanitary sewer services shall be polyvinyl chloride (PVC) SDR 35 pipe
2. Sanitary sewer services are four inches (4") or six inches (6") in diameter and shall have a minimum slope of 1% (1/8" per foot).
3. The maximum allowable slope for a sanitary sewer service is 8%.
4. If a sanitary sewer service line is required to be greater than six inches (6") in diameter, its design and connection to the existing sanitary sewer system shall be considered as a

collection main. Even though the sanitary sewer service is larger than six inches (6") in diameter, it is still considered private and maintained by the property owner.

5. A separate sanitary sewer service line must serve each structure.
6. No sanitary sewer service lines shall cross property lines.
7. Compound sanitary sewer services shall be avoided where feasible.
8. Sanitary sewer service connections at manholes shall be avoided where feasible.
9. Sanitary sewer services shall be located a minimum ten (10) feet downstream of the potable water service, wherever feasible.
10. Sanitary sewer service connections at manholes shall be avoided where feasible.
11. The sanitary sewer service line shall be electronically locatable and have tracer wire installed per *Section 02534, Sanitary Sewer Service Lines* and Standard Detail Drawings.
12. Tapping new connections to the existing sanitary sewer system shall be completed by City.
13. Sanitary sewer service connections to the sanitary sewer collection main shall be made with a tee or tapping saddle and shall be separated by at least five (5) feet along the

sewer main length, including when connections are on opposite sides of the sanitary sewer collection main.

14. Sanitary sewer service wyes are not allowed on the sanitary sewer collection main except in cul-de-sacs where a manhole or tee connection is not feasible.
15. Sanitary sewer service clean-outs are not permitted in the public right-of-way or sanitary sewer easement.
16. Sanitary sewer service connections to 15", 18" or 21" collection system interceptors or trunk lines are not permitted unless approved by the Water & Sewer Department.

4.17 SANITARY SEWER MAINS AND SERVICES IN RELATION TO OTHER UTILITIES

- A. Refer to 3.18 of these Criteria and construction specification Section 02510, Water Utility Distribution Piping for sanitary sewer main and service separation in relation to other utilities requirements.

4.18 SANITARY SEWER LIFT STATIONS AND FORCE MAINS

- A. All lift stations with capacities at 2,000 gallons per day (gpd) or greater are subject to Colorado Department of Health and Environment (CDPHE) Regulation 22.
- B. Cost Responsibilities
 1. Design and Construction
 - a. The Developer shall be solely responsible for all costs associated with the design and construction of the lift station and force mains. This includes the cost of any easements, land acquisition, documents associated with permitting approval through CDPHE and North Front Range Water Quality Association (NFRWQPA), and any other cost associated with the project.
 2. Reimbursement
 - a. Where additional service area outside of the proposed development is anticipated, the City of Greeley will require the lift station and associated improvements to provide additional capacity than what is necessary for the initial development. Refer to Section 2.12 of this criteria for additional clarification.
 3. Operations and Maintenance
 - a. Public Facilities: Public lift stations are defined as any lift station serving more than one user and accepted by the Public utility. Operations and maintenance activities shall be the responsibility of the City for all public lift stations only upon completion and acceptance of the proposed improvements. The Developer shall provide an operations and maintenance manual and procedures for all equipment and processes associated with the lift station. The Developer shall coordinate with the City during

the planning and design phases on equipment operations and maintenance requirements.

- b. Private Facilities: Private lift stations are defined as any lift station serving only one user. Operations and maintenance responsibilities for private lift stations are the sole responsibility of the owner or private entity.

C. Planning and Permitting

1. General

- a. Gravity based solutions are preferred to lift stations as it provides the most reliable and lowest cost service for our customers. The use of a lift station and force main shall be evaluated on a case-by-case basis. If there is an appropriate gravity solution, then the developer shall design and construct the proposed improvements meeting the City of Greeley Criteria. Any lift station or force main shall first be approved by the City following proper justification by the Developer. Where a lift station is determined to be required it shall be designed to allow for an eventual connection into a gravity system.
- b. The lift station and force main design shall adhere to state and regional approval processes and the Developer shall keep informed and notify the City of major milestones during the design and approval processes. The Developer shall adhere to the submittal requirements previously stated in Section 2 of these Criteria.

2. Procedures

- a. The Developer shall employ the services of an engineer licensed in Colorado that has successfully designed and permitted at least two lift stations of similar size as proposed, within the State of Colorado. The Developer and the engineer shall adhere to the following procedures through the planning and design phases:
 - i. Coordinate a conceptual project meeting with the City to provide justification for the project and initial design considerations including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - ii. Upon initial conceptual acceptance for consideration of the need for a lift station, provide written project justification for the project and design considerations including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - iii. Attend follow up meeting following completion of the review of conceptual documents.
 - iv. It is the expectation that the developer keep the City informed of the project's progress from design through construction approval. This includes notifying the City of the major project milestones associated NFRWQPA and CDPHE review and approval process and allowing for City review of major reports and documents. Major milestones include but are not limited to:
 - Site Application submittal to NFRWQPA

- Signed and approved Site Application submitted to CDPHE
 - Basis of Design Report (BDR) submittal to CDPHE
 - Design approval from CDPHE
 - Funding requests
 - Public meetings/outreach
- v. Upon the City's review and acceptance of the conceptual design, the applicant may proceed with the Lift Station Site Application process in accordance with CDPHE Regulation 22.
 - The Site Application shall be submitted to NFRWQPA following review and acceptance by the City
 - Following NFRWQPA and local agencies approval of the Site Application, the applicant shall submit the Site Application and required counterparts in accordance with Regulation 22 to CDPHE for review and approval
 - vi. The Lift Station BDR shall be reviewed by the City prior to submitting the BDR to CDPHE for review and approval. The BDR shall include at least a 60 percent design package and shall only be submitted to CDPHE upon City approval of 60 percent design package.
 - vii. Prepare and deliver final design plans and technical specifications for the City's review and approval.
 - viii. Applicant shall coordinate with the City through the construction bidding process as necessary.
 - ix. Applicant shall coordinate construction inspections with City Inspectors.
 - x. Applicant shall submit all construction submittals for review including shop drawings and data and operation and maintenance manuals.
 - xi. Applicant shall coordinate with the City for start-up testing and required training.
 - xii. Applicant shall submit final record drawings to the City in AutoCAD and pdf format.
3. Colorado Department of Public Health and Environment (CDPHE)
 - a. The design and construction of all lift stations and force mains shall adhere to CDPHE's most recent version of Regulation 22 – Site Location and Design Approval for Domestic Wastewater Treatment Works (The City reserves the right to review all procedures and reports required under Regulation 22 and request revision if necessary. Where CDPHE's Regulation 22 and the City's Criteria differ, the more restrictive of the conditions shall apply.
 4. North Front Range Water Quality Planning Association (NFRWQPA)
 - a. The planning and Site Application process of the proposed lift station and force main shall be in accordance with NFRWQPA wastewater utility plan guidance. The applicant will be required to provide updates to the City's Wastewater Utility Plan

(WUP) for the proposed lift station and force main as part of the Site Application process.

- b. The process for obtaining lift station approval from the Water Quality Control Division (WQCD) begins with the NFRWQPA (www.nfrwqpa.org). CHPHE *Regulation 22*, latest revision, requires that prior to WQCD final design review and approval, the lift station Site Application must be submitted to the NFRWQPA. Refer to the NFRWQPA website and *Regulation 22* for guidelines and requirements on the lift station site location and design approval process.

5. City of Greeley

- a. The Developer shall coordinate with the following City's departments to ensure all procedures and policies are adhered to.
 - i. Water and Sewer Department
 - ii. Community Development
 - ii-a. Engineering Development Review
 - ii-b. Planning Department
 - ii-c. Building Inspections
 - iii. Other Departments as Required

6. Lift Station Design Criteria

- a. Applicable Codes, Environmental Compliance, and Health and Safety
 - i. Applicable Codes: For work done in the City, work shall be performed in accordance with the codes established by the City's building department.
 - ii. Environmental Compliance: Environmental assessments and/or environmental reviews may be required as a preliminary investigation to determine if a particular parcel of real property is subject to recognized environmental constraints such as, and not limited to the following: floodplain areas, wetlands, endangered species, and hazardous conditions. Should environmental constraints exist as identified above, it is the Developer's responsibility to incorporate mitigation measures to comply with environmental requirements in accordance with applicable and current rules and regulations.
 - iii. Health and Safety: Public lift stations are required to conform to all City and OSHA health and safety requirements. City operation staff safety shall also be considered during the design and construction of the lift station including, but not limited to:
 - Readily accessible equipment placement for maintenance activities
 - Classified areas in accordance with the National Fire Protection Association (NFPA) 820 Regulations
 - Lifting assistance for heavy equipment

- Nonslip floor finishes
 - Handrails
 - First-aid and safety equipment
 - Fall protection
 - Limitation of confined spaces – it is desired by the City to limit confined space entries where possible
- b. Determination of Wastewater Flows
- i. Existing wastewater flows shall be calculated using the calculation methods stated in Section 4.03, 4.04, and 4.05. Should the project area not fit the previously stated design flow estimation methods, applicable and industry-standard calculation methods shall be utilized. Methods include real-time flow monitoring or calculations based on land-use. Methods and calculations shall be included in relevant planning documents and subject to City's review.
 - ii. Proposed and future wastewater flow projections shall be estimated for the build-out conditions of the service area. Estimation methods shall be based on projected land-use. The planning period and projected land-use within the service area shall be coordinated with the City during the planning phases.
 - iii. Organic and other applicable wastewater constituent loadings shall be considered and evaluated based on existing and projected land-use. It is the Developer's responsibility to calculate based on most current available information, flows and constituent loadings for accessing available sewer and wastewater treatment capacities.
- c. Impacts on Downstream Lift Stations or Sewer Capacities
- i. Ultimate peak hour design flows shall be used to determine the impact to downstream collection system infrastructure including treatment facilities, lift stations, and sewers. Existing infrastructure needs to be able to accommodate peak flows and loadings from new lift stations and force mains. The capacity of existing infrastructure to accommodate flows from new lift stations shall be justified to the City as part of the planning and design documents.
- d. Lift Station Capacity
- i. Lift station capacity shall be designed to accommodate existing and future projected peak flows for the entire service area.
 - ii. Hydraulic calculations and system/pump curves require consideration and shall be submitted for review during the planning phases to the City of Greeley and as part of the CDPHE's approval process.
 - iii. Receiving sewers shall be evaluated to ensure adequate capacity to accommodate the ultimate lift station flow.

e. Emergency Storage

- i. The lift station shall be designed for at least 60 minutes of emergency storage at peak hour flow conditions or as required by CDPHE. Emergency storage can utilize volume within the wet well above the high level alarm and upstream collection system piping provided that it is demonstrated that back-up will not occur into any existing or potential future service connections or taps. No future taps shall be constructed within the section of influent sewer or sewers to the lift station designated to provide emergency storage. If a piping connection is required to accommodate emergency storage provisions, the invert of the pipe connecting the wet well to emergency storage shall be above the high level alarm. Additional emergency storage may be required at the discretion of the City based on site location, emergency response time, and potential environmental concerns.
- ii. Emergency storage can be accomplished using an additional storage vault structure. The emergency storage structures shall provide adequate access and floor slope for cleaning and shall be designed with pre-cast concrete, cast-in-place concrete, fiberglass reinforced plastic, or other approved equals. If constructed of concrete, adequate protection (i.e. polymer concrete or concrete admixtures) shall be provided to mitigate corrosion caused by hydrogen sulfide. If used, the emergency storage vault shall be designed to provide flow to and from the wet well to the vault and with adequate access for pumping via vacuum truck or other appropriate method.
- iii. If emergency storage can be accomplished through gravity flow from the lift station to another existing collection system, the City may consider that as an option to meet emergency storage requirements. It shall be demonstrated that the gravity overflow, existing collection system, and downstream facilities be adequately sized to accept increased flow. Additionally, should the collection system be operated by another entity, a legal agreement stating the entity can and shall receive emergency flows shall be coordinated and presented to the City during the design review process.

7. Force Main Design Criteria

a. Materials and Sizing

- i. Force main material shall be AWWA C900-16 with minimum wall thickness of at least DR-25. DR-18 or DR-14 shall be required if pressure or surface loading at any location in the system exceeds the DR-25 pressure rating.
- ii. Force mains shall be minimum 4-inch diameter. Force mains shall be sized appropriately for a minimum fluid velocity of 2 feet per second and maximum velocity of 7.5 feet per second. Sizing shall also conform to CDPHE design requirements, whichever is most limiting. Parallel force mains are strongly preferred by the City for maintenance procedures, emergency conditions, and capacity optimization between existing and build-out flows. If parallel force mains are not considered feasible for a specific installation, it shall be demonstrated that the force main diameter is optimal for existing and build-out flow velocities.

- iii. If force main diameter is such that the wastewater velocity is less than 2 feet per second at initial operating conditions, the design shall include VFDs on the pumps to allow the motors for the pump or pumps to increase frequency to increase the wastewater velocity in the force main to be a minimum of 3 feet per second for a minimum flushing time of 5 minutes. Reference the Electrical and Controls section of this criteria.
- b. Access / Cleaning Stations
 - i. Force main clean-out access shall be provided every 500-feet in situations where the force main is 950-feet or longer. Clean-outs shall provide adequate access to allow for pipeline condition observations via video camera and maintenance.
- c. Protection, Bedding and Compaction
 - i. Pipe bedding and backfill of force mains shall conform to the specifications in Section 02315 of these standards.
- d. Force Main Alignments and Separation
 - i. The minimum buried depth of the force main shall be 48-inches from top of pipe.
 - ii. Wastewater force mains shall adhere to CDPHE and City standards for separation between potable water lines and other utilities. Wastewater force mains shall travel below existing potable water lines meeting the minimum requirements as outlined in Section 4.18. Should minimum separation requirements not be possible, refer to encasement requirements in Section 4.15 of the Criteria.
 - iii. Should the wastewater force main alignment be such that it cannot accommodate these separation requirements vertically or horizontally, provisions shall be provided to safeguard the existing utilities in accordance with the City design criteria and construction standards.
- e. Special Permitting Requirements
 - i. In situations where the force main alignment crosses areas that include wetlands, floodplains, irrigation ditches, railroads, and waterways, the Developer shall be responsible for all permitting during the design phase to ensure that local and state requirements are adhered to. The Developer shall document all required permits with the City prior to proceeding with construction. In all cases, the Developer shall evaluate alternative force main alignments to minimize impact to sensitive areas described herein.
 - ii. Easements required for the force main alignment shall adhere to Section 2.06 of these criteria. All easements required for the force main shall be approved by the City and granted to the City prior to City of Greeley approval of construction documents.

8. Land Acquisition and Easements

- a. All land area requests for the lift station sites shall be submitted and approved by the City prior to starting the land acquisition process. Lift Stations shall be located on property deeded to the City. The minimum size for the lift station site shall allow for adequate equipment access, maintenance activities, and ancillary equipment (i.e. generator, odor control, emergency storage, etc.). In no cases shall the lift station site be less than 2,500 square feet in size. Applicant shall provide preliminary lift station site drawings showing major lift station components, security, buildings, and access for the City to review and determine required site size.
- b. Force main alignments exiting the lift station site up to the point of gravity connection shall be contained within an sewer easement and shall be dedicated to the City per Section 2.06 of this criteria.

D. Lift Station Site

1. Location and Topography

- a. The lift station and site location shall be designed and constructed to limit disturbance to the surrounding properties both aesthetically and during construction activities. The site shall allow adequate access to the site from existing public right of way. The lift station site shall be designed to provide adequate drainage away from the lift station and building and conform to City standards for drainage and storm water management plans. Developer shall perform a geotechnical evaluation of the site to determine soil conditions and hydrology as well as recommendations for lift station construction. Lift station sites shall be located outside of the FEMA 100-year floodplain with the finished floor elevation of the lift station a minimum of 2-feet above the floodplain. All lift station site locations are subject to review and approval by the City and CDPHE Regulation 22.

2. Lift Station Building / Enclosure

- a. The lift station shall be enclosed in a weatherproof structure. The lift station enclosure and lift station pumping components as a minimum shall be accessible without permitting for confined space access. As a minimum the lift station enclosure shall be ventilated and heated and conform to the City's planning and building department requirements and applicable structural and building codes. The size of the building or enclosure shall allow for adequate clearance to maintain pumping equipment, piping, valves, electrical gear and controls. The minimum spacing between pumps shall be 30 inches, spacing around pumps of 36 inches, and electrical panel clearance shall be no less than 48 inches or as required by the National Electrical Code. Building or enclosure entry ways, hatches and overhead doors shall allow for convenient access and equipment removal for maintenance and replacement. All lift station enclosures or buildings must be approved by the City

and applicable architectural committees that are associated with the subdivision or local association.

3. Aesthetics

- a. The lift station shall be subject to the City's Development Review process and applicable development standards. The lift station architecture and aesthetics shall be designed to match the surrounding structures. Landscaping shall be considered and planned to match the surrounding environment with low maintenance and water use. Appropriate screening and other methods shall be utilized to minimize noise and visual impacts.

4. Access

- a. All wastewater lift stations shall be sited to allow access by all-weather surface roads capable of accommodating maintenance trucks from public right of way to the lift station site. The access shall at a minimum support HS-20 loading with a minimum width of 15 feet. The access points and site shall be designed to allow WB-50 trucks to maneuver within the site and exit the site without backing into public right of way. The site layout shall allow for access to the wet well and vacuum/jetter truck to clean out accumulated material in the wet well. All hard or concrete surfaces shall be designed for the expected vehicle and equipment loads.

5. Security Fencing

- a. The lift station site shall contain perimeter security fencing minimum 6' in height. The fencing is subject to the City of Greeley Municipal Code and shall be reviewed and approved by the City.
- b. The lift station site access gate shall have a minimum size full width opening of 18-feet and of lockable type.

6. Lighting

- a. Lighting shall be provided at the lift station site to allow for necessary activities during night and times of low visibility. The lighting system shall be designed to provide illumination best suited for the station layout which may include suspended, wall, or ceiling mounted fixtures and shall be suitable for routine maintenance activities and inspections. Site lighting equipped with photocells shall not be

allowed. Refer to Chapter 18 of Greeley Municipal Code for more information, as applicable.

7. Potable Water

- a. The site shall have access to potable water. Potable water connection, service size, backflow device and meter shall be coordinated with the City. At a minimum, there shall be a frost proof yard hydrant located in the vicinity of the wet well.

E. Lift Station Components

1. Pumping System

- a. Each Lift Station shall have a minimum of 2 pumps. The pumps shall be designed to accommodate existing flows and future flows from fully developed contributing area. Firm capacity of the pump system shall be designed (or phased) to pump ultimate peak flow at maximum computed total dynamic head. Pump operation shall be automatic but fitted with the capability to run the system in manual control.
- b. Lift Stations shall be designed as a duplex system as a minimum. Duplex system for ultimate flow of the service area, shall be designed so that each pump is sized for peak hourly flow. The applicant shall provide a spare pump of the same capacity. Lift stations serving service areas that are phased over several years shall be designed initially as a duplex system as a minimum with room to add additional pumps for meeting the ultimate flow demands of the service area. Lift stations that are designed with more than two pumps shall be capable of pumping peak hourly flows with the largest pump out of service. The applicant shall provide a spare pump matching the size of the largest pump in service.
- c. In all cases pumping systems shall be designed to accommodate existing and build-out flows with adequate redundancy as defined by CDPHE Regulation 22 and in these criteria. If future build-out conditions require pumps (greater than 2) that are not needed for near term flow conditions, the lift station shall be designed to add additional pumps, piping, valves, electrical and controls without the need for a major system shutdown and / or bypass pumping.
- d. Pumping system shall be designed to allow for adequate access between other pumps, piping, and ancillary equipment for maintenance activities including, but not limited to, routine maintenance and inspection and pump removal.
- e. Required Pumping System Type: Above Ground Mounted Self-priming Suction

The pumping system is self-priming suction pumps placed on grade with minimal piping to suction from the wet well. The only accepted manufacturer for the pumping system is Gorman Rupp. Pumping systems shall be site-specific designs or pre-packaged systems meeting site requirements. All designs are contingent upon review and approval by the City.

f. Alternate Pumping System

If the Developer, with approval from the City, determines above ground mounted self-priming suction pumps are insufficient for the application, the Developer can seek a variance to utilize either wet well / dry well or submersible pump configurations. The Developer must adequately prove that the alternative pump configuration is the optimal choice for the application and include evaluations between both dry-pit and submersible configurations.

- i. Submersible Pumps: Where above ground mounted self-priming suction pumps are insufficient, City of Greeley will only consider submersible pumps where the ultimate build out peak hour flow rate is less than 100 gallons per minute. Where submersible pumps are approved by City of Greeley, the pumps must be removable without entering the wet well by providing rail and crane system. Control Panels and associated equipment shall be located within an enclosure of adequate size. The Developer shall provide two spare pumps to the City of Greeley.
- ii. Wet Well/Dry Well: Where above ground skid mounted self-priming suction pumps are insufficient and flow rate is greater than 100 gallons per minute during peak hour flow at full build out, the lift station shall be configured to provide separate wet wells and dry wells. Common walls between wet wells and dry wells shall be water and gas tight. Suitable and safe means of access shall be provided to the dry well for operations staff, maintenance, and removal of all equipment from the dry well. Access shall include separate equipment and access hatches. Access to the dry well shall be provided through stairs. Ladder access is not allowed. Where dry wells are considered, the lift station shall be designed to ensure that surface runoff cannot enter the lift station. Where groundwater may exist above the dry well, adequate measures shall be provided to prevent infiltration of groundwater into the dry well and wet well.

g. Pumping System Components

- i. Each pump shall have a dedicated check valve, plug valve, and air-relief valve on the discharge side of the pump. Pressure gauges shall be provided on both the suction and discharge (prior to the check valve) side of the pump. Pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and an isolation valve. It is preferred that these pump system components are supplied by the pump manufacturer if supplied as a skid-type system to ensure compatibility, performance, and single point of supply.

h. Hydraulics

- i. Pumps shall be designed to accommodate existing and future flows. Pump design calculations shall be included in the design reports and subject to City review. Hydraulic calculations shall include pipe friction losses using appropriate friction coefficients and minor friction losses. Net positive suction head available ($NPSH_A$) and net positive suction head required ($NPSH_R$) shall be considered to ensure pump cavitation will not occur. Control descriptions for the pumps shall consider water levels required to maintain adequate $NPSH_A$ and $NPSH_R$.

2. Station Piping

a. Material and sizing

- i. Station piping shall be 316 stainless steel or ductile iron pipe and sized to accommodate the necessary flow ranges. Flanged header pipe shall be ductile iron complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be ductile iron class 150, or as required by pumping application and pressures, and comply with ANSI B16.1. Generally, the liquid velocity in the station piping shall be no less than 3 feet per second and no greater than 7 feet per second.
- ii. All ductile iron piping shall be glass lined in accordance with ASTM B1000, use pipe suitable for glass lining with minimum Class 53 thickness.

b. Expansion Joints/Victaulic Coupling

- i. Station piping shall include expansion joints, flanged coupling adaptors and/or grooved couplings to allow for dismantling of station piping for maintenance and parts replacement.

3. Grinders

- a. Grinders may be required, which the City will determine on a case by case basis, depending on expected flows and loading.
 - i. Grinders shall be in-line only.
 - ii. Accepted manufacturers are Franklin-Miller or approved equal.
 - iii. All grinders are contingent upon review and approval by the City.

4. Valves

a. Plug Valves

- i. Isolation valves shall be eccentric non-lubricated plug valves. Each pump discharge shall have a dedicated isolation valve so that each pump can be isolated from the common discharge header. Plug valves shall be of cast iron body, ASTM A126 Class B. Valve plugs shall be cast iron ASTM A126 Class B covered with a Buna-N Rubber compound. The seats are to be a corrosion resistant alloy either 316 stainless steel or nickel. Valve body shall be semi steel with flanged end connections drilled to 150 pounds, or higher as required by application pressures. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall be equipped with a locking device to hold the plug in the desired position. Valves shall be able to pass a spherical solids not less than 3 inches diameter. Accepted manufacturers include DeZurik, Valvmatic, Milliken.

- b. Check Valves (4" or more in diameter)
 - i. Check valves shall be swing check valves capable of passing a 3-inch spherical solid. Check valves shall meet the latest AWWA C508 standard and be of the resilient hinge check valve type. All internal hardware shall be stainless steel. Valve shall be equipped with flanged ends and be fitted with an external lever and spring. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. For high pumping head applications (150 feet or greater), the Developer shall submit a type of check valve that will minimize hydraulic surges or slam to the system. Each pump discharge shall have a dedicated check valve. Accepted manufacturers include Val-matic, DeZurik, Victaulic, Golden Anderson.
 - c. Combination Air and Vacuum Valves
 - i. Sewage rated combination air and vacuum valves shall be placed at the discharge of pumps as close to the check valve as possible and at any local high points in the station piping. Route discharge line to sump. Accepted manufacturers include Val-matic and Golden Anderson.
5. Bypass Pumping Assembly
- a. Lift Station Out of Service
 - i. A bypass pumping configuration shall be designed to bypass the lift station should it ever need to be taken offline. The bypass pumping configuration shall include provisions to bypass the entire lift station as well as lift station components including the wet well and pumping equipment and station piping. Bypass connections shall also be included on the common discharge header to the lift station pumps (station piping) as well as the force main (site piping) along with isolation valves. All bypass connections shall be at a minimum 6" camlock.
 - b. Approach Manhole
 - i. An approach manhole shall be constructed upstream of the wet well within the lift station site boundaries. The approach manhole shall serve as a common connection for the gravity sewer or sewers feeding the pump station and shall connect to the wet well by a single gravity pipe.
 - c. Wet well
 - i. Lift Station wet wells shall be Polymer Concrete or concrete with Xypex Bio-San C500 admixture to prevent corrosion on the interior surfaces caused by concentrated levels of H₂S and other corrosive properties of raw wastewater.
 - ii. All wet well penetrations shall be link sealed and grouted to prohibit any leakage from the wet well or groundwater infiltration.

- d. Coatings and Paintings
 - i. All exposed carbon steel or ductile iron surfaces, piping and equipment shall have field-applied protective painting or coating except where material (i.e. PVC, stainless steel, hot-dipped galvanized or aluminum) or factory coating warrants exception. All paint and coatings systems shall be approved by the City and shall adhere to City standards for color coding.
- 6. Electrical and Controls
 - a. Arc Flash
 - i. Study
 - i-a. Provide arc flash study on the electrical equipment per NFPA 70E.
 - ii. Labeling
 - ii-a. Provide labeling per NFPA 70E.
 - b. Electrical Equipment
 - i. All electrical control panels with controls and wiring shall be built in accordance with NEC, UL, NFPA 70E, NFPA 820 and ETL standards. The electrical components and enclosure shall be labeled as a complete UL listed assembly with manufacturer's UL label applied to the door. Developer shall coordinate with City Building Department on applicable codes.
 - ii. Developer shall coordinate with the City for electrical utility providing electrical service. Station shall be provided with a separate utility transformer and meter/main with ground fault protection. Primary power to the station shall be 480-volt, 60 Hz, 3-phase service per utility provider standards. Developer is required to pay permitting, design, and costs for primary power to the lift station site. Secondary power service shall be designed by a certified electrical engineer licensed in the State of Colorado. As a minimum, the station shall include service disconnect panel, automatic transfer switch (ATS), motor control center (MCC) or electrical distribution panel. The service disconnect panel shall be mounted on the exterior face of the lift station building common wall to the indoor electrical switch gear.
 - iii. The ATS shall be provided to switch from normal utility power to standby emergency power upon power outage and switch back to normal power once the power outage is restored. The ATS shall have indicating lights for normal power, emergency power, and a digital panel indicating volts and amps. The ATS shall be mounted inside the lift station building integral to the MCC. The ATS manufacturer shall be compatible and approved by the accepted lift station pump manufacturer, Gorman Rupp. The City's standard for standby emergency power is natural gas-powered engine generators manufactured and provided with the lift station pumps manufacturer, Gorman Rupp. If the lift station pumps are provided by a manufacturer other than Gorman Rupp, the Developer shall

provide the ATS and standby emergency power generator specifications and manufacturer for City review and approval.

- iv. Electrical switchgear (480 volt) shall be mounted in a NEMA 1 MCC with removable buckets within a NEMA 3R wrapper. A step-down transformer shall be included to provide power service to a separate light or power panel rated for 120 / 240-volt service. The light or power panel is required to provide service for interior and exterior lighting, receptacles, ventilation and controls. Switchgear shall be manufactured by Cutler-Hammer, Allen Bradley, Square "D", or approved equal by the City.
 - v. Transient voltage suppression rated at 80 KA minimum shall be provided at the main electrical service panel and shall be installed in accordance with the latest requirements of NEC Article 285.
 - vi. Wiring to any instrumentation shall be multi-conductor shielded cable suitable for Class 2 low voltage controls. Must use Black and red wiring in cable for all class 2 low voltage controls.
 - vii. All wiring that that is running from VFD to motor shall be VFD rated cabling if shared with other VFDs.
 - viii. All wiring from control panels to motors shall be in liquid-tight conduit with copper conductors rated not less than 600 volts AC. All wiring shall follow NEC code and local code.
- c. VFDs and Soft Start and Stop
- i. All motor sizes greater than 20 HP shall be equipped with a reduced voltage solid state start and stop or also known as soft start and stop. The use of variable frequency drives (VFD) for the lift station pumps shall be evaluated on a case-by-case basis. The Developer will be required to demonstrate the advantages for installing VFDs for the ranges of pumped flows. The soft start / stop device and / or VFD shall be mounted adjacent to the MCC. Accepted manufacturers for the soft start / stop and VFD equipment shall be Allen-Bradley, Eaton or Mitsubishi.
- d. Level Controls
- i. The primary level control system used for the lift station to turn pumps on and off and sequence lead and lag operations shall consist of the radar level measurement type. The primary level control system shall have a minimum of five differential level set points including low liquid level, start / stop lead pump, start / stop lag pump, start / stop standby pump (if required), and high water level. The level control shall be equipped with a transmitter device and user interface screen for user set points and display of liquid level in the wet well. Contacts shall be provided for selected alarm outputs for integrating into the SCADA and telemetry system. Accepted manufacturers for level control shall be Endress Hauser or a manufacturer approved by the City.
 - ii. In addition to the primary level control system, the lift station shall be equipped with a secondary level control system for back-up. The secondary level control

shall consist of electro-mechanical float switches for low water cut-off, pump on / off, and high-water alarm. Accepted manufacturers for float switches shall be Siemens Water Technologies Model 9G-EF or approved equal.

- iii. The secondary level control system would be based on a PID loop and use wet well levels to modulate the VFD speed.

- e. Lift Station Control Systems

- i. Controls shall provide automatic reset of alarm conditions for normal power fail, high water level, standby pump run, and a common alarm contact. However, alarm conditions shall activate an alarm light that is mounted at the roof line of the lift station building or enclosure. Any pump alarm conditions shall require manual reset and SCADA reset. All lift station alarm outputs shall be transmitted via telemetry system to on-call City operation staff and master SCADA control center.
- ii. The lift station PLC shall be an Allen Bradley CompactLogix 5069-L320ER. Alternative PLC's must be approved by the City.

- 7. Control Panel

- a. Each control panel shall contain adequate surge protective devices.
- b. The PLC control panel shall be sized to adequately contain all PLC and communication equipment and rated for NEMA 4X/12 enclosure.

- 8. Human Machine Interface (HMI)

- a. Redlion G15C1100
- b. HMI program shall be unlocked and copy of program given to City of Greeley I&C department after commissioning of Control Panel.

- 9. PLC (Programmable Logic Controller)

- a. Allen Bradley Studio 5000 Platform
- b. Compactlogix or Controllogix Series
- c. IO check to be done after completion of control panel being installed.
- d. Each PLC shall have a minimum of a 2-hour uninterrupted power supply (UPS).
- e. Program shall be unlocked and copy of program given to City of Greeley I&C department after commissioning of PLC.

- 10. Instrumentation

- a. Vibration Sensor must be provided on each motor.
 - i. Acceptable Manufacturer

- i-a. Allen Bradley
 - i-b. Banner
 - b. Radar
 - i. Must install one radar to read the level of the wetwell and also backup floats
 - ii. Only acceptable manufacturer is Endress Hauser
 - c. Backup Floats
 - i. Must be approved by the City.
 - d. Discharge Flow Meters
 - i. Acceptable Flow Meter Manufacturers
 - i-a. Endress Hauser
 - i-b. Rosemount
 - i-c. Must have an approved vendor do a start up on the flow meter.
 - ii. Communication
 - ii-a. Ethernet IP
 - ii-b. Modbus TCP
 - iii. Flow totals must come from the meter and not be calculated in the PLC.
 - iv. The flow meter shall be fitted with grounding rings as required with 150 pound flanged connections.
 - b. Upstream Flow Meters
 - i. Acceptable Flow Meter Manufacturers
 - i-a. ISCO or approved equal
 - i-b. It will need to have a Tienet box in the manhole.
 - i-c. Must have an approved vendor do a start up on the flow meter.
 - i-d. Manufacture: Isco Tienet 360 LaserFlow. Signature Laser flow meter transmitter.
 - ii. Communication
 - ii-a. Ethernet IP
 - ii-b. Modbus RTU

11. Programming

- a. Alarms
 - i. Contact City of Greeley I&C Department for list.
- b. Trending
 - i. All analog signals
- c. PLC (Programmable Logic Controller)
 - i. Communication
 - i-a. PLC to PLC messaging must be done through Ethernet.
 - i-b. PLC to VFD communication must be done through Ethernet.
- d. HMI/SCADA
 - i. Status Colors
 - ii. Motor Status
 - ii-a. Green - Running in Auto
 - ii-b. Red – Off
 - ii-c. Yellow – Running in Hand or Manual
 - ii-d. Red flashing - Faulted
- e. Back-up Power Supply
 - i. Back-up power shall be supplied at the lift station to power the pumps and ancillary equipment in the event of a power outage. The back-up power system shall be natural gas powered. The Gorman Rupp standby engine system is preferred, and the Developer shall determine if that system is suitable for the application. Other back-up power systems will be considered if application is not suitable for the Gorman Rupp system. If not provided by Gorman Rupp, alternate back-up power system will be evaluated and approved by the City on a case-by-case basis. The City's preference for alternate back-up power systems is Cummins for both the generator and ATS.
- f. Telemetry and SCADA
 - i. The Remote Telemetry Unit (RTU) shall communicate by way of Ethernet or Allen Bradley Ethernet. Use approved City of Greeley radio system. Programming of SCADA system must be done by an approved and qualified contractor.
 - ii. Provide 40-foot pole for SCADA radio, which can be integrated into light pole.
 - iii. Required Data and Inputs in SCADA

- iii-a. Intrusion alarm
- iii-b. Wetwell Level - Floats
- iii-c. Wetwell Level - Radar
- iii-d. Wetwell Low Level activated
- iii-e. Wetwell High Level activated
- iii-f. VFD Running Amps from VFD or Softstart
- iii-g. Flow (gpm)
- iii-h. Flow Totalization - must be the totalizer from flow meter
- iii-i. Flow total from yesterday
- iii-j. Pump motor status
- iii-k. Softstart or VFD status "Faulted"
- iii-l. Softstart or VFD status on/off
- iii-m. Power Fail
- iii-n. Amperage for each pump
- iii-o. VFD status on/off
- iii-p. VFD speed (Hz)
- iii-q. VFD Reference
- iii-r. Station common alarm
- iii-s. Generator Running
- iii-t. Generator Switch in Normal or Emergency
- iii-u. Generator common alarm
- iii-v. Runtime for each pump
- iii-w. Pump starts
- iii-x. Control Panel Temperature
- iii-y. Pump Selector Switches status
- iii-z. H2S Monitoring System in wetwell or discharge manhole

- iii-aa. Calculated Inflow (gpm)
 - iii-bb. Flood Alarm
 - iii-cc. Phase Monitor power status
 - iii-dd. Generator battery voltage
 - iii-ee. Vibration sensors on motors
 - iii-ff. Building or Vault temperature
- g. Alternate Communication
 - i. Provide an option to install fiber from Lift Station to closest City of Greeley fiber pull box.
 - ii. Must use a City of Greeley approved vendor.
- h. H2S Monitoring Systems in Wet well or discharge manhole
 - i. The City may require that the Developer design and install H2S monitoring and mitigation in the manhole the force main discharges into. Factors that may require H2S monitoring in the manhole include pump flow, force main length and location of the discharge manhole.

12. Mechanical

- a. Ventilation
 - i. Adequate ventilation shall be designed in buildings and vaults as required and adhere to all applicable State, NFPA, and OSHA requirements. Ventilating system shall consist of electric or natural gas make-up air units sized to provide a minimum of 6 air changes per hour and shall automatically begin operation upon user selected indoor temperature settings for both summer and winter modes. Supplemental cooling and heating will be required if building temperatures exceed 85 degrees Fahrenheit (F) or fall below 55 degrees F. Ventilation shall be accomplished by the introduction of fresh air in the station and be filtered to remove debris and minimize particles. Ventilation fans shall automatically come on upon entry of the lift station enclosure or building or activated by the light switch adjacent to the entry door.
 - ii. In addition to the make-up air ventilation system, supplemental heat shall be required using electric or natural gas unit heaters to maintain a minimum temperature of 55 degrees F. Unit heaters shall be automatically controlled thermostatically. Heating systems shall be designed based on an outside ambient temperature of negative 20 degrees F.
- b. Air Conditioning
 - i. Air conditioning shall be provided if ventilation system cannot ensure inside air temperate of below 85 degrees F within a reasonable time period of ventilating.

Cooling systems shall be designed based on an outside ambient temperature of 105 degrees F.

c. Drains

- iii. Lift station enclosures or buildings shall contain no floor drains that connect to the wet well. The enclosure at the level the pumps are located shall include a trench drain which slopes to a sump pit equipped with a duplex submersible sump pump system controlled with weighted float level switches. The sump pump system shall discharge to the top of the wet well with an air gap. The pump system shall be sized based on expected drain flows such as air release valves, maintenance, etc. Each sump pump discharge shall contain a check valve and isolation valve along with a pump removal system. The sump pump system shall be connected to the back-up or emergency power system.
- iv. Pumps shall be equipped with drains that flow via gravity to the wet well for evacuating wastewater during maintenance.
- v. The lift station site shall be equipped with a perimeter drain if recommended from the geotechnical study.

13. Odor Control and H₂S Generation

- a. The lift station shall be evaluated for the odor mitigation system and final determination of implementing odor control measures will be reviewed and determined by the City. Supporting data, calculations, or assumptions for hydrogen sulfide generation based on estimated wastewater characteristics and industry standards shall be included in the evaluation. In the absence of supporting data and / or calculations, the Developer shall utilize the latest edition of “Metcalf and Eddy Wastewater Engineering Treatment and Resource Recovery” for medium strength sulfide concentrations in wastewater. Other factors to consider in the evaluation include but are not limited to:
 - Proximity to and use of neighboring properties
 - Wastewater composition (BOD₅, COD, TSS, Sulfides, TKN, Ammonia-N)
 - Wind direction and downwind properties
 - Operation and maintenance requirements of odor control system
- b. If odor control is determined necessary, the type of system shall be selected based on the site-specific needs of the lift station. All ancillary equipment and necessary provisions shall be incorporated into the design of the lift station to provide a functional system. Odor control systems may include but are not limited to the following mitigation technologies:
 - Carbon absorption systems
 - Biological scrubber or filter
 - Chemical scrubber

- c. If odor control is not required, provisions for future addition of odor control facilities (i.e., installation of ventilation ducts and penetration into the wet well for future connections) shall be provided.

14. Force Main Components

a. Connection to Existing Gravity Sewer and Discharge Manhole

- i. Force mains shall connect to a gravity wastewater system at a manhole, or a structure designed to receive pumped wastewater. At a minimum the discharge manhole and the next two downstream manholes shall be polymer concrete, concrete with Xypex Bio-San C500 admixture, or approved HDPE manhole liner systems. The force main discharge shall be designed to minimize turbulence and scour within the connecting structure. The City will determine on a case by case whether odor control is required at the receiving structure.

b. Isolation Valves

- i. It is desired by the City to design the force main to limit required valves along the force main alignment. High points and low points shall be minimized along the pipe alignment.
- ii. If required, isolation valves shall be plug valve type. All direct buried plug valves shall normally remain open (with exception of bypass connection and isolation valves) and be installed with a valve box and lid. Accepted manufacturers include DeZurik, Valvmatic, Milliken

c. Air and Vacuum Relief Valves

- i. High points and low points shall be minimized along the pipe alignment.
- ii. Air relief valves shall be provided on ultimate and local high points throughout the force main alignments. All air relief valves shall be located in an access manhole or vault appropriately sized for the application and maintenance staff access. Air and vacuum relief valves shall be minimized along the pipe alignment and must be approved by City.

d. Fittings

- i. Piping shall be PVC or ductile iron and sized to match the force main size.
 - i-a. PVC force main material shall be in accordance with AWWA C900-16 with minimum wall thickness of at least DR-25. DR-18 or DR-14 shall be required if pressure or surface loading at any location in the system exceeds the DR-25 pressure rating.
 - i-b. All ductile iron piping shall be glass lined in accordance with ASTM B1000, use pipe suitable for glass lining with minimum Class 53 thickness.

15. Testing and Start-up

a. Lift Stations

- i. The Developer shall develop a plan to test and demonstrate successful and flawless performance of all equipment and components of the lift station in manual and automatic mode. The start-up and testing plan shall be submitted to the City for review prior to commencing the start-up. A factory representative for the pumps and controls and City I&C and Operations representatives shall be on site for the start-up operations.

b. Force Mains

- i. Force mains shall undergo hydrostatic pressure testing for at least two hours at two times the working pressure. Test results shall be documented and demonstrate holding pressure within the criteria and specifications described in the City's Design Criteria and Construction Specifications (see Section 01713 Water Distribution System Testing for requirements).

16. Operation and Maintenance Procedures and Warranties

a. Operations and Maintenance

- i. The Developer shall supply the Water and Sewer Department with two (2) complete sets of operation and maintenance instructions, shop drawings, and pump curves. An electronic set on a thumb drive shall also be submitted. Developer and/or manufacturer shall provide one half day training on operations of the lift station for City Staff.
- ii. Operation and maintenance instructions shall be specific to the equipment installed. All non-relevant reference material shall be removed or clearly crossed out using heavy red line.
- iii. All emergency power generation equipment shall have operation and maintenance instructions. Must provide training for operations and maintenance staff. Contractors to verify that generator alarms work in SCADA.

b. Warranties

- i. A two (2) year warranty shall be provided for the lift station system including performance, materials, and installation.
- ii. The date of substantial completion shall be specifically determined, in writing, for the lift station system.
- iii. Any warranties associated with the lift station shall be transferred to the City after final acceptance and construction is complete.

17. Standard Details

- a. Flow Schematic
- b. Below Grade Lift Station
- c. Above Grade Lift Station
- d. Bypass Pumping Detail

SECTION 5

NON-POTABLE IRRIGATION SYSTEM DESIGN CRITERIA

5.01 GENERAL

The City of Greeley (City) uses non-potable (untreated) water to irrigate both public and private property throughout the City. The City has a network of irrigation ditches for supplying source water for irrigation purposes. The typical irrigation system arrangement is a “hub-and-spoke” layout where irrigation water is diverted from an irrigation ditch to an irrigation water storage pond and then pumped to the distribution system to provide sufficient pressure and capacity to serve many customers. Another arrangement specifically for a small irrigation system is a direct connection between the ditch and pump station excluding the storage pond. The goal of the City is to expand the non-potable water system and reduce the use of potable water for irrigation purposes and improve irrigation practices, which is key to the City’s long-term water conservation plan.

The purpose of this section is to provide information for the design and configuration of a non-potable irrigation system. Non-potable irrigation system design shall align with the City of Greeley’s *Non-Potable Water Master Plan* (Master Plan), latest revision. The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City’s system. Refer to standard detail drawings for additional design information.

This section is not intended to be inclusive of all situations and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance.

The Design Engineer shall meet with Engineering Development Review (EDR) and Water and Sewer (W&S) Departments to discuss how new developments fit into the City’s overall Non-Potable Water Master Plan to provide non-potable irrigation service at acceptable pressures in both new and existing areas.

The Master Plan shows proposed service area boundaries and conversion areas. These service area boundaries are subject to change during the planning phase based on property boundaries, non-potable water supplies, planned conversion areas, existing system capacities, and other factors. Final service area boundaries shall be determined by the Water & Sewer Department.

The City has the right to oversize the irrigation system to serve customers outside the development’s improvements limits. The City will reimburse the developer for oversizing based on Section 2.12 of these Criteria.

The Design Engineer shall also meet with the ditch company from where the raw water is being diverted. The City will assist in coordinating the meeting and have a City representative present. The purpose of this meeting is to discuss the diversion requirements such as check structures,

head gates, and flow measurement, and determine if there is sufficient capacity within the ditch to serve the new Non-potable Irrigation System.

The non-potable irrigation storage pond and pump station facility shall be located on property deeded to the City. The raw water supply line and its appurtenances between the water source (i.e. ditch) and the storage pond shall be within a utility easement dedicated to the City.

The Design Engineer shall provide supporting calculations, design methodologies, and references documentation used to establish the design parameters. All information shall be included in the Non-Potable Irrigation System Design Report. Refer to Section 2.08 of these Criteria for Non-Potable Irrigation System Design Report requirements and formatting.

The Non-Potable Irrigation System Design Report shall be stamped and certified by a Professional Engineer registered in the state of Colorado. The design report shall verify that the proposed non-potable irrigation system can provide the required irrigation demands for the service area, at an acceptable pressure, and meet the overall non-potable irrigation system design requirements set forth in these Criteria.

The City of Greeley Water and Sewer Director reserves the right to make final determinations of the system design based on the best interest of the City's system.

5.02 DEFINITIONS

- A. Non-potable Irrigation System – The non-potable irrigation system consists of (1) ditch headgate and appurtenances to divert flows, (2) raw water supply line and appurtenances between the water source and storage pond, (3) storage pond, (4) pump station facility, and (5) distribution mains and appurtenances.
- B. Non-potable Irrigation Main - A pressurized pipeline that conveys non-potable water to individual non-potable irrigation services.
- C. Non-potable Irrigation Services – Non-potable irrigation services include all piping, fittings, and appurtenances used to convey non-potable water from the irrigation main to the consumer.
- D. Air Gap – A method of backflow prevention defined as the unobstructed, physical distance of two (2) feet minimum of free atmosphere between the discharge point of a potable water supply line and the highest level of the irrigation storage pond or the FEMA 100-year floodplain, whichever is greater.
- E. Reduced Pressure Zone (RPZ) Backflow Preventer – A device that can be connected to a potable water system to supply water to a non-potable water system and protect the potable

water system from backflow contamination. The device consists of two check valves with a pressure vacuum breaker in the middle. This device can be used in lieu of an Air Gap.

- F. Shoulder month/season – The periods in early spring and late fall where non-potable customers require some irrigation water, but the agricultural ditches are not operational, occasionally resulting in the non-potable water system being supplied by potable water.
- G. Shoulder tap – A connection from the potable water distribution system to the non-potable water system to provide water for irrigation purposes during the early spring and late fall shoulder months.
- H. Service Area – The general geographic area that is served by or expected to be served by an individual non-potable irrigation supply system.
- I. Conversion Area – A previously developed parcel that is currently irrigated by potable water but may consider switching to non-potable irrigation in the future; the amount of irrigated area for this type of customer is typically known.

5.03 DESIGN FLOW

- A. The non-potable irrigation system shall be designed to transport peak season irrigation demands in accordance with these Criteria.
- B. All irrigation demands used in the design of non-potable irrigation systems are subject to approval by the City.
- C. Pump Station Design Capacity
 - 1. The non-potable irrigation demand criteria presented below are the minimum criteria and the City reserves the right to modify the criteria, at any time, for the design of specific projects. The non-potable irrigation application rates includes provisions for evapotranspiration and operational efficiency losses in the non-potable irrigation system.
 - 2. The City's goal is to minimize the size of the pump station by having a balanced system. A balanced system is where half the irrigable areas within a service area are being irrigated on any given irrigation day. Refer to Section 6 *Landscape Irrigation Criteria* for additional information regarding irrigating operational requirements.
 - a. Weekly Irrigation Application Rates:
 - i. Bluegrass turf, arborvitae, willows = 1.9 inches/week
 - ii. Tall Fescue, columbine, potentilla purple coneflower = 1.6 inches/week
 - iii. Buffalograss turf, sedums, succulents, iris, penstemon = 0.9 inches/week
 - iv. Native grasses, yarrow, rabbitbrush = 0.2 inches/week

- b. Daily Watering Window = 8 hours
- c. Irrigation Days/Week = 6 days (Monday through Saturday)
 - i. Single family residential may irrigate up to three (3) days per week on their assigned days.
 - ii. All other areas including, but not limited to civic and open spaces, common areas for all customer classes, right-of-ways, municipal buildings, multi-family residential, and non-residential areas may irrigate 6 days per week (Monday through Saturday) with half of the area being irrigated on any given irrigation day.
- 3. Sizing the design capacity of a pump station shall be based on the following equation:

$$\sum Q_{i,ii,iii,iv} = \frac{a}{b} \times \frac{c}{d} \times \frac{e}{f \times g}$$

Where:

Q = Pump Station Design Capacity (gpm)

a = Irrigation Application Rate (inches/week)

b = Number of Irrigation Days per Week (days/week)

c = Total Irrigable Area (acres)

d = 12 inches/foot (conversion factor)

e = 325,829 gallons/acre-foot (conversion factor)

f = Daily Watering Window (hours/day)

g = 60 minutes/hour (conversion factor)

5.04 HYDRAULIC DESIGN

A. Raw Water Supply Pipe

1. The design flow shall be based on the time it takes to replace two (2) full days' worth of storage over a 24 hour period.
2. Pipe size shall be computed by Manning's Equation up to a maximum 80% full and friction coefficient of 0.015, but shall not be less than 12-inches in diameter.

B. Pump Station Intake Pipe

1. The design flow shall be based on the Pump Station Design Capacity.
2. Pipe diameter shall be based on a maximum velocity of 1.0 feet per second (fps) when the pipe is flowing full, but shall not be less than 24-inches in diameter.

3. The intake pipe shall be equipped with a passive intake screen. Refer to 5.21 of these Criteria for additional information.

C. Distribution System

1. Distribution System Pressure

- a. For new developments with no conversion areas within the non-potable pump station's service area, the non-potable irrigation pump station and distribution system within the service area shall be designed for a maximum pressure of 125 psi and a working pressure range of 70 - 100 psi at high points and the furthest service point of application.
- b. For new developments that include conversion areas within the service area, the Design Engineer shall consider potable water system pressures based on fire hydrant static pressures provided by the City when sizing the pump station and distribution system. Static pressures that exceed 90 psi shall be brought to the W&S Department's attention.

2. Friction Coefficient

- a. Non-potable irrigation lines shall be designed using a Hazen-Williams friction coefficient "C" equal to 120.

3. Velocity

- a. All pipes shall be sized for maximum water velocity of no greater than five (5) feet per second (fps) at peak flow.

4. The minimum size of non-potable irrigation mains shall be six-inches (6") in diameter.

5.05 DEPTH OF BURY

- A. The minimum depth of cover shall be four (4) feet and the maximum depth of cover shall be six (6) feet for non-potable irrigation mains.
- B. When design or constructability constraints are present, deeper or shallower main installation may be permitted only with acceptance from the City. Additional design and installation considerations may be required by the City depending on the situation.

5.06 CONNECTIONS TO THE EXISTING NON-POTABLE IRRIGATION SYSTEM

- A. Connections to the existing non-potable irrigation system shall be in accordance with the *Construction Specifications, Section 02510, Water Utility Distribution Piping*.

5.07 LOCATION AND LOOPING OF NON-POTABLE IRRIGATION MAINS

- A. All non-potable irrigation mains shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width. City approval is required for all other proposed non-potable irrigation main locations.
- B. The centerline of non-potable irrigation mains shall not be placed closer than three (3) feet

to the inner edge of concrete gutter without prior acceptance by the City.

- C. A non-potable irrigation main serving one (1) lot shall extend all the way across the frontage for that lot.
- D. Non-potable irrigation mains shall extend to the extremities of the property or the subdivision served. Extensions shall be in appropriate locations to provide adequate connections.
- E. The City shall determine on a case by case basis if non-potable irrigation system looping is required for a development.

5.08 NON-POTABLE IRRIGATION SYSTEM PHASED INSTALLATION AND STUBOUTS

- A. Non-potable irrigation system phased installation and stubouts shall be in accordance with Section 3.10 of these Criteria.
- B. Locate temporary blowoff assemblies at the end of each phase or stubout.

5.09 PIPE MATERIAL

- A. PVC: AWWA C900-16 DR 18 (235 PSI) polyvinyl chloride (PVC) pressure pipe, purple color for direct buried applications only. Refer to construction specification *Section 02513, for Polyvinyl Chloride Pressure Pipe* for additional information.
- B. DIP:
 - 1. ANSI/AWWA C151/A21.51 ductile iron pipe with mechanical joints for direct buried applications only. Refer to Section 3.11 C. of these Criteria for corrosion protection requirements.
 - 2. ANSI/AWWA C115/A21.88 flanged ductile iron pipe with flat faced flanges for exposed applications only.
 - 3. Refer to construction specification *Section 02512, for Ductile Iron Pipe* for pipe additional information.
- C. Steel: AWWA C200 steel pipe for both direct bury and exposed applications. Design Engineer shall determine required thickness for each application. The Design Engineer shall submit proposed interior and exterior coatings for City review and approval.

5.10 VALVES

- A. All valves shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width. City approval is required for all other proposed valve locations.
- B. Gate Valves
 - 1. Gate valves shall be installed in accordance with Section 3.12 of these Criteria and *W&S Standard Drawings*, latest revision.
 - 2. All non-potable water line valves located in paved areas shall have a concrete collar

around the valve box in accordance with *W&S Standard Drawings*, latest revision.

3. Refer to construction specification *Section 02515, Water Utility Distribution Valves* for gate valve requirements.

C. Air/Vacuum Valves

1. Air/Vacuum Valves shall be installed at all high points along the non-potable irrigation main and shall be properly sized by the Design Engineer in accordance with the manufacturer's recommendation. The City shall have final determination on valve size and placement. NOTE: It is the City's preference that the number of high points within the pipeline be minimized.
2. Refer to construction specification *Section 02515, Water Utility Distribution Valves* for Air/Vacuum valve requirements.
3. Reference *W&S Standard Drawings* for installation requirements.

D. Non-potable Blowoffs

1. Non-potable blowoffs shall be installed at the end of all non-potable irrigation mains. The City may also require that non-potable blowoffs be located at low points within the system.
2. Reference *W&S Standard Drawings* for installation requirements.

5.11 PIPE ALIGNMENT

- A. The curved pipe alignment design requirements for non-potable irrigation mains shall be in accordance with Section 3.13 of these Criteria.

5.12 THRUST BLOCKING AND PIPE RESTRAINT

- A. Thrust blocking and pipe restraint requirements for non-potable irrigation mains shall be in accordance with Section 3.14 of these Criteria.

5.13 NON-POTABLE IRRIGATION MAIN AND SERVICE ENCASEMENTS

- A. Refer to Section 3.15 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for typical non-potable irrigation main and service encasement requirements.

5.14 NON-POTABLE IRRIGATION MAIN BORINGS

- A. Refer to section 3.16 of these Criteria and construction specification Section 02445, Casing Pipe – Borings and Encasements for non-potable irrigation main boring requirements.

5.15 NON-POTABLE IRRIGATION SERVICES

A. General

1. Non-potable irrigation service lines shall not be installed in trenches with other

conduits/utilities.

2. There shall be no physical connections between the non-potable irrigation system and the potable water system unless an approved backflow device is used to prevent non-potable water from entering the potable water system (i.e. RPZ device).
3. Non-potable irrigation services not utilized shall be abandoned. Refer to appendix section A3 – *Policies Impacting Design and Construction* for abandonment procedures.

B. Irrigation Services

1. Non-potable irrigation services 3/4” to 2” in diameter shall be crosslinked PEXa in accordance with AWWA C904 with acceptable manufacturers is Municipex®, Uponor AquaPEX®, or approved equal.
2. The non-potable irrigation service for a given lot must be tapped on the non-potable irrigation main within the confines of the extended property lines unless excepted by the City for the irrigation of multiple outlots under single ownership. Refer to appendix section A2 – *Compound Tap Exemption Policy for Irrigation of Multiple Outlots*. Otherwise, irrigation systems from a single non-potable irrigation service shall only be allowed for use on that single property. Refer to *City of Greeley Charter and Code, Title 14: Public Services*, Section 14.04.200 for compound tap restrictions.
3. Non-potable irrigation services shall not be located under driveways, trees, or other permanent structure.
4. Non-potable irrigation services shall be located a minimum three (3) feet inside the property being served.
5. Non-potable irrigation service taps shall be separated by at least two (2) feet, measured along the non-potable irrigation main length, including when taps are on opposite sides of the non-potable irrigation main. Non-potable irrigation service taps shall also be a minimum two (2) feet from all joints, fittings, or valves.
6. The corporation stop, curbstop, meter, the service line between the corporation stop and the meter, and five (5) feet past the meter shall all have the same equivalent inside pipe diameter.
7. Non-potable irrigation shutoff valves (curb stops and gate valves) shall be placed within one (1) foot of the property line or easement boundary (inside or outside).
8. Non-potable irrigation meter vaults pits/vaults shall normally be located after the curbstop in a landscaped area or streetscape. Meter pits/vaults shall not be installed in any street, parking area, driveway, or sidewalk unless otherwise approved by the City. If a meter pit/vault is permitted by the Water & Sewer Department to be located in any traffic area, the pit/vault shall be designed to withstand HS-20 traffic loadings. Curbstops with tracer wire test stations shall be in a valve box.. See *W&S Standard Drawings* for additional service and meter installation requirements.
9. There shall be no major landscaping (i.e. boulders, and trees, or shrubs with mature growth greater than three (3) feet), and buildings, or other permanent structures within

ten (10) feet of the meter vault.

10. Pressure boosters are allowed if required. Booster pumps must be prefabricated units with variable speed controls. Provide submittal cut sheets for City approval prior to ordering booster pump.

5.16 NON-POTABLE IRRIGATION MAINS AND SERVICES IN RELATION TO OTHER UTILITIES

- A. Non-potable irrigation mains and services shall have a minimum eighteen-inch (18”) vertical separation and minimum five (5) feet horizontal separation or twice the depth of the invert of the pipe, whichever is greater from all utilities measured from outside diameter.
- B. Where non-potable irrigation lines cross above or below potable water lines with less than eighteen-inch (18”) clearance, pipe encasement shall be designed and constructed so as to protect the potable water line. Note: It is the City’s preference to have non-potable waterlines located below potable water lines.
- C. Non-potable irrigation main crossings under any open irrigation ditch shall have a minimum five (5) feet of cover and shall be encased.
- D. Dry utility crossings shall be encased in high density polyethylene (HDPE) pipe, Standard Dimension Ratio (SDR) 11 from edge to edge of the easement or right-of-way, or ten (10) feet on either side of the non-potable irrigation main, whichever is greater. Perpendicular utility crossings are permitted above and below the non-potable irrigation main. Parallel installation of other utilities in non-potable irrigation easements is not permitted.
- E. Bored utility crossings shall have a minimum twenty-four inches (24”) of vertical clearance from the outside diameter of the utility casing to the outside diameter of the non-potable irrigation line if the bored utility crosses above or below the non-potable irrigation line.
- F. If there are horizontal or vertical clearance conflicts between the non-potable irrigation line and a utility, the City may require that the non-potable irrigation main be lowered, raised, or realigned in order to maintain the required clearances.
- G. For a non-potable irrigation line crossing situation not specifically mentioned in this section, the crossing requirements provided in these Criteria shall be applied to that particular situation to the best extent possible.

5.17 UNDERGROUND MARKING AND IDENTIFICATION

- A. Underground un-detectable marking tape shall be installed 18-inches above non-potable irrigation mains.
- B. Reference construction specification Section 02315, Excavation and Fill for Marking Tape Requirements.

5.18 NON-POTABLE IRRIGATION WATER STORAGE FACILITIES (PONDS)

- A. General

1. All water to be stored in the non-potable irrigation pond and the pond location shall be approved by the Water and Sewer Department prior to proceeding with facility design.
2. Combining non-potable irrigation storage with storm water detention requires approval by both the Water and Sewer Department and Public Works Department Storm Water Division. A written explanation shall be submitted describing the circumstance as to why a combined pond is needed.
3. The Design Engineer shall determine the high and low operating levels, required design storage volume, and the invert elevation of the pump station intake pipe.
4. The Design Engineer shall design a gravity flow raw water supply pipe from the water source (i.e. ditch) to the irrigation storage pond.
5. There shall be no major landscaping (trees, shrubs) with mature height greater than three (3) feet planted within ten (10) feet of the liner anchor trench.

B. Storage Volume Design

1. Non-potable irrigation ponds shall be sized to accommodate a minimum four (4) days of supply based on the Pump Station Design Capacity. The four day supply volume shall not include the dead storage.
2. Dead storage shall be based on the water level that limits the wet well inflow below 75% of the Pump Station Design Capacity. For example, if the Pump Station Design Capacity is 1,000 gpm, the dead storage begins when the inflow is less than 750 gpm.
3. A minimum freeboard of 12-inches shall be provided for storage ponds not combined with storm water and 18-inches for combined storage ponds.
4. Minimum usable storage volume of an irrigation storage pond shall be based on the following equation:

$$V = \frac{Q \times a \times b \times c}{d}$$

Where:

V = Total Useable Storage Volume (acre-feet)

Q = Pump Station Design Capacity (gpm)

a = Daily Watering Window = 8 hours/day

b = 60 minutes/hour (Conversion Factor)

c = Days of Storage (days) = 4 minimum

d = 325,829 gallons/acre-foot (Conversion Factor)

5. The minimum depth of the pond shall be 8-feet from the full pond surface level to the bottom.

6. Pond side slopes shall include a 4:1 safety bench for 12-feet horizontally and 3:1 slope thereafter to achieve maximum depth of pond. If steeper side slopes are required to meet storage volume requirements due to site constraints, then fencing must be installed around the pond for safety purposes. Fencing materials must match architectural components of development or HOA fencing requirements.
7. The non-potable irrigation pond shall be designed with either an overflow spillway if topography allows or an overflow structure hydraulically connected to storm sewer.
 - a. Spillway or overflow structure shall be designed to convey a minimum of 150% of the pond fill rate based on 5.04 A. 1. of these Design Criteria.
 - b. The Design Engineer shall provide necessary design information and construction details on the Construction Drawing for the irrigation pond overflow/spillway.
8. If the non-potable irrigation pond is intended to also function as a stormwater detention facility, with approval from the City, the Design Engineer shall include the additional detention storage volume over and above that required for irrigation operations. Refer to the *SDDC*, for stormwater detention pond design requirements. In addition, the irrigation source water flow shall be measured and recorded. Refer to 5.22 of these Criteria for additional information.

C. Non-Potable Irrigation Pond Liner

1. All non-potable irrigation ponds shall be designed with an approved liner system. Field conditions, constructability, storage volume fluctuations, costs, warranty, and operation and maintenance shall be considered in the selection and design of the pond liner system.
2. Approved pond liner materials are listed in Section 02666 Pond Liners. A layer of 10 oz/sy. geotextile must be included on top and bottom of pond liner material for protection purposes.
3. The Design Engineer may specify a pond liner alternative depending on the project conditions. The alternative pond liner system is subject to approval by the City.
4. Lining installation in areas where groundwater pressure can occur shall be avoided. The bottom of the liner shall be above the water table to prevent the liner from floating.
5. Additional Pond Liner Information:
 - a. Site structures such as piping, concrete, and drains shall be completed prior to lining installation.
 - b. The design and construction requirements for special liner installations such as anchor trenches, pipe protrusions through the liner, liner vents, batten attachments to concrete structures, seaming methods/testing, subgrade preparation, and cover treatment over the liner shall be in accordance with the manufacturer's specifications and the design shall ensure that the liner warranty is not invalidated. Coordination with and approval by the liner manufacturer is required. The proposed special liner installation details are subject to approval by the City.

- c. Construction details for special liner installation items shall be provided by the Design Engineer to be included on the Construction Drawings.

D. Shoreline Protection Treatment

1. Non-potable irrigation ponds shall be designed with a perimeter shoreline protection treatment to protect against wave action erosion. Due to the numerous shoreline protection treatments available (i.e. riprap, boulders, perimeter concrete walls, geotextile products, riparian plantings) the Design Engineer shall propose a suitable shoreline protection treatment depending on the project conditions. The proposed shoreline protection treatment for erosion protection is subject to approval by the City.
2. The Design Engineer shall make special considerations regarding the selection, design, and installation of shoreline protection treatment to ensure that the liner warranty is not invalidated. Coordination with and approval by the liner manufacturer is required.
3. Areas subject to scouring water velocities, such as at the raw water supply pipe discharge conveyance into the pond or beneath the pond fill line/service, shall be adequately protected against erosion and wash out (i.e. concrete splash pad, grouted riprap, large boulders, or appropriately sized riprap).
4. Appropriate construction details for shoreline protection treatment and erosion protection shall be provided by the Design Engineer to be included on the Construction Drawings.

5.19 AERATION SYSTEMS

- A. The Criteria provided here offer generic guidelines for the design of non-potable storage pond aeration systems. Each aeration system is unique and requires special design, therefore, it is the Design Engineer's responsibility to design a fully operational system for the given conditions and provide necessary construction details and specifications to accompany the design.
- B. Refer to construction specification *Section 11230, Aeration System* for additional non-potable pond aeration system requirements.
- C. Aeration System Design
 1. Coordinate the aeration system design and construction with the non-potable irrigation pump station design. House and incorporate aeration system components within the irrigation pump station building.
 2. Aeration system design components shall include, but are not be limited to, air compressors, aftercoolers, condensate separators, electrical controls, valves, pipe manifolds, flow meters, gauges, aeration pods/diffusers, housing requirements, installation and operational instructions, and recommended maintenance.
 3. The Construction Drawings for the aeration system shall show a typical layout, elevation and plan views, and critical dimension for the aeration system design and construction. The aeration system manufacturer is responsible for the layout and design of the aeration system supplied and any special coordination issues that affect

the critical dimensions, layout or orientation of the aeration system.

4. Aeration system shall be sized to provide four (4) pond volume turnovers per day based on the following equation:

$$X = \frac{V \times b}{c}$$

Where:

X = Number of Fine Bubble Diffusers

V = Pond Volume (millions of gallons)

b = 4 (Turnovers/day)

c = Effective Turnover Rate = d x e / f

Where (numbers below are based a disk aeration module with model ADS LWA-3, other manufactures and models will require calculations changes based on specific equipment):

d = Diffuser Depth (feet)

e = Diffuser Turnover Rate = 3.5 mgd

f = Diffuser Effective Depth = 15 ft

5. Fine Bubble Diffusers shall be spaced to provide even coverage.

5.20 NON-POTABLE IRRIGATION PUMP STATION

A. General

1. All pump station site locations are subject to review and approval by the City.
2. Pump station sites shall be located outside of the FEMA 100-year floodplain.
3. The pump station finished floor elevation shall be a minimum of 2-feet above the storage pond's highest water surface elevation to prevent water overflowing the wet well into the pump station building.
4. The non-potable irrigation pump station location shall allow adequate access to the site from new or existing public right of way. The site shall be designed to provide adequate drainage away from the pump station building, pond, and conform to City standards for drainage and storm water management plans.
5. The building shall be sited to allow access by all-weather surface roads capable of accommodating maintenance trucks from public right of way to the pump station site. The access shall at a minimum support HS-20 loading with a minimum width of 15

feet. The access points and site shall be designed to allow WB-50 trucks to maneuver within the site and exit the site without backing into public right of way. The site layout shall allow for access to the wet well and vacuum/jetter truck to clean out accumulated material in the wet well. All paved surfaces shall be designed for the expected vehicle and equipment loads.

6. Developer shall have a geotechnical evaluation completed of the site to determine soil conditions and hydrology as well as recommendations for storage pond, pump station foundation and wet well construction. Refer to Section 2.09 of these Criteria for Geotechnical Soils Report for additional information.
7. The Criteria provided here offer guidelines for the design of non-potable irrigation pumping systems. Each pumping system is unique and requires special design, therefore, it is the Design Engineer's responsibility to design a fully operational system for the given conditions and provide necessary construction details and specifications to accompany the design.
8. Refer to construction specification *Section 15140, Irrigation Pump Station* for additional non-potable irrigation pump system requirements.

B. Pump System Design

1. The pump system shall be designed with a reinforced concrete one common wet well and multiple vertical turbine pumps to provide irrigation flows at varying demands and constant discharge pressure. Pump redundancy is not required.
2. Each pump shall have a dedicated VFD to control the pump.
3. The bottom of the wet well shall be a minimum 4-feet below the invert of the intake pipe.
4. The wet well shall be designed to prevent vortexes and cavitation which can adversely affect pump performance.
5. Pump efficiency shall be a minimum eighty percent (80%) at the specified operating point.
6. The pump system design shall include a skid assembly to support all pump components during shipping and to serve as the installed mounting base. The base shall be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of all components (i.e. pumps, motors, filters, piping, valves, etc.).
7. The pump system shall include a pressure maintenance pump for sustaining the pressure in the non-potable irrigation system during non-irrigated times and shall operate no more than every 15-minutes to maximize pump life. If the pressure maintenance pump operates more frequently then allow larger pressure differential (in pump controls) to reduce operating cycles to recover lost water pressure.
8. Pump system design components shall include, but not be limited to, motors, filters, valves, gauges, mounting and support structures, power and electrical equipment,

control systems, operator interface devices, alarms, data acquisition and telemetry, and monitoring devices.

9. Pump discharge piping and filter waste pipe shall be supported 6 to 18-inches off the building floor and exit through the wall before pipe burial.
10. Filter to waste pipe shall discharge into the storage pond a minimum distance of 100-feet from the Pump Station Intake Pipe inlet and liner protection is required.
11. The Construction Drawings for the irrigation pumping system shall show a typical layout, elevation and plan views, and critical dimensions or clearances for the pump system, building, wet well, electrical, etc.
12. The pump system manufacturer is responsible for the layout and design of the pump system supplied and any special coordination issues that affect the critical dimensions, layout or orientation of the pump system.
13. The pump system design is subject to approval by the City.

5.21 PUMP STATION INTAKE PIPE AND INTAKE SCREEN

- A. Intake pipe shall be AWWA C900-16 DR32.5 (125 PSI) polyvinyl chloride (PVC) pressure pipe, color purple or green or ASTM F679 PVC gravity sewer pipe.
- B. The exposed section of the intake pipe shall have intermediate concrete pipe cradles with a stainless steel strap to secure the pipe to the cradle. The maximum length of unsupported pipe shall be 9-feet.
- C. Intake Screen
 1. Intake pipe shall be equipped with a square shaped passive intake screen constructed of 16 gauge, flattened 304 stainless steel, with 3/8 x 7/8 inch openings. The frame shall be constructed of stainless steel.
 2. The intake screen shall be sized such that the velocity through the screen does not exceed 0.25 feet per second (ft/s).
 3. The bottom of the screen shall be a minimum 16-inches above the bottom of the pond. The intake screen shall be supported by and mounted on top of a reinforced concrete block.
- D. Intake Pipe Isolation
 1. The wet well shall be equipped with a slide gate or the intake pipe equipped with a buried gate valve to shut off flow between the storage pond and wet well. Refer to Construction Specification *Section 15140 for Slide Gates and Gate Valves*.

5.22 RAW WATER SUPPLY SYSTEM

- A. Raw water supply pipes shall have a minimum eighteen-inch (18") vertical separation and minimum five (5) feet horizontal separation or twice the depth of the invert of the pipe, whichever is greater from all utilities measured from outside diameter.

1. Pipe Material: PVC, DIP, or RCP. Refer to City of Greeley *Stormwater Design Standards*, Section 6, subsection 9.3.7 for additional culvert information.
- B. The raw water supply line shall be located on the opposite side of the pond as the non-potable pump station intake structure to promote water turnover within the pond and minimize stagnation that leads to water quality degradation.
- C. Flow shall be controlled by a hand wheel operated slide gate (headgate) mounted to a reinforced concrete headwall. The headwall shall be equipped with a steel trash rack anchored to the concrete headwall with stainless steel hardware.
 1. Head Gate Manufactures/Models: Refer to Construction Specification *Section 11285, Slide Gates*.
 2. Refer to City of Greeley *Stormwater Design Standards*, Section 9, subsection 9.3.7 for additional trash rack requirements.
 3. The headgate configuration shall be approved by both the City and the associated ditch company.
- D. Flow Measurement
 1. A parshall flume shall be used to measure flow in close proximity to the headgate. Construction of the parshall flume shall be dictated by the ditch company.
 2. The flow approaching the parshall flume shall be subcritical and operate under free-flow conditions.
 - a. The parshall flume shall be equipped with an 8-inch diameter stilling well to measure the flow depth using either a stage recorder or a non-contact level radar measurement device with the signal transmitted to the City's SCADA system via the Pump Station's Remote Telemetry Unit (RTU). Power shall be brought from the non-potable pump station to power either unit. Refer to Section 5.2 of these Design Criteria for additional SCADA information.
 - b. Where the Colorado Department of Natural Resources (DNR) requires flow data, a stage discharge recorder shall be mounted on top of the stilling well to compute and log discharge flow and totals.
 - i. Manufacturer and Model: Sutron Corporation, model SDR-0001-4 or approved equal.
 - c. For locations where the DNR does not require flow data, a radar level measuring unit may be used in place of the stag recorder.
 - i. Manufacturer and Model: Endress and Hauser - Micropilot FMR10 or approved equal.
- E. Check Structures

1. A check structure may be required where there is not sufficient depth within the irrigation ditch to provide sufficient head to achieve the raw water supply design flow. If the Design Engineer determines that a check structure is needed, a HEC-RAS model shall be created to compute water surface profiles. The check structure shall not prevent deliveries of water to downstream users.
2. The check structure shall be constructed of reinforced concrete with removable boards.

5.23 PUMP BUILDING

- A. The pump building shall be a precast concrete building sufficiently sized to house all the equipment including but not limited to pump skid, electric and controls cabinets, telemetry cabinet, and aeration system.
- B. There shall be a minimum 4-feet spacing between the building walls and pump skid.
- C. There shall be sufficient space between the pump skid filter(s) and building walls to allow removal of the filter screen for servicing and replacement. Space must be also provided to meet all electrical code requirements.
- D. The minimum wall height shall be 8-feet 6-inches with equipment doors sufficiently sized to be remove and replace electrical and controls panels.
- E. The pump building shall be equipped with two trench type floor drains that run either the width or length of the building and connect directly and perpendicular to the wet well.
- F. Refer to construction specification *Section 15140, Irrigation Pumps for additional requirements*.

5.24 SHOULDER MONTH WATER SUPPLY

- A. All non-potable irrigation systems require a backup potable water tap (shoulder tap) for providing irrigation water when non-potable water is unavailable (“shoulder months”). There is no Plant Investment Fee (PIF) required for a shoulder tap.
- B. Shoulder month water supplies must be approved by the City.
- C. Shoulder month water shall be discharged into the non-potable irrigation system’s water storage facility (pond). A candy cane configured discharge pipe with a minimum two (2) foot air gap shall be provided between the shoulder tap discharge and the maximum operating or overflow elevation of the pond water surface, whichever is greater.
- D. The shoulder tap shall be size based on the maximum water demands during shoulder months or at least four (4) inches in diameter and metered. Only City personnel may operate the shoulder tap.

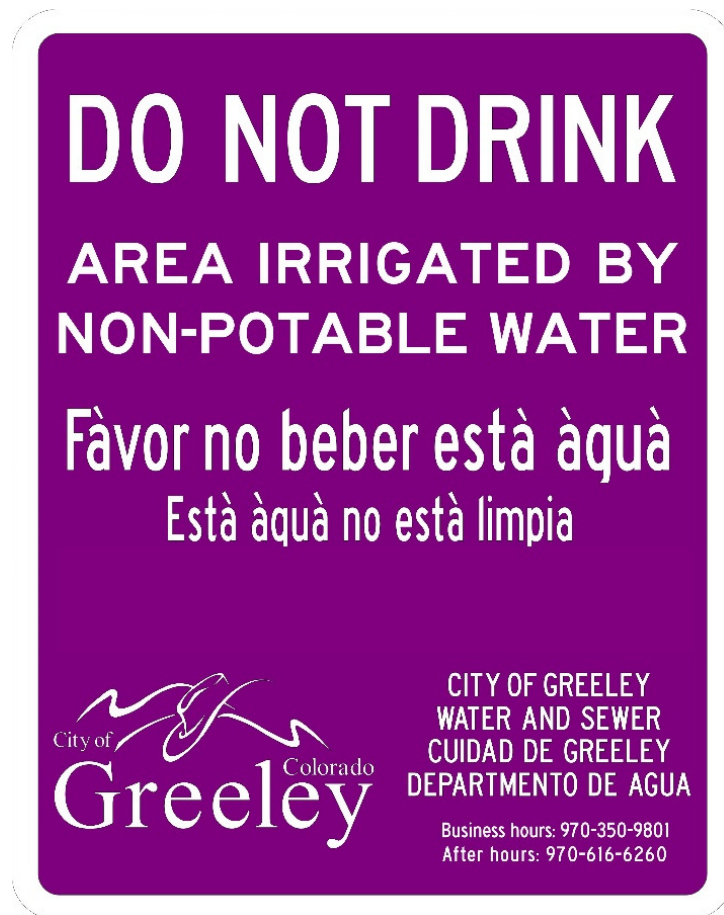
5.25 SCADA

- A. A Remote Telemetry Unit (RTU) shall be provided to communicate with the City's SCADA system. The RTU shall communicate with the City's SCADA via City fiber optic if within 1,500-feet of the pump station. If fiber optic is not available, the RTU shall communicate via XetaWave radios.
- B. The RTU shall communicate with the pump system and instrumentation by way of Modbus serial or Ethernet, or Allen Bradley Ethernet or serial. If there is no ability to communicate with the Control Panel, analog and digital inputs may be utilized.
- C. Refer to construction specification *Section 15140, Irrigation Pumps for additional requirements.*

5.26 SIGNAGE

- A. Signage must be posted at sites where non-potable water is utilized for irrigation. Signs shall be posted near sidewalks and paths that provide access into the non-potable irrigated area(s). Where neighborhoods use non-potable water for irrigating individual homes, all street access points into the neighborhood shall also be posted. Coordinate signage locations with the City of Greeley during design process.
- B. An example of an approved sign is provided below (sign design/layout provided by Area Wide Protective).

- C. Signs shall be 12-inches wide by 18-inches tall. Holes for fastening the sign to post shall not damage nor cover any text.



5.27 WATER DEDICATION REQUIREMENTS FOR NON-POTABLE IRRIGATION

- A. Contact the Water and Sewer Department and refer to *City of Greeley Charter and Code, Title 20: Public Works and Utilities* regarding water dedication requirements.

5.28 WATER SUPPLY WELLS

- A. Under certain circumstances the City may, at its election and in its sole discretion, accept use of a well(s) to meet non-potable needs. In that case, ownership of the well(s) would need to be transferred to the City and the well(s) permit changed to non-exempt irrigation well permit. Depending on the development layout and capacity of the well(s), the well could be used directly for irrigation without filling a storage pond first. The Design Engineer would need to evaluate each system individually and obtain City approval. Sufficient information regarding the well(s) such as condition and sustainable yield will be required to assist in the evaluation.

SECTION 6

LANDSCAPE AND IRRIGATION DESIGN CRITERIA

6.01 GENERAL

The City of Greeley Landscape and Irrigation Criteria and Standards, hereafter referred to as the “Criteria”, is intended to provide information for the design, review, installation and maintenance of landscape and irrigation systems within the City of Greeley to promote the efficient use of water and the reduction of water waste through best management practices. Both landscape and irrigation systems should be designed for non-potable water as outlined in Section 5 of these criteria.

It is the purpose and intent of this Criteria to support the City of Greeley Comprehensive Plan, the Greeley Water Master Plan, and the Landscape Policy Plan for Water Efficiency to:

Promote water conservation

- Reduce or eliminate outdoor water waste
- Reduce peak summer water usage
- Reduce water demand of new construction and development
- Reduce overall per capita demand
- Guide smart development by incorporating land use and water planning principals
- Guide smart development through practices, problem solving, technology and innovation
- Utilize onsite stormwater runoff to supplement landscape irrigation through rainwater harvesting

Support attractive and sustainable landscapes

- Use of low-water plants like native landscapes and xeriscape
- Stormwater and rain garden utilization, such as bio-retention practices, stormwater wetlands, dry wells
- Support an urban canopy by strategically placed trees to reduce heat islands and energy use

These Criteria shall be regarded as the minimum requirements and performance standards for the design, installation and maintenance of landscape and irrigation systems.

Whenever a provision of these Criteria and any other provision of the City of Greeley Municipal Code or any provisions in any law, ordinance, resolution, rules or regulations of any kind, contains any requirements covering any of the same subject matter, the requirements that are more restrictive or impose higher standards shall govern. If there is a discrepancy in the interpretation of these Criteria, the Water and Sewer Director or designee thereof, shall make the final determination of the intent of these Criteria.

Supplemental information including but not limited to forms, checklists, notes, etc. are available on the City of Greeley’s website and shall be referenced or submitted in accordance with the requirements set forth in these Criteria. It is the responsibility of the owner, designer, installer or maintenance contractor to obtain the latest version of any submitted document, as the City will periodically update these items.

- Landscape and Irrigation Criteria Checklists

SECTION 6

LANDSCAPE AND IRRIGATION CRITERIA

- Irrigation Performance Audit Guidelines
- Irrigation Performance Audit Form
- Water Budget Chart and Example
- Pressure calculations worksheet
- WaterWise Best Management Practices
- Example of median and right-of-way designs
- Preferred plant list database

6.02 DEFINITIONS

- A. **APPLICATION RATE:** The depth of water applied to a given area and during a specific time, usually expressed in inches per hour or inches per week.
- B. **CHECK VALVE OR ANTI-DRAIN VALVE:** A valve located under or incorporated within a sprinkler head or other location within the system to prevent the system from draining on the lowest head(s) when the system is off.
- C. **COMPOST:** Fully finished, stabilized, and mature product, derived from decomposed plant and organic material that can be added to the soil as an amendment. Compost provides increased nutrient uptake, increased water holding capacity, and improves the soil structure of the site. This is not the same as topsoil.
- D. **CYCLE AND SOAK:** Method of irrigation where water is applied in multiple, short cycles. This allows the water to be applied more slowly, allowed to soak into the soil and prevent run-off, promoting deeper roots and healthier plants.
- E. **DISTRIBUTION UNIFORMITY:** The measure of the uniformity of the irrigation water over a defined area.
- F. **DROUGHT:** Periods or seasons with below average precipitation.
- G. **EMITTERS:** A pressure compensating emitter component of an irrigation system that disperses water to the landscape (i.e., sprinklers, bubblers, micro-sprays, etc.)
- H. **ESTABLISHED LANDSCAPE:** The point at which plants in the landscape have developed roots into the soil beyond the root ball, which promotes long-term health and growth.
- I. **ESTABLISHMENT PERIOD:** The first year after installing the plant in the landscape or the first two years if irrigation will be terminated after establishment. Typically, most plants are established after one or two years of growth. Native habitat mitigation areas and trees may need three (3) to five (5) years for establishment.
- J. **HARDSCAPES:** A non-living landscape feature that is made of any durable material (pervious and non-pervious) such as building, pavement, walkways and parking areas-including those of crushed stone, patios, and decks.
- K. **HYDROZONE:** An area within a landscape where the plant materials require a similar amount of water. For this document, hydrozones are divided into four (4) categories:

- *Very-Low Hydrozone*: Plant materials that require less than one gallon per square foot of area per growing season of supplemental water once established. The plant materials within this zone are typically drought-tolerant natives. This hydrozone is designated by the letter “V” on landscape plans.
 - *Low Hydrozone*: Plant materials that require between one (1) and nine (9) gallons per square foot of area per growing season of supplemental water. This hydrozone shall be designated by the letter “L”.
 - *Moderate Hydrozone*: Plant materials that require between ten (10) and 14 gallons per square foot of area per growing season of supplemental water. This hydrozone shall be designated by the letter “M”.
 - *High Hydrozone*: Plant materials that require more than 14 gallons per square foot of area per growing season of supplemental water. The plant material within this zone is intended for high-pedestrian traffic areas such as sport fields or community gathering spaces. This hydrozone shall be designated by the letter “H”.
- L. IRRIGATION EFFICIENCY: The measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. Greater irrigation efficiency can be expected from well designed and maintained systems.
- M. LOW FLOW IRRIGATION OR DRIP IRRIGATION: The application of irrigation water at low pressure through a system of tubing or lateral lines and emitters such as point source, pressure compensating compents, dripper lines, micro-sprays and bubblers. Low flow irrigation systems apply small volumes of water, measured in gallons per hour, slowly at or near the root zone of plants.
- N. MAINTENANCE OR MAINTENANCE OF LANDSCAPING: Shall mean but not be limited to regular watering, mowing, pruning, fertilizing, clearing of debris and weeds, the removal and replacement of dead plants and the repair and replacement of an irrigation system. Any activity undertaken to prevent the deterioration, impairment, or need for repair of an area, structure, rights-of-way, or land use.
- O. MASTER SHUT-OFF VALVE: An automatic valve installed at the irrigation supply point which controls water flow into the irrigation system. When this valve is closed water will not be supplied to the irrigation system.
- P. MONOCULTURE: Large planting of the same species or even cultivar.
- Q. MULCH: Organic material such as leaves, bark, straw, wood chips or inorganic mineral materials such as rocks, gravel, decomposed granite or pebbles smaller than a half-inch in diameter left loose and applied to the soil surface for the beneficial purposes of reducing evaporation, suppressing weeds, moderating soil temperature, and preventing soil erosion.
- R. NON-ESSENTIAL AREAS: A high hydrozone with traditional turf that receives little, if any, use (i.e., the only person who walk on those areas is the person maintaining the turf).

- S. PREFERRED TURF: Very-low to low hydrozones grasses such as Buffalo Grass (*Buchloe dactyloides*), Blue Grama (*Bouteloua gracilis*), or other native species.
- T. REFERENCE EVAPOTRANSPIRATION or ET: A standard measurements of environmental parameters which affect the water use of plants. ET is typically expressed as the depth of water in inches or the volume of water in gallons used by an irrigated landscape area over a period of time.
- U. RIGHT-OF-WAY LANDSCAPING Shall mean landscaping located within the public or private right-of-way adjacent to a privately owned lot, outlot, or tract, including parkways.
- V. SEASONAL WATERING SCHEDULE: The programmed schedule set in the Smart Irrigation Controller. The schedule is based on the summation of the water that has been lost to evaporation and that has been used by the plant materials. The amount of water required to meet the needs of the plant materials change with the weather (seasons).
- W. SMART IRRIGATION CONTROLLER: A contractor-grade automatic timing device with nonvolatile memory that automatically adjusts the programmed run time or watering frequency based on changes in weather or soil moisture. Smart controllers may have local weather-based (ET) sensors or soil moisture-based sensors directly, or the smart controllers may be linked to a weather station via internet connection or cellular data card. Acceptable controllers must be selected from the Environmental Protection Agency's WaterSense labeled irrigation controller list. Retail grade controllers are not acceptable.
- X. SOIL AMENDMENT: An organic and inorganic material that is added to native soil to improve texture, moisture holding capacity, nutrient capacity, and water and air infiltration.
- Y. SUSTAINABLE LANDSCAPES: Landscapes that feature climate-appropriate landscape design and efficient technologies and are maintained through efficient irrigation practices to support community water objectives.
- Z. TRADITIONAL TURF: High hydrozones grasses defined as Bluegrass (*Poa pratensis*), genus Poa and turf type tall fescue (*Festuca arundinacea*) and cultivars thereof having dense tufts blades and creeping rhizomes.
- AA. WATER BUDGET: The water that is applied annually from an irrigation system to an established landscape area. It is based upon the area's reference evapotranspiration and is adjusted for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape.
- BB. XERIC LANDSCAPING OR XERISCAPE OR WATERWISE: Shall mean the use hydrozones that are very-low to low-water use in place of plants that typically require more water to survive and include, but are not limited to, plants having a low or very low water requirement.
- CC. ZONE: Typically, an area served by a single irrigation control valve, sometimes referred to as a "station." Zones are comprised of plant materials and soil types with similar water requirements.

6.03 APPLICABILITY

- A. These Criteria shall apply to all landscape and irrigation system designs, installation, and maintenance performed as a requirement of Chapter 8 – Landscape Standards of the Greeley Development Code and any other code, policy or criteria adopted by the City of Greeley. Areas that fall under these Criteria include but are not limited to:
- Civic and Open spaces
 - Common areas for all customer classes (outlots, pocket parks, usable detention, private/on-lot required/usable areas)
 - Right-of-ways
 - Areas not responsible of a single-family and up to four (4) units per lot
 - Municipal buildings
 - Multi-family residential
 - Non-residential (institutional, commercial, and industrial)
- B. Applicability for these Criteria shall follow major development as defined in Chapter 8, Section 24-801(b) – Landscape Standards of the Greeley Development Code.
- C. These Criteria shall govern over privately enforced guidelines or requirements related to landscaping and irrigation (i.e., business association, homeowners association design guidelines, regulations and requirements, etc.).
- D. Exemptions or where these criteria do not apply to:
- Single-family and up to four (4) units per lot
 - Row houses/townhomes individual parcels
 - Ecological restoration projects not requiring a permanent irrigation system
 - Exemptions listed in Chapter 8, Section 24-801(b)(3)- Landscape Standards

6.04 ENFORCEMENT

- A. The City of Greeley shall be provided the opportunity to review all landscape and irrigation plans, site and soil amendments, design, and installation for compliance with these Criteria. The Criteria are enforced by the City or authorized representative.
- B. All landscape improvements, indigenous plant material, and irrigation system components shall meet performance standards and supporting criteria. The City shall review all submittals for general compliance with these Criteria. An approval by the City does not relieve the owner, designer, installer or maintenance contractor from the responsibility of ensuring the design, plans, specifications, construction, maintenance, and record drawings are in compliance with these Criteria.
- C. In the event of Level 3 or 4 drought declared by the Water and Sewer Board, extreme drought water use planting and temporary irrigation may occur at the discretion of the Water and Sewer Director or designee thereof. For drought declarations visit City of Greeley’s website.

6.05 HANDLING OF TOPSOIL

- A. Stripping and stockpiling of native topsoil onsite shall be required during construction. This topsoil shall be incorporated as the final layer of soil for landscaping unless soil contamination has been determined. Stockpiling shall be handled by the Stormwater Management Plan and applicable Best Management Practices- see Stormwater Section 12- Construction Water Quality, as amended. Soil contamination determinations shall be at the discretion of the Public Works Director or his or her designee.
- B. The onsite replacement of topsoil and the addition of soil amendments are critical to successful establishment and ongoing health of plant material and efficient use of water through the life of the project.

6.06 SOIL AMENDMENTS

- A. Soil amendments (organic or inorganic) shall adhere to the Greeley Municipal Code, Section 24-804(e)(3) – Landscape Standards Installation and Maintenance for all properties.
- B. A minimum of four (4) cubic yards of compost per 1,000 square feet of area shall be used for non-native cool season turf.
- C. Per Greeley Municipal Code Chapter 8, Section 24-801(b) and 24-804(e)(3) – Landscape Standards, soil amendment verification documentation and receipts shall be submitted to the Water and Sewer Department, Water Conservation Program prior to installation of plant material, and shall include review of adherence to all criteria and performance standards. Written documentation reflecting approved volume, method of tilling and type of soil amendment is required.

6.07 MULCH

- A. Mulch (organic or inorganic) shall be used in areas used to cover bare ground, reduce evaporation, suppress weeds, moderate soil temperatures, and prevent soil erosion to promote landscape establishment within landscape beds. Seeding for large areas for grasses and naturalized landscape areas do not require mulch.
 - 1. Organic Mulch
 - a. Organic mulch material includes bark, and wood chips. No construction debris such as pallets shall be used.
 - b. Shall be applied at one and a quarter (1.25) cubic yard per one hundred (100) square feet at a depth no less than four (4) inches, and as appropriate to each hyrozone.
 - c. Shall be applied to soil surface, not against the plant stem, or high against the base of tree trunks to minimize disease.

- d. Tree rings of mulch shall be provided for all trees within turf areas subject to mowing operations. Tree rings for evergreen trees shall extend to the dripline of the tree to avoid limbing up of evergreen trees.
- 2. Inorganic Mulch
 - a. Inorganic mulch includes rock, gravel and pebbles (pea gravel) smaller than one and one half-inch (1.5) in diameter for water conservation and weed suppression. Any materials greater than a half-inch is not considered mulch.
 - b. Rock mulch shall have a minimum depth of three (3) inches.

6.08 WEED BARRIER

- A. Black plastic (polyethylene) is not allowed. Woven weed barrier fabrics (polypropylene), recycled rubber, and plastic weed barriers are not allowed with any plant material unless they are used for playgrounds, large-scale vegetable/edible plant production, or areas that are designated as rock greater than one and one half (1.5) inch in diameter (dry creek beds without vegetation).
- B. Ecologically sound biodegradable weed barrier can be used.

6.09 SUSTAINABLE LANDSCAPE DESIGN

- A. Hydrozones
 - 1. For the purposes of this document, hydrozones are broken into the following four categories:

Table 6-1: Hydrozone Category

Hydrozone Category	Water Needs	Landscape Examples
High	>14 gallons/S.F./season	Bluegrass turf, or other non-native cool season turf, arborvitae, willows
Moderate	10-14 gallons/S.F./season	Columbine, potentilla purple coneflower
Low	1-9 gallons/S.F./season	Buffalo grass turf, sedums, succulents, iris, penstemon
Very-Low	<1 gallons/S.F./season once established	Native grasses, yarrow, rabbitbrush

- B. Landscape water budget and plant material
 - 1. Greeley Municipal Code, Chapter 8 – Landscape Standards shall be adhered to.

2. An annual water budget chart shall be submitted for the landscape and irrigation plans. A water budget chart will show the total annual water used, which shall not exceed an average of 15 gallons/square foot for the landscape for all hydrozones per tap.
3. Plants are to be hydrozoned with plants of similar hydrozone (i.e., low with low). Plants of very low hydrozones are not to be planted in moderate to high hydrozones.
4. High hydrozones shall be limited to appropriate high-use areas with high visibility and functional needs. No more than 25% of the design irrigated area shall be high hydrozones. Where commercial and industrial uses include residential or recreational components, such as, but not limited to, assisted living, schools and daycares, picnic grounds, pocket park, outlots, the Water and Sewer Director or his or her designee may approve a greater percentage of high hydrozones. The applicant must demonstrate that the additional high hydrozones (traditional turf grass) areas are being used in high-traffic areas, such as, but not limited to, athletic fields, children's play areas, parks, and courtyards.
5. Preferred turf grass species are not limited in the design.
6. Specifications are found under Stormwater Design Standards, Section 14- Vegetation and Irrigation as amended shall be followed for stormwater detention and retention ponds.
7. Plant material shall be selected from a list of native and other plants determined to be appropriate for and well adapted to the soil and local environmental conditions and solar exposure requirements. The material plant lists can be found under the Water and Sewer Department, Water Conservation's Plant Database and City of Greeley's Forestry Department Front Range Tree Recommendation List. Upon request to the Water and Sewer Director or their designee, additional plants may be added to the list that are appropriate for these criteria.
8. Plant materials should provide an enriched quality of life by providing multi-season interest, color, texture, and diversity in plant material using the City of Greeley's WaterWise Best Management Practices found under Water and Sewer Department, Water Conservation website www.greeleygov.com/wc.
9. Plant material that is banned for use by the City of Greeley, Weld County and/or the State of Colorado shall not be used. This applies to all builders, installers, and owners. See the Colorado Department of Agriculture website for detailed list of restrictions.
10. The following landscape practices are highly recommended:
 - a. Methods outlined in the City of Greeley's WaterWise Landscaping Best Practices created by the Water Conservation program.
 - b. Protection and preservation of native species and natural vegetation.
 - c. Plant selection based on water needs, disease and pest resistance.

- d. Implementing stormwater best management practices into the landscape and grading areas to minimize runoff and to increase on-site retention and infiltration.
- e. Rain gardens, water quality ponds, bioswales and other landscape feature and practices that increase rainwater capture and create opportunities for infiltration while adhering to Colorado Statute 37-92-602(8) the water right of less than 72 hours of water retention and Storm Drainage Design Criteria and Construction Specification manual.

6.10 LANDSCAPE PLANS

Landscape Plan requirements shall be used to aid the applicant, designer, installer and maintenance contractor in the analysis, design, installation, and maintenance of landscapes. These requirements presented herein are the minimum necessary for landscape plan submittals and shall be considered in conjunction with the requirements set forth by the City's Community Development Department and Greeley Municipal Code, Chapter 8 – Landscape Standards.

A general landscape plan shall be included with the Site Development Plan submittal and a more detailed landscape and irrigation plan shall be submitted with the Construction Document submittal. All required forms, checklists and plant list can be found online at the City's website (www.greeleygov.com/wc)

All landscape plans shall adhere to the Water and Sewer Department's Design Criteria and Construction Specification-Potable Water Distribution, Sanitary Sewer Collection, and Non-Potable Irrigation System.

A. The proposed landscape plans shall include:

1. All existing features that may influence landscape design such as prevailing winds, exposures, topography, hardscapes, and existing features like utilities, fences, structures etc. The design shall adhere to local zoning and codes related to utility easements, sight distance requirements, and buffer zones.
2. Design incorporating water efficient techniques described as follows:
 - a. Group landscape material accordingly based upon hydrozones.
 - b. Selected plants shall be well-adapted to the Greeley climate and site conditions. Plants shall be grouped according to water and light requirements.
 - c. Irrigation equipment shall be appropriate to the hydrozone. Water should be applied deeply and infrequently to develop greater drought tolerance.
3. The identification of the landscape function and activities. This includes the overall theme of the site and neighborhood, onsite traffic patterns, and activity and service area needs.

4. Biodiversity in plant material such as trees and shrubs. Monoculture landscapes are not allowed to avoid drastic negative environmental and economic impacts from tree and shrub pests and diseases.
5. A water budget chart that shows the total annual water use, which shall not exceed an average of fifteen (15) gallons/square foot/year for each water tap and percentage of each landscape hydrozone type.
6. Accurate and clear identification of all applicable hydrozones as categorized in Section 6.09 A. and marked as defined in Section 6.02 K.
7. Final landscape design plans shall be stamped by a Colorado registered landscape architect.

6.11 IRRIGATION SYSTEM REQUIREMENTS

Per section Chapter 8, Section 24-804(h)-of the Greeley Municipal Code, an irrigation system design shall be submitted in conjunction with a landscape plan. The irrigation system design shall incorporate the required items set forth below:

A. Irrigation Methods and Layout

1. Provisions shall be made for permanent, automatic irrigation of all plant material, with the following exceptions:
 - a. Very-low hydrozone plantings that do not require supplemental irrigation beyond establishment.
 - b. Trees and other plants placed within the landscape area along residential local street parkways for single-family detached dwellings.
2. The irrigation method shall be selected to correlate the hydrozones shown on the landscape plan and irrigation water type (non-potable versus potable). The following criteria shall be followed during the design of the irrigation system:
 - a. Drip irrigation or bubblers shall be used for trees and shrubs greater than three (3) feet apart.
 - b. Rotors and pop-up heads with rotary nozzles shall be used for turf grass. Spray heads are not allowed unless pressure-compensating and retrofitted with rotary nozzles.
 - c. Only drip irrigation or strip pattern rotary nozzles shall be used to irrigate strips eleven (11) feet wide or less. Spray and rotor irrigation is strictly prohibited in these areas.
 - d. Inline emitter driplines are encouraged for higher density of planting.

- e. Each hydrozone shall be irrigated based on a landscape with similar site and soil conditions and plant material with similar water needs. To the extent reasonably feasible, areas with significantly different solar exposures shall be zoned separately.
- f. Traditional turf and non-turf areas shall be irrigated on separate hydrozones.
- g. On steep grades, an irrigation method with a lower application rate shall be used in order to minimize runoff and, to the extent feasible, these areas shall be zoned separately and zoned in lines parallel to the slope rather than in blocks. On steep grades, traditional and preferred turf shall not be allowed on slopes greater than 25 percent where the toe is adjacent or within ten (10) feet to an impermeable hardscape.
- h. All zones are designed with matching heads with matched precipitation rates and full coverage. Drip, micro-sprays, retrofitted spray heads with rotary nozzles, and rotors shall not be combined on the same zone.
- i. Parking lot medians and islands that are surrounded by pavement shall be located in separate zones from other landscape areas.

B. Equipment

- 1. All equipment used in non-potable irrigation systems including but not limited to valves, valve box lids, sprinkler head tops, valve ID tags, and fittings must be clearly identified most commonly indicated by the manufacturer's addition of the color purple to the components.
- 2. Valves
 - a. A backflow prevention assembly shall be installed in accordance per Section 20-191 of the Greeley Municipal Code-Cross-connection control. All backflow assemblies shall be equipped with adequately sized winterization ports downstream of the backflow assembly and must be the same material type
 - b. To reduce water leaks from the irrigation system, a master shut-off valve shall be installed downstream of the backflow device to shut off water to the system automatically when not operating.
 - c. Flow sensors integrated with the Smart Irrigation Controller are required for single or combined point of connection flows of 15 gallons per minute (GPM) or greater and one (1) inch or greater water taps.
 - d. All valves shall have a manual ball valve installed prior to the lateral valve.

- e. One two (2) inch valve ID tag shall be attached to each control valve one-and-one-half (1.5) inches or greater water tap. Each tag must be labeled with controller and station number.
 - f. Valve box lids shall be branded with minimum two (2) inches characters stating the controller and the zone (station) number for all irrigation systems served by a one-and-one-half (1.5) inches or greater water tap.
 - g. For branching or T's of the main irrigation line that are served by a one-and-one-half (1.5) inches or greater water tap isolation valves upstream of the branching or T's shall be required.
 - h. For irrigation mainline distances over 500 feet, upstream isolation valves are required.
3. Submeters for irrigation systems are encouraged to enable the owner and landscape maintenance contractor to monitor water use. The installation and maintenance of the submeter shall be borne by the owner of the property and not by the City. All such submeters shall be installed in accordance with the specifications established by the City.
 4. Irrigation controllers shall be smart controllers as defined in 6.02.V. Taps sized one-and-one-half (1.5) inches and greater water tap shall have a constant data connection via Wi-Fi or cellular data card so weather-based (ET) data can be received by controller. Controllers shall be installed and programmed according to the manufacturer's specifications.
 - a. Post at each smart irrigation controller a data input chart including the precipitation rate from the audit, water budget, and zone descriptions.
 - b. Within thirty (30) days of the installation of new landscaping, the irrigation system Smart Controller(s) shall be reset to the normal seasonal watering schedule. Minor schedule adjustments for establishing the trees, shrubs, and perennials may be necessary.
 - c. Irrigation days of the week shall follow Section 20-226 of the Greeley Municipal Code-Water conservation and use restrictions; drought response along with the current declaration of the City's water supplies.
 5. Sprinklers and nozzles shall meet the following requirements:
 - a. The type of sprinkler and associated nozzles shall be selected to correlate with the size and geometry of the zone being irrigated.
 - b. Sprinklers shall be spaced no closer than seventy-five (75) percent of the maximum radius of throw for the given sprinkler and nozzle. Maximum spacing shall be head-to-head coverage.

- c. Coverage arcs and radius of throw for turf areas shall be selected and adjusted to water only turf areas and minimize overspray onto vegetated areas, hard surfaces, buildings, fences, or other non-landscaped surfaces.
 - d. Sprinklers, bubblers, or emitters on each zone shall be of the same manufacturer. Multiple manufactures can be used throughout the system if each zone has the same manufacturer.
 - e. Sprinkler heads in turf areas shall have a minimum six (6) inch pop-up riser height. A four (4) inch pop-up riser height is permitted when the irrigation head is in line with a curb along a parking space. If pop-ups are installed within a perennial and groundcover beds, a twelve (12) inch pop-up riser shall be used.
 - f. Spray nozzles are not allowed.
 - g. Nozzles for rotors shall be selected to achieve an approximate uniform precipitation rate throughout the zone.
 - h. All pop-up heads s shall be equipped with check valves and pressure-regulating stems in accordance with Colorado House Bill 19-1231.
 - i. Rotors shall be equipped with internal check valves and pressure regulation.
 - j. Pressure-compensating emitters shall be used for drip irrigation. For sloped areas, check valve(s) shall be installed in the drip line whenever the valve is at a lower elevation.
 - k. Drip line shall be parallel to the slope whenever feasible.
 - l. Properties with single or combined point of connection flow of 15 GPM or greater for a one (1) inch water tap or greater, shall have a control system capable of providing real-time flow monitoring and the ability to shut down and/or isolate the problem area(s) with isolation valve(s) in the event of a high flow condition.
 - m. Emitters shall be set back from foundations in accordance with Chapter 8, Section 24-802- Landscape standards.
 - n. Pop-up heads in turf areas shall be matched precipitation nozzles. Variable Arc Nozzles (VANS) are not acceptable for 90-, 180-, and 360-degree applications. High-Efficiency Variable Arch Nozzles (HE-VANS) are allowed in odd shaped areas (non-linear or triangular head spacing) where 90-, 180- and 360- degree nozzles are not applicable.
6. Sleeving shall meet the following requirements:

- a. Sleeves shall be installed beneath paved areas to route irrigation pipes and wiring bundles. The diameter of sleeve shall be a minimum of twice that of the pipe and wiring bundle but no smaller than a two (2) inch diameter pipe. The ends of the sleeves shall extend past the edge of the curb, gutter, sidewalk, or other hardscape a minimum of eighteen (18) inches.
- b. The sleeve material beneath sidewalks, drives and streets shall be PVC Class 200 pipe with solvent welded joints.
- c. For all sleeving located under concrete, the pavement or other hard surfacing shall be notched on both sides to mark the sleeve location, and tracer wires shall be installed on the upper side and both ends of the sleeving.
- d. Contain no joints when length is less than twenty (20) feet.
- e. Separate sleeving used for irrigation lines and wiring bundles.

C. Water Pressure

- 1. The irrigation system designer shall verify the existing available water pressure.

The irrigation system shall be designed such that the point-of-connection design pressure, minus the possible system pressure losses, is greater than or equal to the design sprinkler operating pressure at final build out.

- 2. All newly installed sprinkler bodies shall operate at the manufacturer's specific optimum performance pressure range, All pop-up bodies retrofitted with rotary nozzles shall operate at no less than twenty (20) psi and no more than forty-five (45) psi.
- 3. If the operating pressure exceeds the manufacturer's specified maximum operating pressure for any sprinkler body or nozzle, pressure shall be regulated at the zone valve or sprinkler heads.
- 4. Pressure boosters are allowed if required. Booster pumps must be prefabricated units with variable speed controls.

6.12 IRRIGATION DESIGN PLAN

The purpose of a preliminary irrigation design plans is to provide a general design and annual water allotment for landscapes. The final irrigation design plans build upon the preliminary design with additional details. In accordance with Greeley Municipal Code, Chapter 8, Section 24-804(h) – Landscape Standards, the irrigation plan shall be designed in conjunction with a landscape plan in a manner to maximize irrigation efficiencies:

- A. Preliminary Irrigation Design Plans shall include:

1. Accurately and clearly identify all applicable hydrozones with square footage using the defined four categories in Section 6.10 and using letter marking found in Section 6.2 of these Criteria.
 2. Include irrigation methods according to the hydrozones. All heads on a zone shall have matched precipitation nozzles.
 3. A water budget chart that shows the total annual water use, which shall not exceed fifteen (15) gallons per square foot over the site.
 4. All necessary system components are sized for adequately meeting the highest seasonal landscape demand with a three-day per week watering schedule. Irrigation shall occur within an eight-hour watering window or as allowable by Section 20-226 of the Greeley Municipal Code -Water conservation and use restrictions; drought response.
- B. Final Irrigation Design Plans shall include:
1. Same information required for the Preliminary Irrigation Design Plan submittal and;
 2. A Smart Irrigation Controller data input chart. Irrigation schedules for landscape establishment period and established planting shall include irrigation frequency, cycles per day, and minutes per cycle, and a note stating that the schedule is a guide only and actual field conditions may require more or less watering time as plants mature. Seasonal adjustment shall be included in the data input chart. The data input chart must provide scheduling for the highest water demand season and fall within the watering window allowable by Section 20-226 of the Greeley Municipal Code- Water conservation and use restrictions; drought response.
 3. A pressure calculation worksheet that shall demonstrate the point-of-connection design pressure, minus the possible system pressure losses, is greater than or equal to the design sprinkler operating pressures.
 4. A seasonal maintenance schedule beginning on April 15 through October 15 shall be shown on the irrigation plan to establish procedures for optimum irrigation efficiency and preventive maintenance practices that will conserve water resources. The maintenance schedule shall include 6.16- Irrigation System Maintenance
 4. Final irrigation design plans must be approved by a licensed Irrigation Association Certified Irrigation Designer (CID).
 5. The following General Notes:
 - a. Contractor installing the system including name, address, and phone number
 - b. All irrigation certifications
 - c. All field adjustments or redesign to show “as-built” drawings after installation is complete
 6. The owner of the property shall be provided:

- a. “As-built” irrigation drawings
- b. Water budget chart
- c. Smart Irrigation Controller data input chart
- d. Two (2) operating keys for each type of manually operated valves
- e. Two (2) of each servicing wrench or tool needed for complete access, adjustment, and repair of sprinklers.

6.13 IRRIGATION SYSTEM INSTALLATION

Irrigation system installation shall be consistent with approved plans and meet the City’s Criteria prior to issuance of Certification of Occupancy or other City approvals. Release of bonding or surety (if applicable) shall be withheld until approval is given.

Materials, installation, and execution for parks shall follow City of Greeley Design Criteria and Construction Specifications, Section 02810 Irrigation Specifications.

Otherwise the following shall occur for irrigation system installation:

A. Quality Assurance:

- 1. Irrigation system installation shall be consistent with approved system design and applicable water type (potable versus non-potable systems). For all systems with one and one-half (1.5) inches or greater water tap, it is recommended that the irrigation system be designed and constructed for non-potable water use.
- 2. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- 3. When contract documents call for material or construction of better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- 4. A Field Supervisor shall review and sign-off on the installation. Field Supervisors shall have at least five (5) years experience in irrigation system installation and be employed by a company that has been established in the green industry for three (3) or more years.

B. Installation

- 1. Contact the City of Greeley Water and Sewer Department at conserve@greeleygov.com when irrigation construction begins.

2. Installation shall be consistent with approved system design.
3. New and existing tree and shrub locations as shown on the landscape plans take precedence over irrigation equipment locations. Conflicts between irrigation system, planting material and architectural features shall be avoided.
4. Assembling pipe and fittings shall be in a manner recommended by the manufacturer and in accordance with accepted industry practices.
5. Spare wires
 - a. In conventional (or traditional, single, multi-stand) systems, two (2) spare control wires and one (1) spare common wire shall be installed for the entire length of the mainline. At each valve location, a minimum of thirty (30) inches wire loop shall be provided and located in the valve box. End of wires shall be capped with water-proof wire connectors.
 - b. In 2-wire (or decoder) systems, one (1) spare 2-wire shall be installed the entire length of the mainline. The spare 2-wire installed shall be in a different color than the rest of the 2-wire being used. At each valve location, a minimum of thirty (30) inches wire loop shall be provided and located in the valve box. End of all wires shall be capped with water-proof wire connectors.
6. Sprinkler assemblies shall be installed as per the specifications and at the locations of the irrigation plans. All sprinkler assemblies shall be installed for best performance. The City reserves the right to conduct follow-up audits as deemed necessary at the expense of the customer to ensure irrigation system efficiencies. Any deviations in the installation from the irrigation plan must be noted and included in the as-built drawings.

C. Testing

1. The mainline of the irrigation system shall be tested for each segment of mainline made operational and upon final installation completion to ensure it is free of leaks, defects, or deficiencies. The system shall be brought to normal operating pressure with the all valve manifolds and isolation valves open and all other conveying components closed. Any loss of pressure after two hours should be recorded, investigated, and isolated. Identified leaks shall be repaired and the mainline retested prior to testing any individual irrigation zones.
2. All irrigation zones shall be tested upon final installation completion to ensure the zones are free of leaks, defects, or deficiencies. Each zone shall be activated for five (5) minutes, and the water use shall be recorded from the installed flow sensor installed or calculated from start and stop water meter readings. Deviations from the zone application rate listed in the irrigation plan shall necessitate investigating the zone(s) for correct installation, layout, components, and repair. Post-repair zone testing will be required.

3. It is unlawful for any owner or user of water to fail to comply to the prevision of the Section 20-153 of the Greeley Municipal Code – Bills may be sent; process of bill disputes and to waste water through neglect or by reason of faulty or imperfect plumbing or fixtures per Section 20-123 of the Greeley Municipal Code- Failure to maintain; unlawful;notice;turnoff.

6.14 IRRIGATION PERFORMANCE AUDIT

Per Greeley Municipal Code, Section 24-801(b)(5) and 24-804(h)(5) a letter of substantial completion of the landscape plan and an irrigation performance audit must be completed prior to issuance of Certification of Occupancy or other City approvals. Release of bonding or surety (if applicable) shall be withheld until approval is given. Details of the Irrigation System Installation, Performance Audit and Landscape and Irrigation System Maintenance

A. Exemptions

1. Systems with only drip irrigation.
2. Landscape plans and plant installation without any turf areas.
3. Case-by-case as determined per the Water and Sewer Director or designee.

B. Certification

1. The contractor in charge of the irrigation system installation must contract to have an irrigation performance audit completed by a licensed professional independent of the installation contractor. Acceptable auditors are Greeley's Water Conservation Program personnel, a CLIA, or QWEL:
 - a. Certified Landscape Irrigation Auditor (CLIA) who is certified by the Irrigation Association, a non-profit industry organization dedicated to promoting efficient irrigation
 - b. Qualified Water Efficient Landscaper (QWEL) who is certified by EPA WaterSense
2. The cost of hiring a CLIA or QWEL shall be the responsibility of the contractor in charge of the installation.

C. Performance Audit Guidelines

1. Irrigation zones tested in the audit must be a representative sample of the entire irrigation system, and at a minimum shall include the evaluation of no less than twenty-five (25) percent of overhead irrigation zones, to include a minimum of two (2) zones per overhead sprinkler type. At the discretion of Greeley's Water and Sewer's Director or designee, the minimum number of zones may be increased depending on the size and complexity of the irrigation system.

2. The minimum acceptable distribution uniformities shall be seventy (70) percent for rotor and rotary zones.
3. Results below minimum acceptable distribution uniformity will require adjustments and/or repairs made to the irrigation system. These corrections will be noted on the irrigation as-builts and the test area re-audited until acceptable results are produced.
4. A signed copy of the Irrigation Performance Audit shall be submitted to and approved by the Water and Sewer Department, Water Conservation Program Manager before issuance of a Certificate of Occupancy or other City approvals.

6.15 LANDSCAPE MAINTENANCE

Per section 24-804(e) installation and maintenance of the landscape areas of the Greeley municipal code, the developer, owners' association, property managers, property owner and/or tenant, as required by Chapter 8, shall be responsible for maintaining in a healthy condition all on-lot and right-of-way landscaping, buffering, perimeter treatment, and screening improvements. The landscape and irrigation maintenance shall incorporate the required items set forth below:

- A. The Owners' Association, property managers, property owner, and/or tenant shall be jointly and severally responsible for the regular maintenance of all landscaping elements and irrigation system in good condition. All landscaping shall be maintained free from disease, pests, weeds and litter.
- B. Regular maintenance shall be consistent with the needs of the plant material and shall include pruning, mowing, fertilization, mulching and weeding, and plant materials replacement. Replacement materials shall be healthy plants of comparable size and species, meeting the original intent of the approved landscape design.
- C. Preferred turf shall follow the City of Greeley's Natural Areas & Trails Department No-Mow policy.
- D. Best management practices to fix erosion shall be used to maintain landscapes and irrigation systems.

6.16 IRRIGATION SYSTEM MAINTENANCE

- A. Annual maintenance of the irrigation system includes backflow prevention assembly testing, rain sensor testing, controller data or Wifi connection testing, and filter and strainer cleaning/replacement, and all other preventive maintenance practices that conserve water resources.
- B. Leak repair, replacement of damaged system components, head adjustments, application rate adjustments, and all other preventive maintenance practices that conserve water resources shall be on-going through out the irrigation season.

- C. A completed and passing backflow prevention assembly test consistent with the parameters outlined per Section 20-191 of the City of Greeley's Municipal Code- Connection Control is required for irrigation system start-up. Proper assembly operations shall also be verified through passing backflow prevention assembly test when the assembly is taken out of service for maintenance or repair.
- D. All irrigation system elements shall be repaired and replaced to maintain the minimum acceptable distribution uniformities of sixty (60) percent for rotor and rotary zones.
- E. Irrigation controllers shall be seasonal adjusted using a cycle and soak method with no programming to irrigate between the times of 10:00 a.m. to 6:00 p.m.
- F. Irrigation days of the week shall follow per Section 20-226 of the Greeley Municipal Code- Water conservation and use restrictions; drought response.
- G. Subject to Chapter 14.08-Water Rates and Regulation, failure to maintain any plumbing or fixtures of any premises are so defective as to waste any water is unlawful and shall be subject to penalties and/or water shutoff.
- H. Irrigation audits should be conducted every five (5) years following the initial irrigation system installation following Section 6.14- Irrigation Performance Audit to support long-term water efficiency.