City of Loveland

Water and Wastewater Development Standards

10th Edition
Effective January 1, 2019

Originally Adopted August 2007
10TH EDITION

OF THE

CITY OF LOVELAND
WATER AND WASTEWATER DEVELOPMENT STANDARDS

EFFECTIVE January 1, 2019

The following Standards have been revised from the Standards currently in place, and shall be binding and in full force and effect as of above date.

There have been five previous versions since the adoption date of August 2007, formerly issued as:
1) Errata 1 on 9/27/2007,
2) Errata 2 on 1/16/2008,
3) Errata 3 on 3/1/2009,
4) Errata 4 on 4/1/2010, and
5) The 5th Edition on 4/1/2011,
6) The 6th Edition on 5/1/2014,
7) The 7th Edition on 5/1/2016,
8) The 8th Edition on 5/1/2017,

These versions along with the following modifications are now known as the 10th Edition.

1. Chapter 1 – definitions
2. Chapter 2 – 2.2.6
3. Chapter 3 – 3.1 and 3.2
4. Chapter 4 – 4.3.6
5. Chapter 5 – 5.4.3 – Removed 5.4.3.B.5
6. Chapter 7 – 7.2.1.F.2, 7.2.2.A.4
7. Appendix A - replaced
8. Appendix F
9. Appendix G – Updated List
# City of Loveland Water and Wastewater Development Standards

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1.1 AUTHORITY OF THIS DOCUMENT

These Standards, with all future amendments, shall be known as the City of Loveland (City) Water and Wastewater Development Standards (Standards).

These Standards shall be the governing Standards for Public Water and Wastewater Systems that are designed and installed in conjunction with the City’s Development Review Process and are within the City’s Growth Management Area (GMA), or other areas whereby the City may own and operate such systems.

These Standards shall be used in conjunction with Larimer County Urban Area Street Standards (LCUASS), where applicable. Where conflicts may exist between these Standards and LCUASS, these Standards shall govern for all matters regarding Public Water and Wastewater Systems. LCUASS shall govern for all public improvements except Public Water and Wastewater Systems within the City’s Rights-of-way.

1.2 INTENT AND ADDITIONAL PROVISIONS

The intent of these Standards is to establish minimum acceptable criteria. The Department of Water and Power may allow application or use of alternate and/or additional Resource Standards that are more stringent than these Standards, with prior written approval.

The Department’s review of plans, reports and drawings or the inspection of installation and construction of Public Water and Wastewater Systems pursuant to these Standards shall not constitute a representation, warranty or guarantee by the Department that such systems are free from defects or will operate adequately for the purpose intended.

1.2.1 Objectives of Standards

A. Minimum Standards These Standards shall be the minimum criteria for planning, design, materials, installation, inspection, testing and documentation of Public Water and Wastewater Systems within the City. In special circumstances, as determined by the Department, the use of alternate and/or additional Resource Standards may be required. The Department has separate approved Standards for Water Booster Stations, Wastewater Lift Stations and Wastewater Force Mains.

1. Reference is further made to LCUASS for provisions concerning certain items not addressed in these Standards; specifically, items concerning Soils Investigations and Reports, Permits, Streets, Traffic Control and Acceptance/Warranty Procedures & Record Drawings.

1.2.2 Alternative Resource Standards

A. Upon first obtaining written permission and approval from the Department, the following alternate and/or additional Resource Standards may be used when certain planning, design, materials and installation may not be specifically addressed in these Standards:

1. AWWA – American Water Works Association (Most Current)
2. ASTM – American Society for Testing and Materials
3. SCE – American Society of Civil Engineers
4. CDOT – Colorado Department of Transportation Standard Specification for Road and Bridge and M & S Standards
5. IPC – International Plumbing Code (Per City Municipal Code, Title 15)
6. IBC – International Building Code (Per City Municipal Code, Title 15)
7. IFC – International Fire Code (Per City Municipal Code, Title 15)
8. Other, as approved by the Department.

1.3 AUTHORITY

The City has duly created the Department of Water and Power (Department). Whereas the Department Director, or authorized representative, shall have the authority on behalf of the City to determine that all planning, design, materials, installation, testing and documentation of Public Water and Wastewater Systems are pursuant to these Standards.

1.4 REVISIONS AND UPDATED STANDARDS

Revisions to these Standards shall be pursuant to LCUASS 1.6.2. The Department will maintain these Standards and any amendments hereto. The Department will post these Standards and amendments on the City’s Internet website, under the Department’s specific website location. The Department does not keep a database of holders of these Standards; consequently, it shall be the responsibility of each holder to verify the most current Standards are being used for any Development Project Area.

1.5 DEFINITIONS OF TERMS AND ABBREVIATIONS

When the following words, phrases, or abbreviations appear in these Standards, they shall have the following definition and meaning:

AASHTO – American Association of State Highway and Transportation Officials
ACI – American Concrete Institute
AISC – American Institute of Steel Construction
ANSI – American National Standards Institute
Appurtenance- Any item, except Public Water and Wastewater main(s), that are considered to be attached and/or serve as a functional part of the Public Water and Wastewater System.
ARV – Air Relief Valve
ASCE – American Society of Civil Engineers
ASME – American Society of Mechanical Engineers
ASTM – American Society for Testing and Materials
AWG – American Wire Gauge
AWWA – American Water Works Association
BO – Blow Off
BOC – Back of Curb
BOW – Back of (side) Walk
BP – Building Permit
Calendar Day – Each and every day shown on the calendar, beginning and ending at midnight.
CDOT – Colorado Department of Transportation
CDPHE – Colorado Department of Public Health & Environment
City – City of Loveland, Colorado, a Home Rule Municipality pursuant to Colorado State Statutes (also sometimes used interchangeably with Department).
Code – Loveland Municipal Code
Commercial Use – A zoning term and specific use of property, as defined in the Code, Title 18.
Construction Costs – The cost of all items and labor necessary to complete installation of Public Improvements, including Public Water and Wastewater Systems pursuant to these Standards
Construction Staking – The act and use of material involved in the placement of identification markers. Such markers shall show horizontal and vertical location(s) of Public Water and Wastewater Systems and all related appurtenances. All Construction Staking shall be performed by, or under the direct supervision of, a licensed Professional Land Surveyor in the State of Colorado.
Contractor – The person, firm or organization to whom a construction contract is awarded by the Developer to do work within a Development Project Area or to whom a Right-of-way Work Permit has been issued by the City. Agents, employees, workers or sub-contractors employed by the Contractor are also bound by the terms of these Standards.
Days – Intended as calendar days unless specifically stipulated otherwise as Working Days.
Department – The Department of Water and Power, City of Loveland (also sometimes used interchangeably with City).
Design Engineer – The Professional [Civil] Engineer, licensed by the State of Colorado who signs the final Public Improvement Construction Plans, as submitted through the City’s Development Review Process. The Design Engineer may also sign the Record Drawings.
Developer – The person or entity responsible for planning, design and installation of Public Water and Wastewater Systems within Public Rights-of-way, Easements or within any portion of an approved Development Project Area.
Development – See Definition contained in Title 18 as well as “Development Project Area” herein.
Development Agreement – An agreement between the City and the Developer defining certain Public Improvement requirements, costs and other related Development Review Process issues. This agreement is typically executed simultaneously with the approval of a Final Plat and final signed Public Improvement Construction Plans.
Development Construction Permit – Pursuant to LCUASS Chapter 6, a permit to construct Public Improvements within an approved Development Project Area. Typically associated with final signed Public Improvement Construction Plans and issued by the City’s Public Works Department prior to beginning installation of Public Improvements.

Development Review Process – The process, pursuant to applicable City Municipal Code, whereby certain residential, commercial and industrial development is regulated and approved.

Development Project Area – An area approved by the City for re-development or development, pursuant to the Code. The Development Project Area may include installation of Public Improvements, including Public Water and Wastewater Systems, pursuant to these Standards and final signed Public Improvement Construction Plans.

DIP – Ductile Iron Pipe

Director – The Director, or a designated/authorized representative, of the Department of Water and Power, City of Loveland. May also replace “Local Entity Engineer” as defined in LCUASS.

DMR – Discharge Monitoring Report

DR – Dimension Ratio (See SDR, Standard Dimension Ratio)

Easement – A right granted to the City/Department to use certain property for purposes of ownership, maintenance, access, inspection and other related incidentals associated with Public Water or Wastewater Systems. The right granted may be exclusive or non-exclusive, depending on the nature and situation within a Development Project Area. When not depicted on a Final Plat, the City/Department shall require the use of separate approved easement agreements/forms. The agreements/forms must be obtained from the Department, prior to use and/or execution and recordation.

Fees – Monetary charges which compensate the City for services rendered or infrastructure constructed.

Fence – An permanent barrier of wood, masonry, stone, wire, metal or other manufactured material, or combination of materials, erected to enclose, partition, beautify, mark, or screen areas of property within any portion of a Development Project Area.

FOCR - Field Order Change Request – A written form requesting certain changes or alterations from the original final signed Public Improvement Construction Plans. The request to change an item may be initiated by the Department’s Inspector or by the Developer/Contractor. All proposed changes must first be approved by the Design Engineer and the Department, prior to affecting any changes in the field.

Final Acceptance – The Department’s documentation and process whereby notification is sent to the Developer/Contractor that the Initial Acceptance and Warranty Period has been satisfactorily completed and that all Public Water and Wastewater Systems are fully accepted by the Department. Such notification shall release the Developer/Contractor from future maintenance obligations.
Final Plat – A land surveying document depicting the subdivision of real property, normally accompanied by approved final signed Public Improvement Construction Plans.

Franchise Agreement – An agreement between the City and private utility companies, specifying terms and conditions for use of the City’s Rights-of-way.

GMA - Growth Management Area – The area of real property identified in the City of Loveland Comprehensive Master Plan and Inter-Governmental Agreement with Larimer County.

GPM – Gallons Per Minute

HDPE – High Density Polyethylene, typically for a certain pipe.

ID – Inside Diameter

Improvement Agreement – See also Development Agreement.

Industrial Use – A zoning term and specific use of property, as defined in the Code, Title 18.

Initial Acceptance – The Department’s documentation and process by which the Public Water and/or Wastewater System is accepted into an observation period, whereby the Developer/Contractor is responsible for material and workmanship failures during the warranty period.

Inspector – An authorized representative of the Department, assigned to make inspections to assure installation and materials are completed in compliance with these Standards and City approved signed final Public Improvement Construction Plans.

JSSA - Joint Sewer Service Agreement – An agreement, approved by the City/Department, for use when two separate property owners desire to share one common private wastewater service line that connects into a Public Wastewater System main.

LCUASS – Larimer County Urban Area Street Standards, as approved by the City, most current addition.

Landscaping – Materials including, without limitation, grass, ground cover, shrubs, vines, trees, and non-living materials, commonly used in landscape development, as well as attendant irrigation systems.

LFRA – Loveland Fire Rescue Authority

Major Structure - A major structure is a component of the Public Water or Wastewater System that will bring direct benefits to an identifiable area, such as water booster pump stations and sewage lift stations.

May – A permissive condition

MJ – Mechanical Joint

MUTCD – Manual of Uniform Traffic Control Devices

NONC – Notice of Non-Compliance - A written notice from the Inspector identifying non-compliance of certain workmanship or materials. May also contain written corrective actions, pursuant to these Standards.

NSF – National Sanitation Foundation

OD – Outside Diameter, typical of a certain pipe.
Official – A person appointed by the Department to administer these Standards.

Ordinance – A law established by the City.

Original Cost of Design and Construction – The cost of financing, engineering, construction, and any other costs actually and reasonably incurred that are directly attributable to the improvements.

OSHA – Occupational Safety and Health Administration, Federal jurisdiction.

Oversize Reimbursement Agreement – A Reimbursement agreement between the Developer and the Department establishing certain costs that are eligible for reimbursement by the City.

PC – Point of curvature

PCR – Point of curb return

PE – Polyethylene, a typical pipe material

PE – Professional Engineer – A Professional [Civil] Engineer, licensed by the State of Colorado. (See also, Design Engineer)

Permittee – The holder of a valid permit issued in accordance with these Standards or other City related processes.

Phasing Plan – A plan or drawing, typically included in the signed final Public Improvement Construction Plans that defines Public Improvements, including Public Water and Wastewater Improvements, installed in sequence within certain portions of a Development Project Area.

PI – Point of Intersection

PICP – Public Improvements Construction Plans – Plans prepared by the Design Engineer, which depict materials, methods and other data required to install Public Improvements pursuant to LCUASS, these Standards and applicable City Municipal Code requirements. Typically, PICPs are associated with the City’s Development Review and/or Building Permit process. PICPs used for installation of any Public Improvement (including Public Water and Wastewater infrastructure) shall be signed by the Design Engineer and relevant City divisions, and as such are designated as final PICPs.

Pipe Zone – A certain portion of the Public Water and Wastewater trench identified in the Department’s Standard Drawing W-1 and WW-1.

PLS – Professional Land Surveyor – A Professional Land Surveyor, licensed by the State of Colorado.

Post Indicator Valve – Typically, an above-ground water main appurtenance that identifies the amount of water used during a building/structure fire.

Pre-Construction Meeting – A meeting convened prior to beginning any Work within an approved Development Project Area. The meeting shall include the Developer/Contractor and the Department’s Inspector and shall facilitate the review of signed Public Improvement Construction Plans and any proposed Work necessary to install Public Water and Wastewater Systems.

Private Improvements – Improvements, which may be installed within a Development Project Area but are not owned, operated or maintained by the City or the Department.

Project – May also be used interchangeably with the term Development Project Area.
**Project Supervisor** – The person appointed by the Developer or Contractor for management and control of the work and material within a Development Project Area.

**Property** – That portion of land within a Development Project Area that may also include installation of Public Water and Wastewater Systems and other Public Improvements.

**PRV** – Pressure Relief/Regulating/Reduction Valve

**PSI** – Pounds per Square Inch, a unit of pressure

**PT** – Point of tangent

**Public Improvements** – Any facility, improvement and related appurtenance that, upon Final Acceptance by the City, is owned, maintained and operated by the City. (See also, Public Water and Wastewater Systems herein)

**Public Improvements Opinion of Cost (Cost Estimate)** – Unit costs based on those approved by the City and assigned to materials and related quantities contained in the PICP. The Cost Estimate shall be broken down by construction phase, when applicable, for each project and shall be submitted by the Design Engineer at the time of first plan review by the City.

**Public Water and Wastewater System** – Water and/or wastewater facilities, improvements and related appurtenances that, upon Final Acceptance, are owned, operated and maintained by the Department.

**Public Water and Wastewater System Master Plan** – A plan and related document, prepared and maintained by the Department, that depict major infrastructure requirements, functions, and operations. (See also W&WMP.)

**Punch List, Initial or Final** – A written list of Work or material items compiled by the Inspector, which do not conform to these Standards, the PICPs or other associated City Codes that govern the Development Project Area. The Developer/Contractor shall bring all such items into conformance with these Standards prior to either Initial or Final Acceptance.

**PVC** – Polyvinyl Chloride, a typical pipe material

**Record Drawings** – Original signed final PICPs, updated and certified by [the] Design Engineer, which depict actual materials, locations and dimensions of the Public Water and Wastewater system.

**Re-development** – Removal or modification of existing improvements and installation and construction of new improvements as defined in the City’s Municipal Code Title 18.

**Reimbursement Agreement** – An agreement, between the Developer who initially installs certain Public Water and/or Wastewater System main(s), and the Department, for the purpose of collecting reimbursement to the Developer from certain future Developers that may potentially connect to said main(s).

**Report** – A bound document, the contents of which may contain certain necessary analyses, surveys, tests, exhibits, and other pertinent data supporting the subject matter.

**Right-of-way** – See LCUASS 1.7.
Right-of-way Work Permit – A document issued by the City that allows a Developer/Contractor to construct Public Improvements or Private Improvements within a Right-of-way or Easement dedicated or granted to the City.

Roadway – The portion of the highway, arterial, collector, or local street, including shoulders, intended for vehicle and/or bicycle use.

SDR/DR – Standard Dimension Ratio, defined as a quotient of: minimum outside diameter of a pipe divided by the minimum wall thickness of the same pipe. Higher SDR quotient numbers result in thinner pipe wall thicknesses and lower pressure ratings.

Shall – A mandatory condition

Should – An advisory condition, recommended, but not required

Sidewalks – Paved or otherwise improved areas for pedestrian use located within the Right-of-way or Easement.

Standards – These Water and Wastewater Development Standards, inclusive of all codes and other referenced standards.

Standard Drawings – Drawings included as part of these Standards that depict typical and normal materials, certain installation methods and locations associated with a specific portion of the Public Water and Wastewater System.

SWO - Stop Work Order – A written instruction/notice from the Department revoking the Developer’s and/or Contractor’s right to continue work within an approved Development Project Area.

Structure – Any item constructed or erected with a fixed location below, upon, or above grade, including but not limited to any type of permanent foundation, traffic signal poles, fences, retaining walls, buildings, inlets, vaults, utility poles, bridges, drainage facilities.

Sub-contractor – A person or entity supplying labor, materials, design or other items directly related to the Development Project Area that is employed by the Contractor.

Substantial Completion – Satisfactory completion of certain Work items within an approved Development Project Area, typically prior to the creation of an initial punch list.

Surety – A financial instrument, such as cash, letter of credit, bond or escrow agreement as approved by the City, securing the Developer’s responsibility to complete construction of Public Improvements within an approved Development Project Area. Surety may also mean a financial instrument securing the Developers’ obligations throughout the Warranty Period.

Validated – A process whereby the Design Engineer reviews and subsequently confirms a certain item or matter is either correct or within the scope of practice, as it relates to the specific item or matter.

Variance – A deviation or alteration from these Standards that has been duly and properly approved by the Department.

Warranty Period – Starting from time of Initial Acceptance, a period of time the Developer/Contractor is responsible for material and workmanship defects in the Public Water and Wastewater System, within an approved Development Project Area.
**Water Utilities Manager** – The person responsible to the Director for general oversight, authority and administration of Public Water and Wastewater systems. The Water Utilities Manager may be authorized to act on behalf of the Director.

**Work** – All installation and construction activity, including materials, labor, supervision and use of tools and equipment necessary to complete installation and construction of Public Water and Wastewater Systems, within an approved Development Project Area.

**Working Day** – Unless approved otherwise by the Department, 7 a.m. to 6 p.m., Monday through Friday, excluding holidays observed by the City.

**W&WIDA** – Water and Wastewater Impact and Demand Analysis Report

**W&WMP** – Water and Wastewater Master Plan (See Public Water and Wastewater System Master Plan)

### 1.6 INTERPRETATION OF STANDARDS

The interpretations of these Standards shall be in conformance with LCUASS 1.8.

### 1.7 DEVELOPMENT REVIEW PROCEDURES AND POLICIES

#### 1.7.1 General

Reference LCUASS and City Municipal Code Title 18, as applicable.

#### 1.7.2 Variances and Appeals Processes

**A. Variances**

Shall be pursuant to LCUASS 1.9.4.A, except with regard to these Standards, the “Local Entity Engineer” shall be the Water Utilities Manager for the Department.

**B. Appeals**

Shall be pursuant to LCUASS, Article 1.9.4.B, except with regard to these Standards, the “Local Entity Engineer” shall be the Water Utilities Manager for the Department and the “Director” shall be the Director of Water and Power.

#### 1.7.3 Off-Site Criteria

**A. Off-Site Utility Easements**

Shall be pursuant to LCUASS 1.9.2.B.3.d. as follows: Prior to approval of any development which requires acquisition and dedication of off-site easements, the Developer shall provide legal documentation demonstrating their ability to obtain such easement without any restrictions and at no cost to the City. Prior to final approval of plat and construction plan documents all off-site easements must be dedicated and recorded with the County Clerk.
1.8 ENFORCEMENT & INSPECTION RESPONSIBILITY

1.8.1 General

These Standards are enforceable by the City/Department at any point in the City’s Development Review Process, including installation and inspection of Public Water and Wastewater Systems.

1.8.2 Inspection Procedures

Special attention is directed to LCUASS 1.2.2.B.8. and LCUASS Chapter 23.

A. The Department shall inspect all Public Water and Wastewater Systems installed pursuant to these Standards.

B. Department Inspection Authority and Duties

1. The Inspector shall be authorized to inspect and enforce these Standards, as applicable. All materials, labor, tools and certain methods for installation shall be subject to inspection and approval by the Inspector. If the Inspector identifies a neglect, omission or disregard of these Standards, such neglect, omission or disregard shall be remedied immediately, pursuant to the Inspector’s written instructions and these Standards.

2. Not more than one week prior to beginning Work within a Development Project Area, a Pre-construction Meeting shall occur between the Inspector and the Developer/Contractor. A Pre-construction Meeting cannot take place unless the Developer/Contractor has a valid copy of the signed final PICPs and a copy of the Developer’s/Contractor’s construction schedule for use in the Pre-construction Meeting. The Developer/Contractor shall be responsible for notifying the Inspector a minimum of forty-eight hours prior to a proposed Pre-Construction Meeting.

3. The Inspector shall have access to the area of installation, materials, labor and tools at all times. Access shall be provided in a manner that does not impede or prohibit such access by the Inspector. The Inspector shall have the authority to reject materials, tools, workmanship and/or certain methods of installation not in compliance with these Standards. Rejected workmanship or installation methods shall be satisfactorily corrected, and any rejected materials and tools shall be removed from the premises. If rejected materials and tools are not removed within five working days, the Inspector may cause the removal of such materials and tools and charge all removal expenses to the Developer/Contractor, or may issue a SWO pursuant to LCUASS 6.1.8. (See Appendix D for a sample of this document.) All instructions and directives from the Inspector shall be in writing in the SWO. Upon receipt of such notice, the Developer/Contractor shall immediately address the items noted in the SWO. Failure to adequately address a written SWO may constitute issuance of fines pursuant to LCUASS 6.1.8.

4. The Developer/Contractor shall not cover any portion of the Public Water and Wastewater System until the Inspector has had an opportunity to inspect all workmanship and materials.

5. If the Inspector considers it necessary or advisable to examine workmanship or materials that have been previously installed and/or completed, and are
deemed not pursuant to these Standards, the Inspector may require the Developer/Contractor to remove, expose, excavate, or otherwise make available certain workmanship areas or materials for examination or further testing by the Inspector. In this case, the Developer/Contractor shall supply all labor, equipment and materials to complete the requested removal, exposure or excavation. Additionally, if such workmanship or material is found not pursuant to these Standards, the Developer/Contractor shall incur all expenses necessary to bring the workmanship or materials into compliance with these Standards.

6. Inspection of workmanship and materials is intended to aid in the compliance with these Standards. Such inspection, however, shall not relieve the Developer/Contractor from any obligations related to the requirements of these Standards. Responsibility for the replacement of materials not in compliance with these Standards shall rest entirely with the Developer/Contractor during installation and, as applicable, throughout the warranty period.

7. The Inspector and the Developer/Contractor are not authorized to waive or substantially modify any portion of the signed final PICPs without first preparing and submitting a FOCR. (See Appendix E for a sample of this document.)

8. The Developer/Contractor shall abide by all City and relevant OSHA safety requirements and programs.

9. Work days and working hours are described under Working Day in Section 1.5 of these Standards and LCUASS 1.11. The Director must first approve any Work beyond the normal Work Day. All hours worked beyond normal Work Day shall be paid to the Department by the Developer/Contractor at a rate of $100 per hour. Initial Acceptance of Public Water and/or Wastewater Improvements shall not occur until payment is received in full.

C. Material/Soil Testing Reports

1. These Standards state the minimum requirements for material and soil sampling, testing, and inspection. All geotechnical tests shall be made and certified by an approved testing laboratory and all test reports, analyses, and recommendations shall be prepared by an Engineer. All costs pertaining to testing shall be the responsibility of the Developer/Contractor. Where certified material test reports are required to be furnished by a manufacturer or supplier, the Developer/Contractor shall furnish duplicate copies of the reports to the Inspector for approval prior to actual use or installation of such material.

2. Whenever, at the discretion of the Department, additional tests or data are required beyond the minimum identified in these Standards or on the signed PICPs, the costs of such tests initially shall be the responsibility of the Department. In the case where such tests or additional data show a failure to meet these Standards or approved PICPs, the Developer/Contractor ultimately shall be responsible for such costs, along with all costs associated with necessary mitigation measures. In the event the Inspector does not approve any material proposed to be used by the Developer/Contractor, said materials
shall be immediately removed from the Development Project Area. If, after PICPs are signed, the Developer/Contractor desires to change any material from that previously shown, said change(s) shall be accomplished by completion of an FOCR.

1.8.3 Inspection for Major Structures

A. Construction of a Major Structure or improvements to a Major Structure may require Inspection services beyond what City staff can provide. Therefore, if required by the City, a City approved 3rd Party Professional Inspection services company shall be contracted for the Inspection services. The 3rd Party Professional Inspector’s services shall be paid for by the Developer responsible for paying for the Major Structure; however the 3rd Party Inspector’s contract shall be between the 3rd Party Inspection company and the City.

1.9 (THIS SECTION LEFT BLANK)

1.10 PUBLIC WATER AND WASTEWATER EXTENSION, OVERSIZE AND REIMBURSEMENT

1.10.1 General

A. Reference City Code Title 13.

B. As determined necessary by the Department, Public Water and Wastewater System mains and related appurtenances shall be installed to the farthest point(s) of a Development Project Area and within all Rights-of-way. Such installation is intended to facilitate the orderly continuation of the Public Water and Wastewater System and to provide adequate service to properties beyond a Development Project Area.

C. All Public Water and Wastewater System mains and major structures providing service to or within a Development Project Area shall be installed at the sole cost of the Developer except when eligible for reimbursement in accordance with City Code Title 13 and these Standards.

1.10.2 Developer Reimbursement for Main Extensions (Third Party Reimbursement Agreement)

A. When a Developer installs a Public Water or Wastewater System main through or adjacent to other property in order to serve his development, and where such other property has the potential to develop in the future in a way that could require use of the main, the Developer may establish a Third Party Reimbursement Agreement. The establishment of a Third Party Reimbursement Agreement is optional.

B. Agreement Timing The Developer must submit a draft Third Party Reimbursement Agreement to the Department before the Department signs the final PICPs. Within thirty (30) days after Initial Acceptance of the main, the Developer must submit a final Third Party Reimbursement Agreement. If the draft or final Third Party Reimbursement Agreement is not timely submitted as
required herein, the City may deny the Developer the right to establish a Third Party Reimbursement Agreement.

C. Agreement Form The Third Party Reimbursement Agreement must be in a form approved by the Department Director and the City Attorney and contain the following:

1. Depiction of the eligible improvements: copies of the final PICPs depicting the location of the main constructed and identifying each encumbered property by parcel number.

2. Determination of total costs eligible for reimbursement.
   a. The draft Third Party Reimbursement Agreement shall identify “total costs” as determined by the Design Engineer’s estimate.
   b. The final Third Party Reimbursement Agreement shall identify “total costs” as determined by invoices for design and engineering costs and construction management costs, and low bid for construction of the main. The final Third Party Reimbursement Agreement shall attach and include competitive bids from at least three (3) qualified contractors, which bids must include a description of the work, estimated quantities, and unit prices for each item required in construction of the main.

3. Determination of reimbursement owed from each encumbered property. Said reimbursement shall be calculated as follows: (i) total costs; (ii) minus any payment due from the Department for oversizing, if applicable; (iii) divided by the number of encumbered properties and apportioned based on linear footage adjacent to the main.
   a. If the line is installed in a Right-of-way or in an easement along a property line between two parcels, the property on each side shall pay fifty percent of the reimbursement amount.

4. The reimbursement amount shall be increased or decreased to reflect fluctuations in the “Engineering News Record” construction cost index (twenty city average). The date of the construction bid shall establish the initial index value.

5. Table depicting the following for each encumbered property:
   a. Parcel number and legal description;
   b. Name and mailing address of current owner;
   c. Linear footage adjacent to the main (including any portion of Right-of-way (if applicable); and
   d. Reimbursement amount due.

6. The City will record the final Third Party Reimbursement Agreement with the Larimer County Clerk and Recorder. The Developer shall pay all recordation fees.

D. Notification of Agreement After the Third Party Reimbursement Agreement has been recorded the Developer shall certify, by affidavit, that all owners of properties obligated to provide reimbursement have been notified in writing through certified mail with return receipt requested. The affidavit and copies of the return receipt are required to be submitted to the city prior to any collection attempts.
E. Collection The City shall attempt to collect the reimbursement as stated in the Third Party Reimbursement Agreement. A service charge equal to three percent (3%) of the amount collected shall be deducted and retained by the City to cover the City’s administrative costs.

1.10.3. Developer Reimbursement for Major Structures (Third Party Reimbursement Agreement)

A. A major structure is a component of the Public Water or Wastewater System that will bring direct benefits to an identifiable area, such as water booster pump stations and sewage lift stations. A Developer may be required to install a major structure to obtain water or wastewater service. Where the major structure will benefit property other than that which is being developed by the Developer, the Developer may be eligible to establish a Third Party Reimbursement Agreement. The establishment of a Third Party Reimbursement Agreement is optional.

B. Agreement Timing The Developer must submit a draft Third Party Reimbursement Agreement to the Department before the Department signs the final PICPs. Within thirty (30) days after Initial Acceptance of the major structure, the Developer must submit a final Third Party Reimbursement Agreement. If the draft or final Third Party Reimbursement Agreement is not timely submitted as required herein, the City may deny the Developer the right to establish a Third Party Reimbursement Agreement.

C. Agreement Form The Third Party Reimbursement Agreement must be in a form approved by the Department Director and City Attorney and contain the following:

1. Depiction of eligible improvements: Copies of the final PICPs depicting the location of the major structure constructed and identifying each encumbered property by parcel number.

2. Determination of total costs eligible for reimbursement. The draft Third Party Reimbursement Agreement shall identify “total costs” as determined by the Design Engineer’s estimate. The final Third Party Reimbursement Agreement shall identify “total costs” as determined by invoices for engineering costs and construction management, and low bid for construction of the major structure. The final Third Party Reimbursement Agreement shall attach and include competitive bids from at least three (3) qualified contractors, which bids must include a description of the work, estimated quantities, and unit prices for each item required in construction of the major structure.

3. Determination of reimbursement owed from each encumbered property. Said reimbursement shall be calculated as follows: (i) total costs; (ii) minus any payment due from the Department for oversizing, if applicable; (iii) divided by the number of encumbered properties and apportioned based on developable area being served, as determined by the Design Engineer and approved by the Department.

4. Table depicting the following for each encumbered property:
   a. Parcel number and legal description;
   b. Name and mailing address of current owner;
Chapter 1 – GENERAL PROVISIONS

1.10.4 Developer Reimbursement for Oversizing Main Extensions (Oversizing Reimbursement Agreement)

A. When the Department requires installation of Public Water or Wastewater System main that is larger in diameter than is necessary to serve a Development Project Area (“Oversizing”), the Department shall pay for eligible costs associated with the larger mains pursuant to an Oversizing Agreement. The establishment of an Oversizing Agreement is optional.

B. The Design Engineer shall determine the diameter of Public Water or Wastewater System main required to serve the Development Project Area. The Design Engineer shall take into account the following items when determining main diameters:
   1. Public Water or Wastewater System Master Plan;
   2. Potential future demand, as related to the surrounding and/or future proposed Development Project Areas; and
   3. Industry standards for hydraulic design.

C. Agreement Timing The Developer must submit a draft Oversizing Agreement to the Department before the Department signs the final PICPs. Within thirty (30) days after Initial Acceptance of the main, the Developer must submit a final Oversizing Agreement. If the draft or final Oversizing Agreement is not timely submitted as required herein, the City may deny the Developer the right to establish an Oversizing Agreement.

D. Agreement Form The Oversizing Agreement must be in a form approved by the Department Director and the City Attorney and include the following:
   1. Copies of final PICPs depicting the location of the main constructed.
   2. Determination of total costs eligible for reimbursement.
      a. The draft Oversizing Agreement shall identify “total costs” as determined by the Design Engineer’s estimate.
      b. The final Oversizing Agreement shall identify “total costs” as determined by low bid for construction of the main and actual quantities installed. The Oversizing Agreement shall attach and include competitive bids from at least three (3) qualified contractors, which bids must include a
description of the work, estimated quantities, and unit prices for each item required in construction of the main.

c. Only the components of the Public Water or Wastewater System main that were oversized are eligible for reimbursement. Eligible items include the cost to furnish and install the oversized main, fittings, valves, and service saddles. The cost of design, engineering, construction management, service lines, fire hydrant laterals, fire hydrants, manholes, surface repairs, traffic control, and connected lines and appurtenances are not eligible items. Wastewater manholes larger than four feet (4') in diameter are eligible on mains larger than eighteen inches (18") in diameter.

3. A copy of the final payment to the contractor, with a letter from the contractor certifying final payment from the Developer.

E. Under an Oversizing Agreement, the Department shall pay the Developer a portion of the eligible costs for the Public Water or Wastewater System main in accordance with the following tables:

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<thead>
<tr>
<th>PERCENTAGE PAID BY THE DEPARTMENT FOR OVERSIZED WATER MAINS</th>
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<tr>
<td>8&quot;</td>
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<td>12&quot;</td>
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For mains larger than those listed above, the City shall pay the Developer a percentage of the costs determined to be fair and equitable in the sole discretion of the City.

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<thead>
<tr>
<th>PERCENTAGE PAID BY THE DEPARTMENT FOR OVERSIZED WASTEWATER MAINS</th>
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<tr>
<td>SIZE OF WASTEWATER MAIN NEEDED</td>
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# CHAPTER 2 -
SUBMITTAL AND REVIEW PROCEDURES, PUBLIC IMPROVEMENT CONSTRUCTION PLANS AND RECORD DRAWINGS

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CHAPTER 2 - SUBMITTAL AND REVIEW PROCEDURES

2.1 GENERAL

2.1.1 General Submittal Criteria and Procedures
A. When PICPs and Record Drawings are required by the City/Department, these Standards, and LCUASS Chapters 2 and 24, shall be used for submittal and review procedures.
B. With prior approval of the Department, PICPs associated only with this Department may be submitted directly to the Department.

2.1.2 Criteria for Major Structure Projects
A. Prior to starting any design for Major Structure Projects the Developer shall have their design and construction management firms meet with the Department to discuss the Major Structure Project. Examples of Major Structures include: sewage lift stations, water booster pump stations, and river or highway crossings.

2.2 SUBMITTALS AND CONTENT

2.2.1 PICP Checklists
A. LCUASS Appendix E4 Contains a comprehensive overall item checklist for PICPs, including Public Water and Wastewater Systems. This checklist should be used for a Development Review application.
B. Public Water and Wastewater Checklist included in these Standards (Appendix A) contains a more comprehensive checklist containing all items required for review for Public Water and Wastewater Systems. This checklist should be used for a non-Development Review application.

2.2.2 PICPs
Refer to Chapter 3 of the Standards for requirements.

2.2.3 Soils Investigation/Geotechnical Report
A. When required by the City’s Code through the Development Review Process, and where applicable, the Report shall identify mitigation measures necessary for trench/bedding and stabilization not specifically addressed in these Standards and address any high groundwater condition.

2.2.4 Water Design Report
Refer to Chapter 4 of these Standards for the content and requirements for the W&WIDA report.

2.2.5 Wastewater Design Report
Refer to Chapter 5 of these Standards for the content and requirements for the W&WIDA report.
2.2.6 Opinion of Cost

A. Pursuant to LCUASS Chapter 20, an Opinion of Cost for all Public Improvements is required with PICPs. The cost of items related to Public Water and Wastewater Systems need to be included in the Public Improvements Opinion of Cost.

2.2.7 Revisions to Signed PICPs

Requests to revise Public Water and Wastewater Systems included within signed PICPs shall be made in conformance with the following criteria:

A. Field Revisions

1. Field revisions are changes to the Public Water and Wastewater System which are substantially insignificant in nature, do not alter or impair overall functional aspects, and are not considerably different from the signed PICPs.

2. Field revisions shall be administered through a FOCR and may or may not be approved at the discretion of the Inspector. A FOCR may be submitted either by the Developer/Contractor or by the Inspector. In either case, a FOCR must be validated and approved by the Design Engineer PRIOR to submittal to the Inspector for approval. All decisions regarding Field revisions shall be final, unless appealed to the Department’s Construction Coordinator. The decision of the Construction Coordinator shall be final within three days.

   a. If the Inspector approves the Field revision, Contractor may then proceed with the work as noted on the FOCR. The revision shall then be clearly denoted on the final Record Drawing sheet(s).

   b. If the Inspector does not approve the Field revision, the Developer/Contractor shall immediately comply with the originally signed final PICPs and these Standards, as applicable.

B. Minor Revisions

1. Minor revisions are changes to the Public Water and Wastewater System which are not substantially different from the signed PICPs.

2. Minor revisions shall be administered through the Department for review and approval prior to starting the Work. Minor revisions shall be clearly denoted on the original PICP sheet(s) by clouding and/or delta notes with explanations in the revision box and submitted to this Department for approval signature. All decisions regarding minor revisions shall be final, unless appealed to the Department’s Senior Civil Engineer. The decision of the Senior Civil Engineer shall be final within three days.

   a. If the Department approves the minor revision they will sign EACH revised sheet (typically in the revision space of the title block). After the sheets are signed the Design Engineer shall then pick up the original sheet and provide two copies of the revised sheet(s). The copies, along with the original revised sheet(s), must be returned to the Department for use by the Inspector prior to commencement of installation on the revised component(s).

   b. If the Department does not approve the minor revision, the Developer/Contractor shall immediately comply with the originally signed final PICPs and these Standards, as applicable.
C. Major Revisions

1. Major revisions shall be revisions to the signed PICPs which are not deemed minor revisions and which affect the functional aspects of the Public Water and Wastewater System. Examples of major revisions include, but are not limited to:
   a. A change in horizontal or vertical location(s) that also may require a change in an approved Right-of-way, Easement or other previously approved configuration within a Final Plat.
   b. A change in size or configuration of a main serving areas either beyond an approved Development Project Area or within an approved Development Project Area which substantially differs from the final signed PICPs.
   c. Other major changes the Department deems beyond the scope of the original approval through the City’s Development Review Process.

2. Major revisions cannot be approved solely by the Department. The Developer/Contractor shall be required to submit the appropriate documents to the City’s Planning Division for review by relevant City Departments. Certain major revisions may also require a public hearing, e.g. Planning Commission and/or City Council. Additionally, any Work related to a major revision cannot be allowed to continue until such time as the Department has approved the major revision.

2.3 RECORD DRAWINGS
(THE SECTION SUPERSEDES LCUASS SECTION 24.5)

2.3.1 Required

A. Record Drawings for Public Water and Wastewater Systems are required for all PICPs that have been signed as approved for construction by the Department.

2.3.2 Maintenance of PICPs and Other Documents by the Contractor (for use in submitting Record Drawings)

A. PICPs and other documents used for the preparation of Record Drawings should be stored separately from PICPs and other documents used for the actual installation of Public Water and Wastewater Systems.

B. PICPs and other documents shall be maintained in a clean, dry, legible condition and in good order.

C. Changes or revisions from the final PICPs should be recorded concurrently, as installation progresses.

D. All PICPs and other documents used for the preparation of Record Drawings shall be available for review by the Inspector, upon request.

2.3.3 Content of Record Drawings

A. The PICPs shall be updated with all design changes that occurred after plan approval.
   1. Record Drawings shall include, at a minimum, the following:
a. Dimensions, grades/slopes, lengths, elevations and details that, in the opinion of the Department, were substantially changed or revised from that shown on the final PICPs.

b. Horizontal and vertical locations of underground utilities and appurtenances that were not shown on the final PICPs, referenced to a minimum of three permanent surface improvements.

c. All dimensions shall be referenced to property corners, if surface improvements have not been constructed.

2. All changes and revisions shall be marked legibly and shall be denoted by clouding, boxes or other visible ways of clarifying the change or revision.

B. Record Drawings should be prepared by the original Design Engineer.

1. Record Drawings submitted by a Professional Land Surveyor are prohibited; however, a Professional Land Surveyor may provide certain data to assist the Design Engineer with preparation of Record Drawings.

C. Record Drawings shall be submitted in the form of full size blue or black-line sheets.

D. Record Drawings shall include a copy of the originally signed PICP title sheet, and all sheets related to the Public Water and Wastewater Systems.

1. Do not submit any PICP Record Drawing sheets specifically depicting streets, storm drain, and grading to the Department for Record Drawing review, these sheets should be submitted directly to the Public Works Department.

E. Each Sheet (including the title sheet) must be clearly labeled RECORD DRAWING in bold font. Below or very near the RECORD DRAWING label, a statement, signed and sealed by the Design Engineer, must be annotated as follows:

I _______________________________ certify all Public Water and Wastewater System improvements shown herein, including any noted changes or revisions, are in general conformance with the design/construction documents, pursuant to this Record Drawing copy of the final PICPs.

2.3.4 Submittal Process of Record Drawings

A. The Record Drawings shall be submitted to the Inspector for review and final approval.

B. The Inspector shall have five (5) working days either to approve Record Drawings or contact the Design Engineer if changes are required. Subsequent approvals/disapprovals shall also be within five working days.

C. If further changes are deemed necessary, the Inspector will contact the Design Engineer and request a resubmittal. Upon revising the Record Drawings the Design Engineer shall resubmit the Record Drawings to the Inspector.

D. If no further changes are required to the initially submitted Record Drawings, said drawings shall be approved by the Inspector and remain property of the Department.
2.4 WATER SERVICE SUMMARY REPORT

2.4.1 Required

A. A Water Service Summary Report is required to be completed for all residential subdivisions to provide additional information on the placement of the water and wastewater services on the site.

B. Contact the Department for templates and examples of the Report.

2.4.2 Submittal Process

A. If required, the Water Service Summary Report shall be submitted to the Inspector for review and final approval along with Record Drawings.

B. The Inspector shall have five (5) working days either to approve the Water Service Summary Report or contact the person who completed the Report if changes are required. Subsequent approvals/disapprovals shall also be within five working days.

C. If further changes are deemed necessary, the Inspector will contact the person who completed the Report and request a resubmittal. Upon revising the Water Service Summary Report the person who completed the Report shall resubmit the Report to the Inspector.

D. If no further changes are required to the initially submitted Water Service Summary Report it shall be considered approved by the Inspector.

2.5 TESTING REPORTS

2.5.1 Required

A. Water Mains require the following reports:
   1. Bacteriological Test results (from a State Certified Laboratory);
   2. A City of Loveland Water Line Pressure Test report (for the hydrostatic test results).

B. Wastewater Mains require the following report:
   1. A video recording (CD/DVD) of the wastewater mains (after flushing).

2.5.2 Submittal Process

A. If a City of Loveland Water Line Pressure Test report is required. The Inspector shall provide the Test Form which will contain the specific required pressure test values. After the test is complete the Contractor shall sign the bottom of the form indicating the test results.

B. A copy of any and all required reports shall be provided to the Inspector prior to Initial Acceptance.
2.6 ACCEPTANCE AND WARRANTY

2.6.1 Initial Acceptance

A. Upon the Inspector’s acceptance of the following items the Department will issue a letter of Initial Acceptance which notifies the Developer that the Warranty period for Public Water and/or Wastewater Systems may begin, pursuant to these Standards.
1. Record Drawings
2. Water Service Summary Report (if applicable)
3. Testing Reports (as applicable)

B. The Developer is responsible for maintaining and repairing the Public Water and/or Wastewater System during the warranty period.

C. The Warranty period for Public Water and/or Wastewater systems shall be two (2) years and shall start from the date that Initial Acceptance occurs.

D. At any time during the Warranty Period the Department may notify the Developer of needed repairs.
   1. If the repair areas are considered to be an imminent danger to public health, safety, and welfare, the Developer shall act within twenty-four (24) hours to complete the repair.
   2. If the work is not considered a safety issue, the Developer has 10 working days to schedule the work, and sixty (60) calendar days to complete the work. Time extensions may be granted due to weather constraints.
   3. If the Developer does not complete the warranty repairs in the time frame specified, the Department may choose to make the repairs. If so the Department will invoice the Developer for any costs for the related work plus a $500 administrative fee.
   4. A new warranty period shall not be applied to any repair work performed during the warranty period.

2.6.2 Final Acceptance

A. Prior to the completion of the Warranty period the Inspector will re-inspect the Project area.

B. If any new deficiencies are found, either in quality or extent of construction, the Developer shall be notified in writing that these new deficiencies shall be corrected prior to Final Acceptance.
   1. The Developer shall have thirty (30) calendar days to address the deficiencies.
   2. Upon completion the Developer shall contact the Inspector.

C. Once all deficiencies have been satisfactorily completed and any repair fees have been paid (if any), the Department will issue a letter of Final Acceptance to the Developer.

D. The Warranty period shall terminate with the Final Acceptance date.
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CHAPTER 3 - INFORMATION REQUIREMENTS FOR PUBLIC IMPROVEMENT CONSTRUCTION PLANS EXCLUSIVELY FOR PUBLIC WATER AND WASTEWATER SYSTEMS

3.1 GENERAL

A. All plans that include modifications to existing or proposed Public Water and Wastewater Systems, regardless of the sheet title are considered PICP and such shall contain the Water & Power Department – Water/Wastewater Division signature block.

B. In cases where PICPs include Public Water and Wastewater Systems or may be exclusively for Public Water and Wastewater Systems, the PICPs shall be prepared and submitted pursuant to LCUASS, Chapter 3 and these Standards, as applicable.

C. To further aid in the preparation of PICPs, a supplemental checklist is included in these Standards (Appendix A) depicting certain specific requirements for Public Water and Wastewater Systems.

D. Expiration of Plan Set – PICP and revised PICP pages shall be valid for a period of three years from the date of approval on the City of Loveland Public Improvement Construction Plans Approval Block by the Transportation Development Division. If the PICP approval block does not contain the Transportation Development Division signature; then the approval date shall be the date of the Water/Wastewater Division signature.

3.2 SPECIFIC REQUIREMENTS

A. In addition to the applicable requirements set forth in LCUASS, Chapter 3, the following additional requirements shall apply when preparing PICPs inclusive of, or exclusively for, Public Water and Wastewater Systems.

B. Vertical datum - the PICP shall reference the benchmark from the City of Loveland ‘95 Level Net Survey

3.2.1 Construction Notes

A. General construction and material notes shall be annotated onto PICPs pursuant to LCUASS, Chapter 3, Appendix E-4.

B. Special and more specific construction and material notes related to Public Water and Wastewater Systems shall be per these Standards, Appendix B.

3.2.2 Utility Plan(s) (General)

A. If the proposed Development is relatively small in nature the construction information for the Public Water and/or Wastewater system can be shown on an overall Utility Plan.

B. The plan sheet(s) shall be numbered sequentially, clearly integrated into the PICPs, and shall depict all applicable notes.
C. Plan view sheet(s) are required for all sizes of Public Water and Wastewater systems. Scale may be 1 inch = 50 feet, 40 feet, or larger. These sheets may also include details and designs for lowerings, crossings, and other special configurations pursuant to Chapter 4 and 5 of these Standards.

D. Plan and profile sheet(s) are required for all sizes of Public Wastewater Systems. Plan view scale may be 1 inch = 50 feet, 40 feet, or larger with profile view scale shown with consistent and relative units to the plan view scale.

E. Plan and profile sheet(s) are required for all Public Water Systems having mains 12 inch or larger. Plan view scale may be 1 inch = 50 feet, 40 feet, or larger with profile view scale shown in consistent and relative units to the plan view scale. A specific profile view/design shall also be required for all lowerings and crossings. In certain instances, plan and profile for any other size of main may also be required, depending on unclear or special circumstances, as determined by the Department.

F. All vertical datum shall be based on the City’s latest vertical datum criteria.

G. All construction and/or sequence phasing shall be clearly annotated such that each phase is depicted in a “stand alone” manner. In some cases, Public Water and Wastewater Systems may be required to extend beyond a particular phase to mitigate acceptable redundancy for water and discharge points for wastewater. In these cases, PICP plan sheets shall clearly show all applicable phase lines, design, details, Rights-of-way, Easements and any other items necessary to properly accommodate such extension beyond a particular phase. Existing and proposed property, Rights-of-way, Easements and Tract lines that are adjacent and/or encompass the proposed Public Water and Wastewater System. All such lines shall be consistent with a proposed or recorded Final Plat or other lawful property description instrument, duly recorded with Larimer County. All lines shall be clearly referenced and dimensioned relative to one another.

H. Longitudinal stationing based on centerline of main, for all Public Water and Wastewater Systems appurtenances (e.g. service lines and associated taps, all fittings, fire hydrants, vaults, blow-offs, air-vacs, manholes, etc.). In general, stationing shall read in ascending order in the direction of the north arrow or to the right. Stationing for Public Wastewater System mains and appurtenances shall typically read in ascending order from the downstream manhole to the upstream manhole.

I. Horizontal locations for all proposed and existing Public Water and Wastewater Systems shall be identified by linear dimensions or offset stationing to centerline of Rights-of-way, Easements or Tracts. In some cases, additional horizontal dimensioning may be required for purposes of clarity and further reference. For proposed Public Water and Wastewater Systems, horizontal bearings and distances may also be used in conjunction with linear dimensioning. Horizontal coordinates (northing/easting) will not be allowed, except in cases of open fields or larger parking areas.

J. Roadway, Right-of-way and/or access-way names in bold font.

K. Proposed finished surface contours in area(s) over and nearby all proposed Public Water and Wastewater Systems. This requirement is especially critical for areas
beyond the typical street section (e.g. from back of curb or walk towards private property).

L. Existing structures, dry and wet utilities and ground surfaces (shown as phantom lines and shapes). All existing items shall be dimensioned in a manner that clearly shows their relationship to all portions of proposed Public Water and Wastewater Systems. Examples of existing items include, but are not limited to, the following:
1. Water, wastewater, irrigation water, reclaimed water, storm drainage, electrical, cable television, communications, gas, oil, steam, petroleum, traffic control devices and any related appurtenances.
2. Overhead power or communication lines.
3. Existing ground contours.
4. Fence lines and gates.
5. Ditches or swales with contour lines.
6. Curbs and gutters, sidewalks, crossspans.
7. Pavement limits.
8. Bridges or culverts.
10. Signs.
11. Landscape features (trees, shrubs, hedges, turf, flowerbeds, etc.).
12. Other items deemed appropriate by the Department.

3.2.3 Public Water System Plans

A. All fittings (crosses, tees, valves, bends, blow-offs, air-vacs, fire hydrants, etc.).

B. Service lines with diameter and longitudinal stationing of connection point to the main.

C. Location and size of associated meter pits/vaults. If pits/vaults cannot be located pursuant to the Department’s Standard Drawings’ typical dimensions, provide necessary horizontal and linear dimensions or stationing to depict non-standard locations.

D. Steel casings with diameter, thickness, length, and longitudinal stationing of beginning and ending of casing. Show location of cathodic protection test stations and label anode design. Include/show type of pipe carrier/skid system.

E. Longitudinal stations for beginning and ending of lowerings and vertical sweeps.

F. Type and class of pipe material, length between fittings, diameter and slopes, as applicable.

G. Limits of special bedding, if required.

H. Complete horizontal curve data for water main(s).

I. Matchlines with stationing and sheet numbering.

J. Construction Phase lines with relative stationing.

K. Designate separation between different pressure zones, as applicable.
L. Hatching or beginning and ending stationing for all portions of the water main being restrained by restrained joint fittings.

3.2.4 Public Wastewater System Plans

A. Manholes with diameters and designation numbers/letters.
B. Type and class of pipe material, length, diameter, and slopes for all mains.
C. Type of pipe material, length, diameter, slopes, and longitudinal stationing at connection points to the main for all service lines.
D. Steel casings with diameter, thickness, length, and longitudinal stationing of beginning and ending of casing. Show location of cathodic protection test stations and label anode design. Include/show type of pipe carrier/skid system.
E. Concrete encasements, with stationing.
F. Grease interceptors, with stationing and horizontal ties.
G. Sand and oil interceptors.
H. Other wastewater appurtenances associated with the design.
I. Matchlines with stationing and sheet numbering.
J. Construction Phase lines with relative stationing.

3.2.5 Utility Profile(s) (General)

A. Existing ground contour profile; dashed and denoted as such.
B. Proposed finished grade contour profile, solid line and denoted as such.
C. Existing structures, dry and wet utilities, with elevations and sizes.

3.2.6 Public Water Systems Profile

A. Longitudinal station and vertical elevations of all existing structures and utilities in close proximity or crossing the proposed main. Vertical clearance dimensions between the proposed main and the associated structure or utility may also be required.
B. Longitudinal stationing for all fittings, valves, and related appurtenances with vertical flow line elevations.
C. Longitudinal stationing and top of pipe elevations of all points of vertical change, grade breaks, and vertical bends.
D. Lengths and diameter for all portions of main(s).
E. Depth for all portions of main(s) where the main consistently follows finish contour elevations. Within locations a main does not consistently follow finish contour elevations, grades/slopes shall be annotated for all portions of such mains.
F. For all vertical sweeps, denote full vertical curve data and denote begin and end of vertical curve (VPT, VPC). Denote top of pipe elevations every twenty-five feet throughout entire portion of vertical curve.
G. Size and longitudinal station for each connection (including individual service taps) to the proposed main.

H. Longitudinal stations and vertical top of pipe elevations for each component (fittings, pipe sections, beginning and ending of casing, bends, etc.) of each lowering, crossing, or vertical sweep.

I. Groundwater barriers with longitudinal stationing.

J. Limits of any special bedding.

K. Limits and type of any insulation.

3.2.7 Public Wastewater System Profile

A. Longitudinal stationing for all manholes and other related appurtenances.

B. Rim and all inflow and outflow invert elevations for each manhole.

C. Length, diameter and slope for all mains.

D. Longitudinal stationing for each groundwater barrier/cut-off wall.

E. Longitudinal stationing and vertical elevations for beginning and ending of each steel casing.

F. Pipe joint encasements, with stationing and type of encasement.

G. Vertical clearance dimensions between the proposed main and any existing or proposed nearby or conflicting structure or utility.

H. Longitudinal station for each service line connection to the main.

I. Limits of special bedding, if required.

J. Groundwater limits per approved Geotechnical Report

K. Construction Phase lines with relative stationing.

3.2.8 Utility Details

A. A copy of each applicable Standard W/WW Detail Drawing (See Appendix G) shall be shown on the Utility Detail plan sheet(s). All Standard Drawings must depict the original drawing content, borders and City/Department information. Standard Drawings shall not be altered without first obtaining written approval from the Department.

1. If altered, and with approval by the Department, the Standard Drawings must clearly depict “REVISED – Project Name” in bold font, near the title block area of the drawing.

B. Non-standard design for Public Water and Wastewater Systems (e.g. lowerings, crossings, special fittings, encasements, deflections, etc.) shall be depicted on the appropriate plan and/or profile sheet(s).

3.2.9 Landscape Plan

A. All existing and proposed water and wastewater systems and services.

B. All existing and proposed landscaping, trees, and bushes with types denoted.
C. All existing and proposed (if any) irrigation meters and meter size denoted. If the landscape area is proposed to be irrigated off of the domestic meter then denote the domestic meter and meter size.

D. If a dedicated irrigation meter is proposed: provide the total irrigated area (not required if hydrozone plan – see the Department’s instructions for a hydrozone submittal).
# CHAPTER 4 -
## WATER DESIGN CRITERIA

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CHAPTER 4 - WATER DESIGN CRITERIA

4.1 GENERAL

This chapter specifies the minimum standards necessary for system analysis, layout, and design of Public Water Systems. Water main sizes and general system layout will typically be provided by the Department, based on dynamic analysis using the Department’s hydraulic model and proposed demands related to the Development Project Area.

In addition to these Standards, alternate Resource Standards may be used or required pursuant to Chapter 1, Section 1.3 of these Standards.

4.1.1 Separate Requirements and Standards

There are separate requirements and standards for booster stations, cross connection and backflow prevention that may be obtained from the Department.

4.1.2 Conformance to Standards and Master Plans

A. All Public Water Systems shall conform to these Standards, the most current version of the W&WMP and other applicable Codes and Standards approved by the Department.

B. Where these Standards are not specific, alternate and/or additional Resource Standards may be used, provided the more stringent requirement is used. The Department shall approve the use of any alternate and/or additional Resource Standard prior to inclusion of such standard within any Development Project Area or PICP.

4.1.3 Standard Drawings for Public Water Systems

A. Appendix G includes Standard Drawings; these drawings shall be used when typical scenarios for design and construction warrant such use. When used, Standard Drawings shall be annotated onto Utility Detail sheet(s) of PICPs and referenced on each PICP plan sheet. Each Standard Drawing depicted on Utility Detail sheet(s) shall include the entire content of the original approved drawing (e.g. borders, title blocks, dates, notes, etc.).

B. Any alteration to a Standard Drawing must first be approved by the Department. If approved, alterations must be clearly marked “Revised – Project Name” in bold font and shall depict any revisions by cloud.

4.1.4 Acceptable Materials – See Appendix F of these Standards.

4.2 ANALYSIS CRITERIA

4.2.1 W&WIDA

In conjunction with the City’s Development Review Process, the Department may request that the Design Engineer submit a W&WIDA report concurrent with a development application.
Chapter 4 – WATER DESIGN CRITERIA

4.2.2 Contents & Format of the W&WIDA

At a minimum, the following shall be contained in the W&WIDA:

A. Project location and description: Text identifying the location of the Development Project Area, the nature of the proposed development and the land use. Provide the proposed project zoning and density (DU/acre).

B. Identify the existing water system and proposed connection points to the Public water system. Provide the Master Plan analysis for the area. Identify any offsite areas contributing to demands.

C. Calculated water demands for all initial and future phases. Provide as a flow rate in gallons per minute (gpm) and gallons per day (gpd).

1. Average Day Demand (ADD)

<table>
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<tr>
<td>Residential</td>
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<tr>
<td>Single Family Residential and Single Family Attached (2 units)</td>
<td>400 gpd/DU</td>
</tr>
<tr>
<td>Multi-family Residential (3 units or more) as Single Family Attached or condos</td>
<td>320 gpd/DU</td>
</tr>
<tr>
<td>Non-Residential*</td>
<td></td>
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<tr>
<td>General Commercial: Retail/Offices</td>
<td>0.2 gpd/SF</td>
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<tr>
<td>Hotels/Motels</td>
<td>75 gpd/room</td>
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<tr>
<td>Restaurants</td>
<td>3.0 gpd/SF</td>
</tr>
<tr>
<td>Industrial/other commercial</td>
<td>1,200 gpd/acre</td>
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<tr>
<td>Institutional</td>
<td>800 gpd/acre</td>
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*Alternate types of demands can be considered for site specific uses that may not fit into these categories.

2. Max Day Demand (MDD)

\[ MDD = 2.5 \times ADD \]

3. Peak Hour Demand (PHD)

\[ PHD = 6.0 \times ADD \]

4. Irrigation Demands

5. Max Day fire flow demand

D. Provide a hydraulic modeling analysis for the proposed water system design showing all distribution lines and all looping connections to the existing water system. The analysis needs to also include irrigation if dedicated irrigation meters are proposed. Provide an output data report and a corresponding network map showing the location of all nodes and pipes.
E. The design shall verify the Minimum Hydraulic Performance Criteria:

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<th>Pressure (psi)</th>
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<tr>
<td>MIN static pressure</td>
<td>45</td>
</tr>
<tr>
<td>MAX static pressure</td>
<td>125</td>
</tr>
<tr>
<td>MDD + Fire Flow</td>
<td>20</td>
</tr>
<tr>
<td>PHD</td>
<td>40</td>
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F. Discuss the proposed design results. Identify needs for any special improvements, e.g. PRV’s, zone breaks, transmission, or trans-distribution mains, etc. Identify any needs for oversizing pipes in conjunction with the Master Plan.

G. Discuss and identify any alternate water sources and or delivery systems for irrigation water.

H. Discuss any deviation from these Standards and provide justification for any proposed variances. All such variances must be approved by the Department prior to approval of the Development Project Area by Planning Commission and City Council.

I. Provide an overall plan depicting the following information:
   1. Map Scale (max 1 inch = 200 feet), North Arrow, and Vicinity Map.
   3. Proposed and existing water system layout. Mains and appurtenances with sizes, flows, node pressures and demands (minimum and maximum).
   4. Pressure zone(s) and contours.
   5. Underlying land uses, zoning, and densities.
   6. Other existing and proposed utilities that might affect the proposed system layout or performance.

4.3 WATER SYSTEM DESIGN AND LAYOUT

4.3.1 General
The City’s Public Water System includes transmission, trans-distribution and distribution mains with related appurtenances. Other specific Public Water System components may include pressure reduction valves, booster pump stations, and storage facilities.

In addition to the Main Extensions and Oversize requirements in Section 1.10.2 A of these Standards, each Development Project Area shall have redundant sources of water supply. Redundant supply provides a combination of adequate fire flow, uninterrupted customer service and acceptable water quality. Redundancy is typically achieved by making at least two separate and distinct connections to the existing Public Water System. The Department, depending on required flows and/or other constraints or system capacities in the area of the proposed Development Project Area, may require a greater number of connections.
Additionally, within internal portions of the Development Project Area, other separate and additional redundant connections shall be required wherever possible. Additionally, it is critically important within each Development Project Area that the site layout be designed in a manner that accommodates acceptable access for future maintenance by the Department. For each Development Project Area, the Design Engineer shall make provisions regarding applicable utility and hard surface separation requirements, as well as Easement and/or Tract widths, noted in these Standards.

A. Distribution Mains

Public Water System distribution mains deliver potable water to individual customers and may be tapped along their length with individual service connections. Distribution mains normally have in-line valves placed frequently to lessen the impacts associated with shut downs, line breaks and potential service interruptions. Distribution mains are typically sized to provide domestic, fire protection and irrigation flows to and throughout the Development Project Area. Use of other systems such as reclaimed water (purple pipe) or irrigation ditches may reduce the need to deliver irrigation demand through the Public Water System. However, the Department must first approve such alternate systems.

1. Allowable Sizes. 6, 8, 12 and 16-inch diameters. Chapter 7 addresses allowable materials and installation requirements for pipe.
2. Residential. The minimum allowable pipe size shall be 6-inch diameter.
3. Commercial/Industrial and High Density Residential. The minimum allowable pipe size shall be 8-inch diameter.
4. Overall System layout. The general minimum requirements for system layout shall be as follows:
   a. Section Lines or close proximity minimum size shall be 16-inch diameter.
   b. Quarter (¼) and Sixteenth (¼₁₆) Section Lines or close proximity minimum size shall be 12-inch diameter.
   c. Master Plan sizing layout may override these general Standards. The Department may also require oversizing of certain mains, beyond those identified in the Master Plan recommendations.

B. Trans-Distribution Mains are larger diameter mains that move water between Distribution mains and may have frequent Distribution main connections. Typically, tees and/or individual taps less than 6 inches shall not be allowed on Trans-Distribution mains.

C. Transmission Mains are large diameter mains that move water through the system between supply and storage points, between pressure zones and between Trans-Distribution mains. There should be no individual service taps allowed on Transmission mains; the Department must first approve any type of connection to a Transmission main.
4.3.2 Horizontal

A. Location. Within the platted right-of-way and improved public streets, main(s) should generally be located on the north and east sides of public streets at 5 feet south of the northern or 5 feet west of the eastern lip of concrete gutter. Main(s) may be located within a parkway or tree lawn area with prior approval from the Department. Main(s) located within parking areas or open space should be located symmetrically within an Easement.

B. Separation

1. Wet utilities (e.g. public wastewater, public or private stormwater, public or private reclaimed water and any related appurtenance) running parallel to a public water main and/or related appurtenance shall not be closer than 10 feet. This distance shall be measured from the nearest outside edge of each pipe or related appurtenance. Reference Standard Drawing W-101 for additional clarification and requirements.

2. Dry utilities (e.g. natural gas, electric, cable TV, telephone/communications and all any appurtenance) running parallel to a public water main and/or related appurtenance, shall not be closer than 6 feet (outside edge to outside edge). This distance shall be measured from nearest outside edge of each pipe or relative appurtenance. Reference Standard Drawing W-101 for additional clarification and requirements. Light Poles require 6 foot separation.

3. Other Features
   a. Curb & Gutter, sidewalks, medians and other minor structures: Public water mains should generally be designed to run parallel and be a minimum of 5 feet horizontally from hard surface improvements (e.g. front or back of sidewalk, lip or back of any type of curb and gutter, etc.) and a minimum of 12.5 feet horizontally from the outside edge of any building.
   b. Landscaped Features: The outside edges of any shrub or bush (upon maturity) shall be not be allowed within 5 feet of the nearest outside edge of a public water main and/or any related appurtenance. The outside edge of any tree trunk (upon maturity) shall not be allowed within 10 feet of the nearest outside edge of a public water main and/or any related appurtenance.
   c. Berms greater than 2 feet high and/or with side slopes steeper than 4:1 shall not be allowed within 10 feet of a public water main and any related appurtenance.
   d. Permanent signs, walls, etc. shall not be allowed within 10 feet of a public water main and any related appurtenance.

C. Alignments

1. Straight. In general public water mains shall be laid with straight alignments using manufactured bends. Manufactured Bends shall be DIP mechanical joint (MJ) type.

2. Pipe-joint deflection. Mains proposed within curved portions of ROWs or easements may be designed utilizing pipe-joint deflections.
a. DI pipe. Each pipe-joint deflection shall not exceed 80% of that allowed by the Ductile Iron Pipe Research Association’s (DIPRA) current publication.

b. PVC pipe. Each pipe-joint deflection shall not exceed one (1) degree per length of pipe. If the Design Engineer would like to use a greater degree of deflection then they shall provide written information on the allowable joint deflection, along with written instructions on how the pipe shall be installed, by the manufacturer of the PVC pipe. Approval of this method may be allowed on a case-by-case basis.
   1) Joint deflections are allowed at Joint Restraint Devices per manufacturer’s recommendations.

c. PICP plan & profile views. When pipe is deflected at each joint to accommodate horizontal curvilinear alignments, each curved alignment section shall be labeled with curve data. Data shall include PC and PT stations (labeled as Begin Joint Deflection and End Joint Deflection respectively), radius, delta, length, joint deflection per joint and pipe segment lengths.

d. Pipe bending. Longitudinal, barrel portion pipe bending shall not be allowed.

4.3.3 Vertical

A. Cover. Normal bury depth for all water mains shall be 4.5 feet minimum and 6.0 feet maximum, as measured from finished grade to top of pipe. Crossings and lowerings with less than 4.5 feet of cover shall be subject to frost protection requirements noted in these Standards.

B. Alignment/Grade. When utilizing manufactured bends, water mains shall be designed to maintain a uniform positive or negative grade between all bends (high and low points).
   1. If a profile is provided in the PICPs then all portions of uniform grade/pipe shall be denoted mathematically by percent or decimal of slope. All bends shall be denoted with a top-of-pipe, vertical datum elevation, and a horizontal reference station.

C. Crossings. When a water main crosses another public or private utility, irrigation or drainage ditch, the crossing design shall protect the main and utility’s structural integrity, prevent contamination of the main and mitigate future system impacts and costs of repair. The agency responsible for the utility, ditch, railroad or other structure crossed may also impose additional criteria.
   1. All crossings shall be clearly identified and dimensioned on the plan view and profile view (if included) on the PICPs.
   2. Water crossing over Wastewater/Stormwater/other Non-Potable Systems. When a public water main crosses these types of systems, the water main should cross above, with a minimum 18 inches vertical clearance from such system, and maintain cover pursuant to 4.3.3.A of these Standards.
      a. A vertical clearance of less than 18 inches may be allowed, with prior approval from the Department. In these cases, the Department may
also require encasement, joint wrap, frost protection, or the use of a solid steel casing pipe.

3. **Water crossing under Wastewater/Stormwater/other Non-Potable Systems.** When a public water main crosses under these types of systems, the water main should maintain 18 inches of vertical clearance from such systems.
   a. The joints of the non-potable utility shall be wrapped 10 feet either way of the crossing, at a minimum.
   b. Water mains crossing under or lowered under large utilities (36” in diameter and larger) shall be required to be installed in a steel casing pipe.
   c. A vertical clearance of less than 18 inches may only be allowed with prior approval from the Department.
      1) For small utility crossings (less than 36” diameter) with less than 18 inches of clearance: the entire width of the trench shall be flowfilled from springline of the water main to springline of the utility pipe.

D. **Lowerings.** In cases where a main cannot meet the separation requirements of the previous section, the main shall be lowered to cross underneath a wet or dry utility.

   1. All lowerings are subject to clearance and frost protection requirements noted in these Standards.
   2. Lowerings may be designed utilizing either manufactured bends or pipe-joint deflections (also known as vertical sweeps).
      b. Pipe-joint deflection for DI pipe. Each pipe-joint deflection shall not exceed 80% of that allowed by the Ductile Iron Pipe Research Association’s (DIPRA) current publication.
      c. Pipe-joint deflection for PVC pipe. Each pipe-joint deflection shall not exceed one (1) degree per length of pipe. If the Design Engineer would like to use a greater degree of deflection then they shall provide written information on the allowable joint deflection, along with written instructions on how the pipe shall be installed, by the manufacturer of the PVC pipe. Approval of this method may be allowed on a case-by-case basis.
   3. All lowerings shall be noted on the PICPs and specifically shown and designed in a “to-scale, engineered” profile view. Each profile view shall show horizontal stations for each bend, fitting, valve, casing ends and any deflections. Each profile view shall also show vertical distances and vertical elevations (to top of pipe), relative to the finish grade and to the utility(s) being crossed. Plan and Profile views shall show horizontal and vertical distances to other utilities or structures in the immediate area of the lowering.
      a. If pipe-joint deflection is used, each curved alignment section shall be labeled with curve data. Data shall include PC and PT stations (labeled
as Begin Joint Deflection and End Joint Deflection respectively), radius, delta, length, joint deflection per joint and pipe segment lengths.

4. Ditch Crossings/Lowerings. Crossings with Named Ditch Companies may require that the Ditch Company be contacted for their approval of each crossing. In addition to the requirements of these Standards, the Ditch Company may modify or add to the requirements of these Standards, provided the requirements are more stringent.

a. Steel Casing. The casing shall be of sufficient length so that the ends of the casing may be exposed without excavating in the ditch right-of-way/easement; a minimum of 10 feet beyond any toe or top of slope of the ditch. Refer to Section 4.4.10 Steel Casing Pipes and Standard Drawing W-104 for additional requirements.

b. Cut-Off Wall. A clay or concrete cut-off wall shall be placed on both ends of the casing pipe; extending vertically 1 foot above the maximum free surface water elevation of the ditch (or as required by the Ditch Company).

c. Cover, shall be 3 feet or more from the flow line of the ditch to the top of the casing pipe.

d. Valves. The crossing shall be isolated by valves near each end of the crossing/casing. Typically, in-line valves should be placed approximately 40 feet from each end of the casing pipe. Refer to Standard Drawing W-19 for additional requirements.

e. Rehabilitation. All ditches shall be restored according to the ditch owner’s criteria.

4.3.4 Frost Protection

A. General. To protect from frost, public water mains require a minimum of 4.5-feet of cover, from top of pipe to finished grade.

1. Open Conduits. To protect from frost, public water mains require a minimum of 3-feet of clearance between open conduits (e.g. stormwater boxes, pipes, and culverts) and other open channels that are exposed to the atmosphere and/or free flow of air.

2. Crossings/Lowerings. If 18” minimum clearance is provided at a crossing, insulation is required for large open conduits (36 inch diameter and larger).

3. Casings. Insulation is not required between open conduits and casings.

B. When minimum clearances cannot be obtained, insulation shall be provided to protect the public water main through the extents of the insufficient cover or crossing. The insulation needs to be provided plus an additional 10 feet beyond each end along the water main. The Design Engineer shall designate the insulation requirements (thickness x length x width) on the PICPs.

4.3.5 Dead-Ends/Stubs

A. The maximum length and size of a dead-end main shall be determined relative to the number of service lines and fire protection needs; however, in no instance shall a Public Water System main or fire hydrant lead having no
permanent taps/services exceed 250 feet. All temporary stubs used for phasing shall be considered dead-ends.

B. In cases where a main cannot meet these criteria, the main shall be designed to create a looped/redundant Public Water System with appropriate connections to an alternate portion of the City’s existing or proposed Public Water System.

C. All dead-ends/stubs shall terminate with a fire hydrant or blow-off (See Standard Drawings W-3 or W-5). A temporary 2-inch blow-off can be used for temporary stubs at phase lines which have no services. See Section 4.4.6.C and Standard Drawing W-6.

D. A tee post shall be placed at the terminus of all dead ends/stubs.

4.3.6 Access Roads

A. Access shall be encompassed by a Right-of-Way, Easement, or Tract.

B. Access roads shall be a minimum fifteen (15) feet in width and 8% maximum longitudinal slope. Access roads shall have a 2% crown or cross slope.

C. Access Roads shall be in the form of a permanent paved public street. Alternatively, Access Roads may be a permanent type material placed on a compacted stable subgrade. Approved materials are 6-inch thick CDOT CL-B concrete (compressive strength of 4,500 psi), 6-inch thick CDOT CL-5 aggregate, combination thereof, or other type approved by the Department.

D. Turning radius for Access roads should be designed for Type BUS-40 vehicles (per AASHTO) (40 foot centerline radius).

4.4 APPURTENANCES

4.4.1 Valves

A. Gate valves shall be used on water mains up to and including 12-inch diameter. Butterfly valves shall be used on water mains 16-inch diameter and above. Valves, including butterfly valves, shall be direct bury unless otherwise required by the Department. Placement of valves shall be as follows:

1. Typically, on each branch of all crosses and tees, for intersecting mains. Refer to Standard Drawing W-2.

2. No further than 600 feet apart, on Distribution mains.

3. No further than 1,200 feet apart, on Trans-Distribution mains.

4. No further than 2,600 feet apart, on Transmission mains.

5. Fire service lines and fire hydrant leads shall have a valve placed at the tee, on the main. Fire service line valves shall be supplied with a valve box and locking lid assembly.

6. Valves shall be placed on both sides of all encased crossings. Refer to Standard Drawings W-19.
7. A valve shall be placed at the terminus of a cul-de-sac in cases where a fire hydrant is required at the end of a cul-de-sac. The valve shall be located not closer than 5 feet from lip of gutter, or edge of pavement.

B. Valves and valve boxes shall not be located within any portion of a concrete gutter pan or cross-pan. Additionally, valves and valve boxes shall not be located closer than 2 feet to any lip of gutter or cross-pan.

C. Butterfly valve actuators/nuts shall be located on the north(ery) and west(ery) sides of all mains. See Standard Drawing W-23.

D. Valves within open field areas or areas to be developed in the future, shall depress the valve box lid to 6-inches below finished grade and cover the valve box lid with plastic or be at grade with a 2’ diameter x 4’ thick concrete pad around the valve box. The location shall be marked with a flexible carsonite marker post with reflective label stating “CITY OF LOVELAND WATER MAIN (OFFSET ___ FT).”

4.4.2 Tapping Saddles & Valves

1. These connections to an active water main are only allowed for a lateral size of one nominal pipe diameter less than the main size. (eg a 8”x6” tap).
   a. If there is a Key Facility that could be put out of water the Director of Water and Power may allow a size on size wet tap.

2. For all other connections a Tee connection is required.

4.4.3 Fire Hydrants

A. Spacing. The criteria noted herein are general guidelines and may be changed or varied due to use of sprinklers or other factors as determined by the Loveland Fire Rescue Authority (LFRA.).

1. Single-Family & Two-Family residential developments shall have fire hydrants spaced as follows:
   a. No portion of a structure shall be more than 300 feet from the hydrant as measured via the street.
   b. Hydrants shall not be placed more than 600 feet apart.

2. Multi-Family & Attached Single-Family developments shall have fire hydrants spaced as follows:
   a. No portion of a structure shall be more than 200 feet from the hydrant as measured via the street.
   b. Hydrants shall not be placed more than 400 feet apart.
   c. Multiple Hydrants may be required per LFRA criteria.

3. Commercial Mixed-Use & Industrial developments shall have fire hydrants spaced as follows:
   a. No portion of a structure shall be more than 175 feet from the hydrant as measured via the street.
   b. Hydrants shall not be placed more than 350 feet apart.
   c. Multiple Hydrants may be required per LFRA.
4. Streets. Where new water mains are extended along/within streets, and where fire hydrants are not required for protection of adjacent structures, fire hydrants shall be provided at a spacing not to exceed 1,000 feet. When the roadway is divided by a median, then fire hydrants must be placed on alternate sides of the roadway every 500 feet.

B. Locations
1. Intersections. Generally, fire hydrants shall be located at each street intersection. In addition to the horizontal dimension requirements noted in Standard Drawing W-3, hydrants shall be placed at the BCR (begin curve radius) or ECR (end curve radius) for curbs and/or sidewalks.
2. Mid-Block. Fire hydrants shall be placed between lots at the extension of the property line.
3. Cul-De-Sac. Fire hydrants shall be located at the entrance of all cul-de-sacs. Additional fire hydrants shall be located per section 4.4.2.A on cul-de-sac longer than 400 feet. A fire hydrant may be placed at the terminus of the water line at the end of the cul-de-sac.

C. Clearance / Cover
1. Fire hydrants shall be placed pursuant to Standard Drawing W-3.
2. There shall be no permanent structure or obstruction within 10 feet of the nearest edge of a fire hydrant. Shrubs and bushes (upon maturity) cannot be within 5 feet, tree trunks (upon maturity) cannot be within 10 feet of the nearest edge of a fire hydrant.
3. Hydrants shall be located within a Right-of-way or Easement.
4. Fire hydrant leads shall have a minimum 4.5 feet of cover from top-of-pipe to finish contour elevation.
5. Fire hydrant guards per Standard Drawing W-4 are required in areas where hydrants are located in traffic areas.

4.4.4 Thrust Restraint / Devices
A. All fittings (e.g. bends, reducers, tees, crosses, plugs/caps, fire hydrant tees to boots, valves, etc.) shall be restrained by a concrete thrust block or an approved mechanical joint restraint device.
B. Mechanical Joint Restraint
1. Mechanical joint restraint devices shall be used for the following, unless approved otherwise by the Department:
   a. All pipe joints within a casing
   b. All new construction fire hydrant laterals.
2. The required restraint length shall be determined by the Design Engineer for each occurrence and designated on the plan by stationing and/or shading.
3. For mains sizes larger than 12 inch: the Design Engineer shall specify the type of fitting joint, pursuant to these Standards, and in certain cases, may also be required to provide thrust/restraint calculations to determine if other and/or alternate thrust/restraint systems are necessary.
C. **Concrete Thrust Blocks:** Refer to Standard Drawings W-20 and W-21 for details and design of typical thrust block configurations.

D. **Gravity Blocks** are used for upper vertical bends: All vertical gravity blocks shall be sized by the Design Engineer and indicated on the plans.

4.4.5 **Services**

A. **General**

1. All portions of service lines shall be installed having a minimum of 4 feet (48 inches) and a maximum of 4.5 feet (54 inches) below finish contour elevation.

2. Domestic services taps shall be made off the Public Water System main and shall not be connected to any portion of a fire hydrant lead or fire service line.

3. **Booster Pumps/Tanks:** Booster pumps for domestic service that are proposed external to the building are allowed with an air gap/reduced pressure (RP) device only. Booster pumps or Tanks are not allowed for the sole purpose of decreasing the size of the tap/meter and service line. Booster Pumps are prohibited on irrigation systems.

B. **Domestic Service Types/Scenarios** Notwithstanding the applicable provisions of the City’s Municipal Code, Title 13, the following scenarios shall apply:

1. **Residential Single Family, Duplex or Townhome:** A type of dwelling unit whereby each unit is situated upon its own separate, platted lot, shall be serviced individually by one tap, service line and meter (including meter pit) for each platted lot.

2. **Residential Multi-Family:** A type of dwelling unit containing three or more residences whereby each residence is not situated upon its own separate, platted lot shall be serviced by one tap, service line and meter (including meter pit or vault) for each Multi-Family dwelling unit (e.g. master meter).

3. **Commercial:** A building with one or more internal tenant spaces whereby each tenant space is situated on its own separate, platted lot shall be serviced individually by one tap, service line and meter (including meter pit or vault) for each platted lot.

4. **Commercial:** A building with one or more internal tenant spaces whereby each tenant space is not situated upon its own separate, platted lot may be serviced by one or more taps, service lines and meters (including meter pit or vault) for each building and/or tenant space.

5. **Industrial:** See Commercial service scenarios.

C. **Irrigation Services**

1. Irrigation Services Taps and service lines may be made off the Public Water System main with a dedicated meter or off the customer side of a domestic service line.

2. **Irrigation System Design - Pressures in the water system fluctuate through the year. Historically high demand peak irrigation season is June through**
August. The Design Engineer is responsible to verify the minimum water system pressures occurring seasonally and throughout the day, especially during peak demand periods.

a. Contact Department Staff to determine a preliminary design pressure range based off of our design model. The design model uses a conservative time extended period simulation of the max day demand.

b. Use the low end of the preliminary design pressure range for the irrigation design.

c. The applicant will be responsible to verify the final pressure at the time of final design.

3. Dedicated irrigation system meters shall be designed based on the available flow through the meter at the project site, but shall not exceed the flows set forth set by the manufacturer.

4. A meter justification letter is required for dedicated irrigation meters. See Section 4.4.5. The letter needs to be signed and/or stamped by a certified landscape or irrigation designer.

D. Fire Services

1. Approved fire sprinkler systems
   a. NFPA 13 (Commercial) and NFPA 13R (Low-rise residential structures up to and including 4 stories). These fire service lines:
      1) Shall have separate, dedicated taps off the Public Water System main.
      2) Shall not be tapped off any portion of a domestic service line.
      3) Shall be 4 inches to 12 inches, unless hydraulic calculations from the licensed fire-sprinkler designer can confirm a smaller diameter can meet supply requirements.
      4) Shall be designed with an isolation valve at the point of connection to the Public Water System main. All isolation valves shall have locking type lids inserted in the valve box assembly.
      5) The minimum tap and valve size shall be 4 inches.
   b. NFPA 13D and P2904 fire sprinkler systems are approved to protect one- and two-family dwellings. These fire systems can be designed using the domestic water line or a separate fire service line. A tank and pump system may also be used for NFPA 13D systems but these are not directly connected to the Public Water System. Water supply requirements are specified in NFPA 13D or the International Residential Code (P2904 systems).
      1) A property requiring a new domestic service line and a new fireline connection may be served from a single tap off of the Public Water System at the City’s discretion.
      2. Fire service lines shall be considered privately owned and maintained, from the connection of the service line into the isolation valve, continuing on to a building structure.
      3. Fire service lines shall be located a minimum of five (5) feet from any domestic service line.
4. Fire service lines shall not be tapped off any portion of a fire hydrant lead.

5. Fire service lines are not required to be metered.

6. Companies installing underground fire service lines from the Public Water System main to the fire sprinkler risers must be registered as State of Colorado Fire Suppression System Contractor – Underground per current requirements of Colorado Division of Fire Prevention and Control.

4.4.6 Meters

A. Types

1. Single Meter Configuration and vault dimensions are detailed in Standard Drawings.

2. Multiple Meter Individual meters in a multiple meter configuration may not exceed 3/4 inch, with a maximum of five meters within one vault.

B. Location shall be per standard detail. Meter pits and vaults should not be installed within any parking area or parking stall, driveway, alley, or sidewalk area. In certain cases, and with prior approval of the Department, pits and vaults may be installed within these areas, provided appropriate easements, access, and traffic loads are adequately accommodated.

1. In areas where high ground water may inundate 3/4 or 1-inch meter pits, the Developer shall be responsible for the additional cost for NSF-61 epoxy-coated meters.

2. Landscape and structures (e.g. trees and shrubs (upon maturity), boulders, retaining walls, drainage facilities, utility vaults, poles, etc.) shall not be within 10 feet of any outside edge of a meter pit or vault.

C. Couplings Other than a curb stop valve, there shall be no more than one additional coupling/splice in a service line between the corporation stop and meter.

D. Meter/Service Line/Tap sizes For all single meter installations (except for 3 inch meters), the tap/valve and service line shall be the same nominal size as the meter. For 3 inch meter installations, the tap/valve and service line shall be 4 inch diameter with a 4”x3” reducer before the meter.

E. Meter Sizing

1. All meters depicted in PICPs shall be sized by the Design Engineer to properly accommodate projected peak flows for domestic and, in some cases, irrigation use.

2. Meter and service line sizing shall be based on the current version of the I.P.C.

3. The maximum allowable flow rate for any meter shall be per Positive Displacement guidelines as shown in Table 6-1- AWWA meter standards and provided below:

<table>
<thead>
<tr>
<th>Meter size (inches)</th>
<th>Max Flow Rate (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>30</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
</tr>
</tbody>
</table>
4. The final capacity of a water meter in the City’s system is based upon system pressure and tap diameter and there is no guarantee of a meter capacity based upon a given size.

F. Meter Justification Letter
1. Required for all commercial, industrial, irrigation and multi-family (3 units or greater) water meters.
2. The Meter Justification Letter should be addressed to the Department and shall include the following:
   a. Reference to the project name/location,
   b. Reference the version of the IPC manual used for the sizing calculations,
   c. A summary table of the proposed/existing fixture counts, total fixture unit count, and equivalent gallons per minute demand flow,
   d. The total flow will need to include irrigation or reference why it is not being included,
   e. A statement of the meter size and type chosen (reference the size and type of Sensus meter), and
   f. The contact information of the Design Engineer,
   g. The letter will need to be sealed and signed by the Design Engineer.

4.4.7 Air Relief Valves
A. On water mains 12-inch diameter and larger, a combination air valve, air-release valve and air/vacuum valve, (ARV’s) shall be provided at all high points. ARV’s placement and design shall use A.W.W.A. M-51 design criteria. ARV’s shall be placed in manholes or vaults. See also Standard Drawings W-14 and W-15.

4.4.8 Blow-Off Valves/Structures
A. On water mains 12-inch diameter and larger, in-line blow-off valves shall generally be placed at severe low points, lowerings and/or at crossings. The Department will assist the Design Engineer in determining sizes and placement of blow-off valves/assemblies. Refer to Standard Drawing W-16.
B. Dead-end blow off hydrants are typically used at permanent dead ends. Refer to Standard Drawing W-5.
C. 2-inch temporary construction blow-offs can be used for stubs at phase lines which have no services.
1. The main between the temporary blow-off and the nearest inline valve shall be emptied of water after final testing and acceptance.

2. A 2-inch tap with a 90 degree vertical bend may be made directly into the cap of the main. The bend should be connected to a short section of 2-inch diameter pipe with a 2-inch curb stop valve. This valve shall be closed after the blow has been completed.

3. All fittings for temporary 2-inch blow-offs shall be brass.

4. An adequately sized concrete thrust block shall be poured behind the stub.

5. The blow off may be buried after completion. The location of blow off shall be marked with a tee post.

4.4.9 Pressure Reducing Valves

A. Pressure reducing valves shall be installed with prior approval from the Department. Refer to Standard Drawing W-13.

4.4.10 Backflow Prevention Assemblies

A. To prevent contamination of the City’s potable water system, a backflow prevention assembly shall be installed where backflow or back-siphon from a private water user’s system may exist. The assembly shall be placed on the customer side of the water meter and installed per Colorado Cross-Connection Control Manual.

4.4.11 Steel Casing Pipes

A. The Department reserves the right to require a specific pipe material for any public water main installation.

B. All joints of the water main within the casing shall be restrained together to be able to retract the pipe in the future.

C. Each casing pipe installation shall be specifically designed by the Design Engineer.

D. The need for cathodic protection of steel casing pipes shall be evaluated with a soil-test evaluation in accordance with Section 4.4.11.A.

1. At a minimum a single 17 lb anode and CP test station is required on each end of a steel casing pipe.

E. CP design requirements shall be in accordance with Section 4.4.11.B

4.4.12 Corrosion Control for Metallic Pipe and Fittings

A. Soil-Test Evaluation

1. In all cases where metallic pipe will be used (DIP or Steel), the Design Engineer shall have a certified Geotechnical Engineer perform a soil-test evaluation in strict accordance with AWWA C105, Appendix A (also commonly known as a 10-point soils test) and submit the results of the evaluation to the Department for consideration and review.

   a. The Water-Saturated Soil Box method shall be used to measure the resistivity of the soil.
b. The distance between sample locations shall be at the discretion of the Department, however testing frequency shall not be less than one test for every 400 linear feet of pipe.
c. Soil samples shall be taken at pipe depth.
d. Soil samples shall be tested in saturated condition.

B. Cathodic Protection (CP) Design

1. If the results of the 10-point soils test concludes the soil is corrosive to metallic pipe (10 points or greater), the Design Engineer shall submit to the Department for approval a comprehensive plan with proposed design for cathodic protection. The design shall be completed by a registered PE and National Association of Corrosion Engineers (NACE) certified CP Technologist Certification or higher.

2. Anodes & CP Test Stations: Shall be installed as specified by the results of the CP design.

C. Isolation: Protected water mains shall be insulated from unprotected mains in all cases as necessary. Insulating flanges shall be required for pipe connections which are dissimilar metals. Insulators shall also be required at the outlet end of corporation stops.

D. Joint Bonding: All DIP joints shall be bonded over with the use of copper wires or plates.

E. Polyethylene Encasement: Required for all DIP and/or fitting.

4.4.13 Groundwater Barriers

A. Groundwater barriers for the water system are not typically required. However, in cases of high groundwater, the Department reserves the right to require groundwater barriers for the water system. This requirement may be enforced by the Department at any time during the project. Reference Standard Drawing W-103.

B. Groundwater barriers shall be designed to impede passage of groundwater through the entire portion of the excavated trench.

C. Groundwater barriers shall extend through the full depth of the granular bedding/pipe zone material and project 1 foot beyond each side of the trench wall. Groundwater barriers shall extend to a point 1 foot above the maximum peak wet season level of sub-surface groundwater as determined by the design engineer, but not less than 3 feet above the top of the pipe. This requirement applies in all cases, including those locations near or adjacent to a natural waterway, pond/lake, or irrigation ditch. Other requirements may apply due to specific criteria from each ditch company.

4.5 EASEMENTS/TRACTS

Easements or Tracts shall encompass all portions of the Public Water System that may extend beyond or outside a platted right-of-way. Easements, when dedicated by a Final Plat, shall be designated as Public Utility Easements, exclusively for the Public Water System. Alternately, Easements conveyed by separate instrument
shall be granted pursuant to the Department’s Grant of Easement forms. Tracts, when encompassing public water mains and related appurtenances, shall also be designated as Public Utility Easements.

4.5.1 **Width of Easement or Tract/Main location**

A. The minimum width for an Easement and Tract shall be 25 feet. In no case shall a main or related appurtenance be located closer than 10 feet to the nearest Easement, Tract or private lot line.

B. Mains located between two private lots and not within a Tract, shall be placed within an Easement. The Easement shall be situated entirely on one lot or the other with the main located within the Easement as noted in 4.5.1. A, herein.

C. Easements containing more than one water main shall be increased by an additional 6 feet for each additional main.

D. Easements containing both water and wastewater mains shall be a minimum 30 feet in width.

4.5.2 **Hydrants & Meters and Other Appurtenances**

A. Hydrants, meter pits, meter vaults and other related appurtenances shall generally be centered within a designated Easement. At a minimum, Easements shall extend 10 feet *beyond* all sides of any hydrant, hydrant lead, meter pit, vault or other Public Water System appurtenance.

4.5.3 **Restrictions within Easements and Tracts.**

A. **Permitted Improvements.** Pavement, sidewalks, bike paths, minor swales and berms and certain landscape features may be allowed within an Easement or Tract that encompasses a Public Water System main.

B. **Landscape Restrictions** See Section 4.3.2.B

C. **Prohibited Improvements.** Structures, *e.g.* permanent concrete base “kiosk” or clustered mailboxes, sheds, light poles, overhanging decks, buildings (with permanent or temporary foundations), permanent fences and other substantial structures, shall not be allowed within any portion of an Easement or Tract designated to encompass a Public Water System.
## CHAPTER 5 -

WASTEWATER DESIGN CRITERIA

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CHAPTER 5 - WASTEWATER DESIGN CRITERIA

5.1 GENERAL

This chapter specifies the minimum standards necessary for system analysis, layout and design of Public Wastewater Systems. Wastewater main sizes and general system layout will typically be provided by the Department, based on dynamic analysis using the City’s hydraulic model and proposed demands related to the Development Project Area.

In addition to these Standards, alternate Resource Standards may be used or required, pursuant to Chapter 1, Section 1.3 of these Standards.

5.1.1 Separate Requirements and Standards

There are separate requirements and standards for Pre-Treatment and Lift Stations which may be obtained from the Department.

5.1.2 Conformance to Standards and Master Plans

A. All Public Wastewater Systems shall conform to these Standards, the most current version of the W&WMP and other applicable Codes and Standards approved by the Department.

B. Where these Standards are not specific, alternate and/or additional Resource Standards may be used, providing the more stringent requirement is used. The Department shall approve the use of any alternate and/or additional Resource Standard, prior to inclusion of such standard within any Development Project Area or PICP.

5.1.3 Standard Drawings for Public Wastewater Utility Systems

A. Appendix G includes Standard Drawings; these drawings shall be used when typical scenarios of design and construction warrant such use. When used, Standard Drawings shall be annotated onto Utility Detail sheet(s) of PICPs and referenced on each PICPs plan sheet.

B. Each Standard Drawing depicted on Utility Detail sheet(s) shall include the entire content of the original approved drawing (e.g. borders, title blocks, dates, notes, etc.). Any alteration to a Standard Drawing must first be approved by the Department. If approved, alterations must be clearly marked “Revised – Project Name” in bold font and shall depict any revisions by cloud and delta designation.

5.1.4 Acceptable Materials --For materials see Appendix F of these Standards.

5.2 ANALYSIS CRITERIA

5.2.1 W&WIDA

In conjunction with the City’s Development Review Process, the Department may request the Design Engineer submit a W&WIDA report concurrent with a development application.
5.2.2 Contents & Format of the W&WIDA

At a minimum, the following shall be contained in the W&WIDA:

A. Project location and description: Text identifying the location of the Development Project Area, the nature of the proposed development and the land use. Provide the proposed project zoning and density (DU/acre).

B. Identify the existing wastewater system and proposed connection points to the Public wastewater system. Provide the Master Plan analysis for the area. Identify any offsite areas contributing to the flow.

C. Calculate wastewater demands for all initial and future phases. Provide as a flow rate in gallons per minute (gpm) and gallons per day (gpd).
   1. Average Daily Flow (ADF)

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Typical ADF/unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td></td>
</tr>
<tr>
<td>Single Family Residential and Single Family Attached (2 units)</td>
<td>200 gpd/DU</td>
</tr>
<tr>
<td>Multi-family Residential (3 units or more) as Single Family Attached or condos</td>
<td>160 gpd/DU</td>
</tr>
<tr>
<td>Non-Residential*</td>
<td></td>
</tr>
<tr>
<td>General Commercial: Retail/Offices</td>
<td>0.1 gpd/SF</td>
</tr>
<tr>
<td>Hotels/Motels</td>
<td>75 gpd/room</td>
</tr>
<tr>
<td>Restaurants</td>
<td>1.5 gpd/SF</td>
</tr>
<tr>
<td>Industrial/other commercial</td>
<td>600 gpd/acre</td>
</tr>
<tr>
<td>Institutional</td>
<td>400 gpd/acre</td>
</tr>
</tbody>
</table>

*Alternate types of demands can be considered for site specific uses that may not fit into these categories.

2. Peak Design Flow (PDF)

\[
PDF = PF \times ADF + I/I \text{ allowance}
\]

where

\[
PF = 1 + 14/(4+P^{1/2}) \ [\text{Harmon’s Peaking Factor}] \text{ with maximum PF of 5.}
\]

\[
P = \text{the design contributing population in thousands}
\]

\[
\text{Population} = 2.5 \ \text{people/DU}
\]

\[
ADF \text{ is in million gallons per day (MGD)}
\]

\[
I/I \text{ allowance} = 0.1 \times ADF
\]

D. Provide a modeling analysis for the proposed wastewater system showing all collection lines and connections to the existing wastewater system. Provide
an output data report and a corresponding network map showing manholes and pipes.

1. Data report shall include a table of pipe segments, inverts, depths, slopes, minimum and maximum design flow rates, minimum and maximum velocity, and maximum d/D.

2. For all large area analysis the design shall route flows through the proposed piping network and take into account the length of pipe and time of concentration within the pipe.

E. The design shall verify the Minimum Hydraulic Performance Criteria for allowable Depth and Velocity.

F. Discuss the proposed design results. Identify the needs for any special improvements. Identify any needs for oversizing pipes in conjunction with the Master Plan. If a lift station is proposed, provide justification and discuss why other alternatives to a lift station were not chosen.

G. Discuss any deviation from these Standards and provide justification for any proposed variances. All such variances must be approved by the Department prior to approval of the Development Project Area, by Planning Commission and City Council.

H. The report shall include an overall map showing wastewater collection system layout with the following information:

1. Map Scale (max 1” = 200 ft.), North Arrow, Vicinity Map
2. Proposed and existing Easements and Rights-of-way
3. Offsite wastewater mains, proposed basin delineation and future areas that could be serviced by a main or lift station.
4. Topography, utility crossings, and any proposed lift stations.
5. Other existing and proposed utilities that might affect the proposed system layout or performance.

5.2.3 Hydraulic Design

A. Sizing. The wastewater design flow shall be the daily peak flow plus wet weather infiltration and inflow. Downstream of a lift station force main, the maximum pumping rate must also be included.

1. **Manning’s Equation** shall be used to compute the required pipe size.

\[
Q = \frac{1.486}{n} \cdot A \cdot R^{\frac{2}{3}} \cdot \sqrt{S}
\]

- \(Q\) = flow in (cfs)
- \(n\) = Manning's Coefficient 0.013
- \(A\) = Area of Flow (ft^2)
- \(R\) = Hydraulic Radius (A/P)
- \(S\) = Slope of Pipe (ft/ft)

Where \(P\) = wetted perimeter

2. **Minimum Sizes.** The minimum size for any public wastewater main is 8 inch. The minimum private service size is 4 inch.
3. Force mains. Force Main sizing is addressed in a separate Sewage Lift Station Standards document.

B. Depth. The maximum allowable depth to diameter ratio in a wastewater main shall be \( d/D = 0.5 \) for sewers up to 15 inch diameter, for wastewater mains larger than 15-inch a \( d/D = 0.75 \) is allowable.

Where: \( d = \) Depth of Flow
\( D = \) Diameter of Pipe

C. Velocity. The wastewater mains should be designed so that the design flow is greater than 2 fps. Upon written approval of the Department, the design flow may be lower than 2 fps. However, in no case shall it be less than 1.5 fps. The design velocity shall not exceed 10 fps.

D. Slopes. The following table gives the minimum and maximum allowable slopes for wastewater mains. The minimum slopes are based on a mean velocity of 2 fps when the pipe is full, and the maximum slopes are based upon a velocity of 10 fps when the pipe is flowing full. In no case shall service line slope be less than 0.0104 ft/ft.

<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>Minimum Slope (Percent)</th>
<th>Maximum Slope (Percent)</th>
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<tr>
<td>Services</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>2.08%</td>
<td>21.02%</td>
</tr>
<tr>
<td>6</td>
<td>1.04%</td>
<td>12.25%</td>
</tr>
<tr>
<td>Mains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.40%</td>
<td>8.34%</td>
</tr>
<tr>
<td>10</td>
<td>0.28%</td>
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<tr>
<td>12</td>
<td>0.22%</td>
<td>4.86%</td>
</tr>
<tr>
<td>15</td>
<td>0.15%</td>
<td>3.61%</td>
</tr>
<tr>
<td>18</td>
<td>0.12%</td>
<td>2.83%</td>
</tr>
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<td>21</td>
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<td>2.30%</td>
</tr>
<tr>
<td>24</td>
<td>0.08%</td>
<td>1.93%</td>
</tr>
</tbody>
</table>

5.3 WASTEWATER SYSTEM LAYOUT AND COMPONENTS

5.3.1 General

The City’s Public Wastewater System includes Interceptor, Trunk and Collection mains (gravity and force) and related appurtenances. Other specific Public Wastewater System components may include Lift Stations.

Typically, within a Development Project Area, wastewater mains and related appurtenances are owned and operated by the Department and located within an Easement, Right-of-way or Tract. These mains and related appurtenances shall meet the requirements noted in these Standards.

Utility locations, alignments and separations noted herein are required for new construction, rehabilitation and retrofit areas.

Additionally, it is critically important within each Development Project Area that the site layout be designed in a manner that accommodates acceptable access for future maintenance by the Department. For each Development Project Area, the Design Engineer shall make provisions regarding applicable utility and hard
surface separation requirements, as well as Easement and/or Tract widths, noted in these Standards.

5.3.2 Horizontal

A. Location Within the platted right-of-way or Easement, main(s) should be located at the centerline of the right-of-way or Easement. In cases where a raised median is proposed, the main shall be located 10 feet west or south of the centerline, outside of the raised median flow-line. Manholes should be located such that they are not within the wheel travel path of vehicles and in no case, be located closer than 5’ to the lip of curb and gutter.

B. Separation

1. Water & Storm Drain shall be located a minimum of 10 feet horizontally clear from any portion of the public wastewater system.
2. Dry Utilities (e.g. natural gas, electric, cable TV, and telephone/communications and all appurtenances) shall not be closer than 6 feet (outside edge to outside edge) to any portion of the public wastewater system.
3. Underdrains not specifically designed to mitigate trench stability for the public wastewater system, shall be a minimum 10 feet horizontally clear from any portion of the public wastewater system.
4. Other Features
   a. Curb & Gutter, sidewalks, medians and other minor structures: Shall be located a minimum of 10 feet from any proposed Public Wastewater System main and related appurtenance, unless crossed perpendicular. The Department may require a casing pipe when crossing perpendicular to major curbed medians or other major structures.
   b. Landscape Features: The outside edge of any shrub or bush (upon maturity) shall not be allowed within 5 feet of the nearest outside edge of a public wastewater main and/or any related appurtenance. The outside edge of any tree trunk (upon maturity) shall not be allowed within 10 feet of the nearest outside edge of a public wastewater main and/or any related appurtenance.
   c. Berms greater than 2 feet high and/or with side slopes steeper than 4:1 shall not be allowed within 10 feet of a public wastewater main and/or any related appurtenance.
   d. Permanent signs, walls, etc. shall not be allowed within 10 feet of a public wastewater main and any related appurtenance.

C. Alignments

1. Straight. Public wastewater mains shall be laid with straight alignments between manholes. Joint deflection shall not be allowed.
2. End of run. All runs shall end in a manhole, including runs that may terminate at a future construction phase line.
   a. Cul-de-sac. Mains shall be extended to an acceptable point within the cul-de-sac and terminated in a manhole.
b. **Last lot.** Mains shall extend at least 10 feet past the nearest lot corner of the last lot to be served by the Public Wastewater System and terminated in a manhole.

### 5.3.3 **Vertical**

**A. Cover.** Normal bury depth for wastewater mains is generally 8 feet of cover from finish grade to top-of-pipe. Minimum depth of cover shall be 3 feet, as measured from finished grade to top-of-pipe.

1. **Deep Mains.** When mains have greater than 20 feet of cover, calculations shall be submitted by the Design Engineer showing the proposed pipe material and bedding design is adequate, from a short and long term structural standpoint.

**B. Crossings.** When a wastewater main crosses another public or private utility, irrigation or drainage ditch, the crossing design shall protect the main and utility’s structural integrity, and mitigate future system impacts and costs of repair. The agency responsible for the utility, ditch, railroad or other structure crossed may also impose additional criteria.

1. **Wastewater crossing over or under Water Systems.** See Section 4.3.3.C
2. **Wastewater crossing over Storm Drain Systems.** When a public wastewater main crosses these systems the wastewater main should cross above, with a minimum 18 inches vertical clearance from the storm drain, and maintain cover pursuant to 5.3.3.A of these Standards.
   a. A vertical clearance of less than 18 inches may be allowed, with prior approval from the Department. For large storm drains (36 in diameter and larger) with less than 18 inches of clearance: the entire width of the wastewater main trench shall be flowfilled.
3. **Wastewater crossing under Storm Drain Systems.** When a public wastewater main crosses under these systems the wastewater main should maintain 18 inches of vertical clearance from such systems.
   a. A vertical clearance of less than 18 inches may be allowed, with prior approval from the Department.
      1) For small storm drains (less than 36” diameter) with less than 18 inches of clearance: the entire width of the storm drain trench shall be flowfilled from 4” below springline of the wastewater main to springline of the storm drain.
      2) For large storm drains (36” in diameter and larger) with less than 18 inches of clearance: the wastewater main shall be installed in a steel casing pipe.
   b. Wastewater mains crosses under large utilities (36” and larger) shall be required to be installed in a steel casing pipe.
4. **Ditch Crossings.** Crossings with Named Ditch Companies may require the Ditch Companies be contacted for their approval of each crossing. In addition to the requirements of these Standards, the Ditch Company may modify or add to the requirements of these Standards, provided the requirements are more stringent.
a. Steel Casing. The casing shall be of sufficient length so that the ends of the casing may be exposed without excavating in the ditch right-of-way/easement; a minimum of 10 feet beyond any toe or top of slope of the ditch. Refer to Section 5.4.5 Steel Casing Pipes and Standard Drawing W-104 for additional requirements.

b. Cut-Off Wall. A clay or concrete cut-off wall shall be placed on both ends of the casing pipe; extending vertically to 1 foot above the maximum free surface water elevation of the ditch (or as required by the Ditch Company).

c. Cover, shall be 3 feet or more from flowline of the ditch to the top of the casing pipe.

d. Ditch Rehabilitation. All ditches shall be restored according to the ditch owner’s criteria.

5.3.4 Future Connections

A. Extension into Future Phases: In cases where a main will extend into a future phase within the Development Project Area, the main shall terminate into a permanent manhole. The manhole shall be located not closer than 10 feet to a phase line and shall be contained within an easement or right-of-way. The manhole shall also include “knockouts” or 3 feet of pipe stub-out w/cap, to accommodate any future connection(s). See also Standard Drawings WW-2 and WW-3.

B. Temporary, Dead-End Streets. Mains within temporary dead-end streets shall also conform to all requirements of LCUASS Section 7.6.4.

5.3.5 Access Roads

A. Permanent unobstructed access to every manhole is required.

B. See Section 4.3.6 for Access Road requirements.

5.4 APPURTENANCES

5.4.1 Manholes (new cast-in-place and pre-cast)

A. Placement

1. **Spacing.** Maximum spacing between manholes shall be 500 feet with typical spacing at 400 feet.

2. **Points of Change.** Manholes shall be placed at every change in direction, grade, size of main and at connections to existing Public Wastewater System mains. Manholes shall typically not be allowed to have less than a 90 degree angle between the incoming and outgoing mains.

3. **End of runs.** Manholes shall be placed at the end of all wastewater runs, regardless of permanent or temporary status.

4. **Location.** Manholes should not be located in the traveled-way/wheel path of a paved public street.
a. Manholes on runs crossing field areas may be buried only with prior Department approval. Bury depth should not exceed 3 feet. Field markers shall be used to designate location.

5. Watertight. Typically, manholes should not be placed in areas subject to surface runoff, flooding or ponding. If placement of manholes within these areas cannot be avoided, all barrel, cone and base joints shall be permanently watertight and shall also have watertight ring and covers.

6. Locking Lid. Manholes placed within areas designated by the Department as “restricted access”, shall have a locking lid with the rim permanently bolted to the manhole cone section.

B. Size. Manholes shall be sized according to Standard Detail WW-2. Sizes are minimums, based on straight/through alignments. Larger manholes may be required to accommodate multiple incoming mains or large radius horizontal flow-line channel bends.

C. Inverts

1. Drops. Manholes shall have a minimum 0.1 feet flow-line channel drop on straight/through alignments. Manholes with horizontal flow-line channel bends greater than 30 degrees and/or with interconnecting mains, shall have a minimum 0.2 feet drop between all incoming flow-line channel invert elevations and the downstream flow-line channel invert elevation.

2. Size Change.
   a. When a smaller main joins a larger main, the mains shall be typically set such that elevation of the crowns of the two pipes are equal.
   b. For lateral connections to interceptor mains, the invert of the lateral should be placed at the crown of the interceptor. This includes service line connections.

D. Drop Manholes are discouraged and may be allowed on a case-by-case basis. Prior to approval of a drop manhole, the Design Engineer must provide alternatives for review and consideration by the Department. If approved, drop manholes shall be designed as follows:

   2. Internal Drop. Preferred for deep wastewater mains when the external drop structure would be infeasible. See Standard Drawing WW-5.

E. Hydrogen Sulfide Resistance. Manholes located in areas with a high probability of hydrogen sulfide corrosion shall be constructed with, or coated with, Hydrogen Sulfide resistant materials. (See Appendix F for approved materials) Typical locations for such manholes include, at force-main discharge points, drop manholes or on large diameter mains with turbulent flows.

   1. Calming Manholes. Manholes located at the terminus of a force main shall be coated with Hydrogen Sulfide resistant materials. If the force main is privately owned and maintained then the Calming Manhole shall also be private, with the public portion beginning at the gravity outlet of the Calming Manhole.
2. The number of manholes to be coated with Hydrogen Sulfide resistant materials downstream of a Calming Manhole is two (2) at a minimum. Additional manholes may be required to be coated by the Department based on the size of the force main discharge.

3. The Department shall first approve all cases and locations, prior to signing final PICPs.

5.4.2 Groundwater Barriers / Cut-Off Walls

A. Groundwater barriers and/or Cut-off walls shall be installed with all Public Wastewater Systems. See also Standard Drawings WW-7 and W-103.

B. Groundwater barriers shall be designed to impede passage of groundwater through the entire portion of the excavated trench.

C. Groundwater barriers are typically located upstream of wastewater manholes. Groundwater barriers shall be spaced a maximum distance of 400 feet apart.

D. Groundwater barriers/walls shall extend through the full depth of the granular bedding/pipe zone material and project 1 foot beyond each side of the trench wall. Groundwater barriers/walls shall extend to a point 1 foot above the maximum peak wet season level of sub-surface groundwater as determined by the design engineer, but not less than 3 feet above the top of pipe. This requirement applies in all cases, including those locations near or adjacent to a natural waterway, pond/lake, or irrigation ditch.

E. Groundwater barriers/walls shall be installed on both sides of any natural waterway, pond/lake, or irrigation ditch. Other requirements may apply due to specific criteria from each ditch company.

5.4.3 Services

A. General

1. All wastewater service lines, from the point of connection (including the physical connection joint to a main or to a manufactured wye/saddle) into a residential, commercial or industrial building, shall be owned and maintained by the respective building and/or property owner.

2. For that portion of a service line situated within the right-of-way or easement, the Department shall review, approve and monitor all materials and installation of said service line, pursuant to these Standards and the City’s Municipal Code, Title 13.

B. Location/Size

1. Typically, service line sizes are 4 and 6 inch. Lines 8 inch and larger are generally regarded as being part of the Public Wastewater System. See Section 5.2.3 for minimum and maximum grades. See also Standard Drawing WW-6.

2. The maximum number of service line connections into any manhole shall be three.

3. Within the right-of-way or easement, the service line shall not have any additional bends or fittings beyond the 45° wye (GxS or Gasket x Spigot), except as needed as approved by the City.
4. Within the right-of-way or easement the service lines shall be located a minimum of 10 feet clear from any portion of the Public Water System (measured between the closest edges).

5. Service lines shall not cross any portion of an adjacent private lot without being situated in a private easement.

6. A joint/shared service line may cross portions of adjacent private lots; provided a JSSA is executed between the parties and, any appropriate private easement(s) is executed to the satisfaction of this Department. A JSSA form can be obtained from the Department.

C. Service Types/Scenarios - Notwithstanding the applicable provisions of the City’s Municipal Code Title 13, the following service scenarios shall also apply.

1. Residential Single Family, Duplex, Townhome A type of dwelling unit whereby each unit is situated upon its own separate, platted lot, shall be serviced individually by one service line for each platted lot.

2. Residential Multi-Family A type of dwelling unit containing 3 or more residences whereby each residence is not situated upon its own separate, platted lot, shall be serviced by one common private service line for each dwelling unit.

3. Commercial A building with one or more internal tenant spaces whereby each tenant space is not situated on its own separate, platted lot shall be serviced by one common private service line for the entire building. All service lines shall connect into a manhole(s).

4. Industrial See Commercial service scenario.

D. Private mains – Typically all mains 8” and larger shall be considered public. Any service line that is upsized to 8” or larger based on slope concerns is still considered a private service. Because the private wastewater system is connected to the public wastewater system all private mains and manholes shall be installed per the criteria for public mains and manholes. Private manholes shall meet the standards required for vacuum testing. Inspection results will need to be provided to the inspector prior to initial acceptance.

5.4.4 Grease, Sand / Oil Interceptors

A. General

1. Sand / Oil and Grease Interceptors are privately owned and maintained, and shall be shown on the PICPs. The interior piping shall be installed in accordance with Standard Details WW-8 and WW-9.

2. Unless approved otherwise by this Department, interceptor vaults shall be located external to the building being served. The interceptor shall also be situated upon the dedicated, platted lot for the building served. The interceptor shall not be located in a drive-thru area and location in parking spaces should be avoided. The entire portion of each interceptor vault shall be accessible at all times for pumping, maintenance and inspection.

3. Interceptors shall have two compartments; the smallest (outlet side) shall be at least one-third the capacity of the entire interceptor.
4. Grease interceptors shall provide a minimum of thirty (30) minutes retention time at peak flow for removing fats, oils and grease from the wastewater flows.

5. Interceptor capacity shall be sized by the Design Engineer using the City’s most current adopted Building and Plumbing Codes, or other acceptable methods of sizing. Sizing calculations shall be provided at the time of building permit.

6. If the calculated volume/size is within 10% of the next smallest available size of interceptor, the smaller interceptor may be approved for installation.

B. Grease Traps
1. Reference the Plumbing Code, as adopted by the City of Loveland.

2. A flow control or restrictor device is required. If the device is external to the grease trap it must be accessible at all times for maintenance and examination.

3. Grease traps rated at less than 50 gpm/100 lbs. capacity are not permitted.

4. Grease traps shall be accessible at all times for cleaning, maintenance and examination.

5. Grease trap locations shall comply with Larimer County Health Department requirements.

C. Combination Sand and Oil Interceptors
1. Combination sand & oil interceptors smaller than 300 gallons shall not be allowed.

D. Venting
1. Interceptors shall be vented in accordance with the City’s current adopted Building and Plumbing Codes.

E. Seal joints/openings
1. Piping through interceptor walls shall be sealed with an approved sealant for the intended use of the interceptor to prevent infiltration and exfiltration.

2. Appropriate sealant shall be used to join applicable interceptor sections to prevent infiltration and exfiltration.

F. Domestic Waste
1. Domestic wastewater shall not enter or flow through any portion of an interceptor. All domestic wastewater flows shall connect into a service line pursuant to 5.4.3.B herein and downstream of any interceptor.

G. Certification
1. The Design Engineer may be required to certify the appropriate treatment device was installed in accordance with final signed PICPs and manufacturer’s recommendations. A certification form may be obtained from the Department.
5.4.5 Steel Casing Pipes  
A. Each casing pipe installation shall be specifically designed by the Design Engineer.  
B. The need for cathodic protection of steel casing pipes shall be evaluated with a soil-test evaluation in accordance with Section 4.4.11.A.  
   1. At a minimum a single 17 lb anode and CP test station is required on each end of a steel casing pipe.  
C. CP design requirements shall be in accordance with Section 4.4.11.B.  

5.5 EASEMENTS/TRACTS  
Easements or Tracts shall encompass all portions of the Public Wastewater System that may extend beyond or outside a platted right-of-way. Easements, when dedicated by a Final Plat, shall be designated as Public Utility Easements, exclusively for the Public Wastewater System. Alternately, Easements conveyed by separate instrument shall be granted pursuant to the Department’s easement agreement forms. Tracts, when encompassing public wastewater mains and related appurtenances, shall also be designated as Public Utility Easements.  

5.5.1 Width of Easement or Tract/Main location.  
A. The minimum Easement or Tract width shall be 25 feet. In no case shall a main or related appurtenance be located closer than 10 feet to the nearest Easement, Tract or private lot line.  
B. Easement or Tract width may be increased beyond the minimum 25 feet, dependent on depth of the main.  
C. Mains located between two private lots and not within a Tract, shall be placed within an Easement. The Easement shall be situated entirely on one lot or the other with the main located within the Easement as noted in 5.5.1.A, herein.  
D. Easements containing more than one wastewater main shall be increased by an additional 10 feet for each additional main.  
E. Easements containing both wastewater and water mains shall be a minimum 30 feet in width.  

5.5.2 Manholes and Other Appurtenances  
A. Manholes and other related appurtenances shall generally be centered within a designated Easement. All Easements shall extend a minimum of 10 feet beyond on all sides of any manhole and other related Public Wastewater Public system appurtenances.  

5.5.3 Restrictions within Public Utility Easements and Tracts.  
A. Permitted Improvements. Pavement, sidewalks, bike paths, minor swales and berms and certain landscape features may be allowed within an Easement or Tract that encompasses a Public Wastewater System main or appurtenance.  
B. Landscaping Restrictions See Section 5.3.2.B
C. **Prohibited Improvements.** Structures, *e.g.* permanent concrete base “kiosk” or clustered mailboxes, sheds, overhanging decks, buildings (with permanent or temporary foundations), permanent fences and other substantial structures, shall not be allowed within any portion of an Easement or Tract designated to encompass a Public Wastewater System.
CHAPTER 6 -

TRENCHING, BACKFILLING AND COMPACTION

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6.1 GENERAL

6.1.1 Scope
A. This chapter addresses trenching and backfilling including subsurface drainage, dewatering, preparation of subgrades, pipe bedding, backfilling, compacting, Construction Staking and finish grading for Public Water and Wastewater Systems.

6.1.2 Larimer County Urban Area Street Standards
A. Replacement and repair of plantings, landscaping, sprinkler systems, surface obstructions, pavement, driveways, sidewalks, curbs, gutters, and similar surfaces shall be in accordance with the LCUASS.

6.1.3 Quality Assurance
A. Soil compaction tests shall be performed in accordance with:
   ASTM D698 --- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   ASTM D6938 --- Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
   ASTM D1556 --- Standard Test Method for Density and Unit Weight of Soil In Place by the Sand-Cone Method.
   ASTM D1557 --- Standard Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
   ASTM D4253 --- Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

B. Construction Staking
1. All Public Water and Wastewater Systems shall be Construction Staked by, or under the direct supervision of, a Professional Land Surveyor licensed in the State of Colorado.
2. Survey notes and other Construction Staking notes shall be entered into a bound, water resistant data book. All survey data/books shall be available for review upon request by the Inspector.
3. Adequate Construction Staking shall be provided to establish acceptable horizontal and vertical control. In cases where conflicts may exist or additional Construction Staking may assist the Inspector in determining compliance with signed PICPs, the Developer/Contractor/Land Surveyor shall supply such staking at no cost to the Department.
4. Cut/offset Construction Stakes shall be placed at a location whereby the stakes are not destroyed during trenching and backfill operations and can
be easily read/identified by the Inspector. If Construction Stakes are
destroyed in any manner, the stakes shall be replaced at the direction and
request of the Inspector.

5. The only acceptable method for verifying and confirming horizontal and
vertical layout during actual installation of Public Water and Wastewater
Systems shall be by certified laser device or cut/offset Construction
Stakes.

C. Job Conditions, during installation

1. Drainage and Groundwater
   a. Contractor shall obtain all necessary permits prior to starting
dewatering operations.
      1) If groundwater will be discharged into an irrigation ditch, pond,
      stream or waterway, or will drain to an irrigation ditch, pond
      stream or waterway, a Colorado Department of Public Health and
      Environment dewatering permit will be required.
      2) Permit applications may take 30 days or more to be reviewed by
      the Colorado Department of Public Health and Environment.
   b. Water that is encountered in the trench shall be removed to the extent
      necessary to provide firm subgrade, permit connections to be made in
      dry conditions, and prevent the entrance of water into the pipeline.
   c. Surface runoff shall be diverted as necessary to keep excavations and
      trenches free from water during construction.
   d. The excavation or trench shall be kept free from water until the
      structure, or pipe, to be installed therein, is completed to the extent
      that no damage from hydrostatic pressure, flotation, or other cause
      will result.
   e. The pipe under construction shall not be used for dewatering.

2. Sequencing
   a. Not more than 300 linear feet of open trench excavation and pipe
      installation will be allowed at any time. This distance may be
      amended, with the Department's approval, based upon job conditions.
   b. Initial trench backfill shall be performed within 300 linear feet of
      pipeline installation. This distance may be amended, with the
      Department's approval, based upon job conditions.
   c. Backfill shall be completed, at the end of each day, to the extent that
      no damage from hydrostatic pressure, flotation, or other cause will
      result.
   d. Where excavation is a hazard to automotive or pedestrian traffic, the
      amount of open trench and the time duration of that opening is to be
      minimized.
      1) Contractor shall be solely responsible for construction site safety.
      2) All excavations shall be properly barricaded, signed, and
         protected to prevent unauthorized access.

3. Underground Obstructions
a. The Design Engineer and/or Contractor shall field verify all Record Drawing information obtained from the Department, prior to start of any Work within the Development Project Area.

b. Contractor shall notify each utility owner and request utilities to be field located by surface reference.

c. The request for the location of utilities shall be made a minimum of 48 hours prior to trenching or excavation (exclusive of holidays and weekends).

d. The Contractor shall expose and verify the size, location, and elevation of all underground utilities and other obstructions, sufficiently in advance of construction to permit changes to be made to the Construction Drawings, and to secure approval of those changes.

e. In the event there is a conflict, the Contractor shall notify the Department and the affected utility company.

f. In the event there is a conflict, the proposed work may be modified, at the Department's discretion and with the Design Engineer's concurrence.

g. Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the Contractor's operations.

h. If the Contractor removes any underground obstructions, the following shall apply:

1) Drainage culverts may be salvaged and reused, if written approval is first obtained from the applicable City/County or State agency.

2) Other underground obstructions shall be replaced or repaired as directed and first approved by the affected City/County or State agency.

3) Field drains shall be repaired or replaced to their original condition, or better.

4. Maintenance and Correction

a. Trench settlement, including any related damage to pavement, curb and gutter, sidewalks or other structures, which occurs during the warranty period, shall be the responsibility of the Developer/Contractor.

b. The Developer/Contractor shall be responsible for obtaining all necessary permits to affect repairs within the Right-of-way or Easement.

c. The Developer/Contractor shall coordinate all repairs with the appropriate City Departments, including this Department.
6.2 MATERIALS

6.2.1 Stabilization Material

A. If the existing soil in the trench bottom is judged to be unsuitable by the Department, a minimum of the top 6-inches of the pipe subgrade shall be removed and replaced with a stabilization material.

B. Stabilization material is crusher-run rock, conforming to ASTM D448, or CDOT Table 703-2 No. 357, or an approved substitute.

<table>
<thead>
<tr>
<th>Stabilization Material</th>
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<tbody>
<tr>
<td>Size</td>
</tr>
<tr>
<td>2”</td>
</tr>
<tr>
<td>1”</td>
</tr>
<tr>
<td>1/2”</td>
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<tr>
<td>#4</td>
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</tbody>
</table>

C. In all situations where stabilization material is required, geotextile fabric shall be placed in between stabilization material, and pipe bedding.

   a. Grab strength: 180 lbs. (ASTM D4632)
   b. Seam strength: 160 lbs. (ASTM D4632)
   c. Puncture strength: 80 lbs. (ASTM D4833)
   d. Trapezoid tear: 50 lbs. (ASTM D4533)
   e. Apparent opening size (AOS): less than 0.297 mm. (greater than No. 50 sieve) (ASTM D4751)
   f. Permeability, cm/s: k fabric > k soil for all classes (ASTM D4491)
   g. Ultraviolet degradation at 500 hours: 50% strength retained for all classes. (ASTM D4355)

6.2.2 Pipe Zone Bedding Materials

A. The bedding area shall extend from 4 inches (or 1/4 O.D., whichever greater) below the bottom of the pipe to 12 inches above the top of the pipe, herein known as the “Pipe Zone”.

B. Bedding shall not compromise the integrity of poly-wrap or other material/covering used to protect the pipe system from corrosion or other conditions.

C. Reference Standard Drawings W-1 and WW-1.
D. Public Water System Pipe Zone bedding: shall be granular material, uniformly graded, sand conforming to ASTM C33 or CDOT Table 703-2, for fine aggregate.

<table>
<thead>
<tr>
<th>Public Water System bedding</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
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</tr>
<tr>
<td>3/8”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>95-100</td>
</tr>
<tr>
<td>#8</td>
<td>80-100</td>
</tr>
<tr>
<td>#16</td>
<td>50-85</td>
</tr>
<tr>
<td>#30</td>
<td>25-60</td>
</tr>
<tr>
<td>#50</td>
<td>10-30</td>
</tr>
<tr>
<td>#100</td>
<td>2-10</td>
</tr>
</tbody>
</table>

E. Hydrant gravel: shall be a well-graded crushed stone or gravel, conforming to CDOT Table 703-2 No. 67.

<table>
<thead>
<tr>
<th>Hydrant gravel bedding</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Percent Passing</td>
</tr>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>3/4”</td>
<td>90-100</td>
</tr>
<tr>
<td>3/8”</td>
<td>20-55</td>
</tr>
<tr>
<td>#4</td>
<td>0-10</td>
</tr>
<tr>
<td>#8</td>
<td>0-5</td>
</tr>
</tbody>
</table>

F. Public Wastewater System Bedding: shall be granular material, uniformly graded, crushed material, conforming to either of the following:

1. CDOT Table 703-2 No. 67

<table>
<thead>
<tr>
<th>Public Wastewater System bedding (No. 67)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Percent Passing</td>
</tr>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>3/4”</td>
<td>90-100</td>
</tr>
<tr>
<td>3/8”</td>
<td>20-55</td>
</tr>
<tr>
<td>#4</td>
<td>0-10</td>
</tr>
<tr>
<td>#8</td>
<td>0-5</td>
</tr>
</tbody>
</table>
2. CDOT Table 703-2 No. 8 (aka squeegee)

<table>
<thead>
<tr>
<th>Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
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<tr>
<td>3/8&quot;</td>
<td>85-100</td>
</tr>
<tr>
<td>#4</td>
<td>10-30</td>
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<td>#8</td>
<td>0-10</td>
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<tr>
<td>#16</td>
<td>0-5</td>
</tr>
</tbody>
</table>

G. Services:
1. The water services should be bedded with the same material as the main line.
2. The wastewater service should be bedded with the same material as the main line.

6.2.3 Groundwater Barriers
A. Clay ground water barriers shall meet the following soil classifications:
   - CH - inorganic clays of high plasticity, fat clays.
   - SC - clayey sands, sand-clay mixtures.
   - CL - inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, clean clays.

B. Concrete shall not be used unless specifically approved by the Department. Concrete used in ground water barriers shall meet the requirements of Chapter 9, Cast-In-Place Concrete.

6.2.4 Trench Backfill Material
A. Trench backfill material shall be placed from the top of the Pipe Zone to the ground surface or to the bottom of the pavement section, whichever is applicable.

B. Ordinary/Native Backfill- material shall consist of material excavated from the site and be free from frozen matter, stumps, roots, brush, other organic matter, cinders or other corrosive material, debris, rocks or stones which are larger than 6 inches, in any dimension, or other materials considered unacceptable by the Inspector.
1. Rocks or stones, which are larger than 3 inches, in any dimension, shall not be placed within one foot of the pipe or within one foot of the top of the trench backfill.

C. Imported Backfill- material imported from off-site locations. Material shall be free of rock or gravel larger than 3 inches, and free of debris, waste, frozen materials, vegetation and other deleterious matter. Material shall meet
the acceptable ASTM soil classification groups for locally available material. Top soil shall not be used as fill.

**D.** Structure Backfill- material shall meet Class 1 Structure backfill, conforming to CDOT Standard Specifications Section 703.08

<table>
<thead>
<tr>
<th>CL 1 Structure Backfill Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
</tr>
<tr>
<td>2”</td>
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<tr>
<td>#4</td>
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<tr>
<td>#50</td>
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<td>#200</td>
</tr>
</tbody>
</table>

**E.** Flowable Fill- material shall be required for utility trenching in existing pavement or as directed by the Inspector. Shall meet the requirements from LCUASS 22.2.3.D.

**F.** Conventional Backfill– known as “nonflowable fill.” Shall meet the requirements from LCUASS 22.2.3.E.

### 6.2.5 Native Seed Mix (if used)

**A.** Mix Design

1. Modifications to the following mix design can only be made with prior approval of the City.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Variety</th>
<th>% in Mix</th>
<th>Lbs PLS/acre</th>
<th>Lbs PLS/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>drill seed method</td>
<td>broadcast seeding method</td>
</tr>
<tr>
<td>Pascopyrum smithii</td>
<td>Western wheatgrass</td>
<td>Arriba</td>
<td>8.1</td>
<td>2.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Bouteloua gracilis</td>
<td>Blue grama</td>
<td>Hachita, Lovington</td>
<td>0.43</td>
<td>0.15</td>
<td>0.3</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Little bluestem</td>
<td>Pastura, Cimarron</td>
<td>1</td>
<td>0.35</td>
<td>0.7</td>
</tr>
<tr>
<td>Buchloe dactyloides</td>
<td>Buffalograss</td>
<td>Sharps Improved, Tatanka, Cody</td>
<td>57.7</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Bouteloua curtipendula</td>
<td>Sideoats grama</td>
<td>Vaughn, El Reno, Niner</td>
<td>3.9</td>
<td>1.35</td>
<td>2.7</td>
</tr>
<tr>
<td>Stipa viridula</td>
<td>Green needlegrass</td>
<td>Lodorm</td>
<td>28.9</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>
Chapter 6 – TRENCHING, BACKFILLING AND COMPACTION

6.3 CONSTRUCTION

6.3.1 Preparation

A. Topsoil shall be stripped from areas, which are to be disturbed by construction, and stockpiled.

B. Topsoil shall be segregated from non-organic trench excavation material, and debris. Sod shall be either ground up into the topsoil or segregated and disposed of. No sod pieces greater than 3 inches shall remain in the topsoil.

C. Topsoil and other soil with organics or other unsuitable material shall not be placed as trench backfill.

6.3.2 Trenching

A. Trenches shall be excavated by open cut methods, except where boring or tunneling is shown on signed PICPs, or as otherwise approved by the Department.

B. Trench width shall be maintained to within 3 inches of that specified on Standard Drawings W-1 and WW-1.

C. Care shall be used when operating mechanical equipment in locations where it may cause damage to trees, buildings, culverts or other existing property, utilities or structures above or below ground.

D. Mechanical equipment shall be operated in such a manner the bottom elevation of the trench can be maintained with uniform trench widths and vertical sidewalls of the bedding zone.

E. Trench alignment shall be sufficiently accurate to permit pipe to be aligned properly with minimum clearances between the pipe and sidewalls of the trench (or trench box) pursuant to Standard Drawing W-1 and WW-1 of these Standards.

F. The trench sidewall shall not be undercut in order to obtain clearance.

G. If the trench bottom is rock, the Contractor shall over-excavate the trench bottom and backfill and compact with suitable bedding material. The minimum over-excavation depth shall be 12 inches below the bottom of the pipe. The trench width through the extents of the rock excavation shall match the trench width above the top of rock elevation. The Department may allow blasting within rock, with prior approval.

H. Over-excavation shall be backfilled and compacted with acceptable Bedding Material or Stabilization Material at the Department’s discretion.

I. Contractor shall follow the most current regulations concerning excavations set forth by OSHA. Trench safety is the sole responsibility of the contractor.
Chapter 6 – TRENCHING, BACKFILLING AND COMPACTION

J. Trench support is the sole responsibility of the Contractor. The Department’s presence in no way implies approval of trench support methods being utilized. The Department/Inspector reserves the right not to enter a trench which, in the Inspector’s opinion, may be unsafe.

6.3.3 Pipe Zone and Subgrade

A. Pipe Zone trench bottom shall be graded uniformly to provide clearance for each bell and barrel section of pipe.

B. Loose material, water, and foreign objects shall be removed from the trench bottom.

C. The Contractor shall provide a firm trench bottom, which is suitable for application of Pipe Zone bedding material.

D. Wherever wet or unstable material is encountered in the bottom of the trench, said material shall be over-excavated to a depth of 6 inches, minimum.
   1. The over-excavation shall be backfilled with Stabilization Material and compacted as required by the Department.
   2. Use geotextile where necessary around Stabilization Material and on the subgrade to stabilize subgrade and prevent fines from migrating into granular materials.
   3. The Department may require the Contractor to provide an opinion from a Geotechnical Engineer if the Department determines the conditions merit special investigation.

6.3.4 Stockpiling Excavated Materials

A. Suitable material for backfilling shall be stockpiled in an orderly manner, and stored away from the edge of the trench.

B. Contractor shall dispose of unsuitable or excess excavated materials.

C. Excavated material shall not be stockpiled against or over existing structures or appurtenances.

D. Excavated materials shall not be stockpiled beyond, or in a manner not consistent with an approved erosion control plan.

6.3.5 Pipe Zone Bedding

A. Reference Standard Drawings W-1 and WW-1.

B. Bedding material shall be distributed and graded to provide uniform and continuous support beneath the pipe, including services at all points between bell ends, or pipe joints.

C. Pipe shall not be supported by the bells.

D. A minimum of 4 inches of bedding shall be placed prior to the installation of the pipe, including services.

E. Bedding material shall not be dropped on unsupported pipe or pipe, which is supported only at the ends. Pipe shall be uniformly supported before continuing with bedding lifts.
Chapter 6 – TRENCHING, BACKFILLING AND COMPACTION

F. Bedding material shall not be placed in a manner that could damage protective coating, poly wrap, or similar elements of the pipe system.

G. Bedding material shall be consolidated under and around the pipe.

H. To prevent lateral displacement, bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe.

I. Care shall be taken when installing pipe to prevent damage to protective coatings, poly wrap, or similar elements of the pipe system. Workers shall not walk on coated or protected pipe.

J. Any pipe coatings, poly wrap, or other surface damage shall be repaired according to manufacturer/supplier recommendations and in a manner acceptable to the Department prior to backfilling.

6.3.6 Groundwater Barriers / Cut-Off Walls

A. Groundwater barriers / Cut-Off Walls shall be constructed in a manner that impedes passage of water through the entire portions of the trench pipe zone and backfill material.


6.3.7 Backfilling and Compaction

A. All trench backfill shall be mechanically compacted, including services.
   1. No compaction shall be done by use of a drop hammer compactor.
   2. Compaction shall not be performed by jetting or water settling.

B. Backfill of pipe and appurtenances and around vaults and valve boxes shall be compacted in a manner which is capable of producing the required results.

C. Backfill material shall be deposited in uniform horizontal layers which shall not exceed eight inches (compacted depth), in all areas, unless otherwise approved by the Department.

D. Equipment or backfilling methods which damage the pipe, pipe coatings, poly wrap, or other elements of the pipe system shall not be utilized.

E. Sheeting removal (if utilized)
   1. Do not remove sheeting prior to backfilling.
   2. Use effective methods to protect the construction, other structures, utilities and properties during sheeting removal.
   3. Voids left by sheeting removal shall be filled with dry sand.
   4. Sheet ing which is left in place shall be cut off at an elevation 18 inches below the finish grade of unpaved areas, or 24 inches below the subgrade of paved areas.

F. Topsoil shall be replaced to the depth of stripping over all areas, which are to be reseeded or otherwise restored. See Section 6.3.10 for reseeding.
6.3.8 Manhole Frames and Valve Boxes

A. Prior to completion of backfilling, manhole frames, vault frames and water valve boxes shall be raised to subgrade. Manhole adjustment shims shall not exceed eight (8) inches.

B. Valve boxes and manhole/vault rings shall be straight and properly aligned.

C. Valve boxes shall be inspected by placing a valve key on the operating nut to ensure a proper alignment and that the valve box is plumb.

D. Construction materials and foreign matter shall be removed from the interior of manholes, vaults and valve boxes immediately. Care shall be taken to insure foreign matter dies not enter the wastewater collection system.

E. Asphalt or oil which covers a manhole lid or valve box cover shall be removed and the lid or cover replaced so access to the structure is available.

6.3.9 Field Quality Control

A. This section applies to all Public Water and Wastewater System mains and appurtenances. All tests shall be the responsibility of the Developer/Contractor and shall reflect results in accordance with these Standards.

B. Field moisture/density testing control
   1. Field tests will be conducted to determine compliance of moisture/density requirements in accordance with ASTM D6938. Moisture/density testing may also be performed according to ASTM D1556. Where inconsistent or conflicting test results are obtained other methods of determining in place moisture and density may be required.
   2. Moisture/density tests are the responsibility of the Contractor, and shall be performed by a private Geotechnical Consultant.
      a. The Department may elect to perform separate moisture and density tests for compliance of the work at any time.
      b. Test results are for discreet locations only and do not guaranty acceptance for trenches or backfill zones in their entirety.
   3. The method of testing the compacted material shall be determined by the Geotechnical Consultant or the Department. The validity of the results shall be the responsibility of the Geotechnical Consultant.
   4. Test results shall be submitted to the Department by the Contractor or the Geotechnical Consultant within 24 hours of the test, or by the end of the next working day.
   5. Copies of the field work sheets are acceptable.
   6. Results of all moisture and density tests shall be submitted to the Department and approved by the Department prior to acceptance of water and wastewater systems. Approved test results shall be available on the job site.
   7. Moisture/density test shall be performed at a depth not more than 2 feet above the top of the pipe bedding and in 2-foot increments up to the final grade.
8. Moisture/density test shall be performed at a minimum of 200 lineal feet, as measured along the length of the pipe, or as determined by the Department. Testing may be requested at an increased frequency and/or at specific locations.

9. A minimum of one test shall be performed for every 2 vertical feet of compacted backfill material. Test locations shall be staggered within each lift so that successive lifts are not tested in the same location.

10. Moisture/density tests shall be performed on trench backfill, a minimum of one time for each service line installed. Certain cases may require additional tests, as required by the Department/Inspector.

   a. Moisture/density tests in the vicinity of vaults and valve boxes shall be performed at a maximum of 1 foot away from the vault sections or valve box.
   b. Tests shall be performed in random directions from the vault or valve box, on separate lifts. A minimum of two tests shall be performed at each valve box and vault location.

12. Tests for Public Wastewater System appurtenances.
   a. Moisture and density tests in the vicinity of manholes shall be performed at a maximum of one (1) foot away from the manhole section. If nuclear test methods provide uncertain or inconsistent results due to the proximity of the structure, sand cone tests or other approved methods will be used.
   b. At least one test shall be made in all four directions from each manhole and at different elevations.

13. Failed test areas shall be recom pacted and retested at Contractor’s expense.

14. Compaction and moisture content shall be to the following minimum standards unless recommended otherwise by the geotechnical engineer and approved in writing by the Department. (Reference ASTM D698 or AASHTO T99, unless otherwise indicated).
   a. Ground water barrier material: 95% of maximum standard Proctor dry density (ASTM D698) between optimum moisture content and three percent over optimum moisture content.
   b. Pipe Zone bedding: 85% of relative density (ASTM D4253 & D4254)
   c. Trench backfill: 95% of standard Proctor maximum dry density (ASTM D698).

15. Moisture content.
   a. The acceptable range of moisture content for compacted trench backfill will be within two percent (+/-) of the optimum moisture content determined by the standard Proctor test (ASTM D698) unless recommended otherwise by the geotechnical engineer and approved in writing by the Department.
   b. Variances may be requested by submitting a report and recommendation from a private Geotechnical Consultant.
accompanied with a letter that specifically identifies the variance. Submittals should be directed to the Water and Power Director.

c. If water is added to the material, the material shall be harrowed, disked, bladed, or otherwise worked to ensure a uniform moisture condition.

6.3.10 Seeding (if used)

A. All disturbed areas shall be restored to natural grade, and reclaimed.

B. Seeding can only be done during the months of March to May or October to November.

C. Fine grade the proposed area to be seeded to establish an even gradient over the entire surface. Provide even transition areas between changes in slope.

D. Clear topsoil of roots, plants, sod, stones, lumps, and other material harmful to plant growth and the appearance of a smooth finish grade. Provide positive surface drainage of planted areas.

E. Limit soil preparation to areas which will be planted in the immediate future.

F. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily. Apply water if necessary to bring soil to optimum moisture content for tilling and planting. Maintain within 2 percent above or below optimum moisture content at all times during the work.

G. Rip existing soil to a depth of eight (8) inches minimum in one direction a minimum of eighteen (18) inches apart. Soils that have been over compacted by traffic shall be ripped or tilled to break up restrictive layers and then harrowed or rolled to firm the seed bed. The seed bed shall be friable enough to allow seed to be placed at the proper depth. Remove any stones larger than eight (8) inches.

H. Seed shall be uniformly sown by drill or by broadcast methods (seeding rates shall be doubled the amounts specified for broadcast if hand broadcast). Hydroseeding shall not be used. Do not drill or sow seed during high winds or when the ground is frozen or otherwise unable to be worked.

I. The reseeded areas shall be mulched with weed free hay. Straw shall not be used as mulch. The hay shall be crimped in to the soil.

J. Protect seeded areas against erosion.
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CHAPTER 7 - PUBLIC WATER SYSTEM MATERIALS & INSTALLATION

7.1 GENERAL

7.1.1 Scope

A. This chapter addresses minimum acceptable materials and certain installation methods for the City’s Public Water System. Separate Standards for design, materials and installation can be provided, upon request to the Department, for Booster/Pump Stations.

B. Specific/approved manufacture type(s) for each material is identified in the materials list, Appendix F

C. Pipe material shall be consistent for each size/diameter of pipe used throughout the entire portion of a Development Project Area. Pipe material shall not be interchanged except where another type of pipe material is specifically indicated and approved by the Department.

D. Pipe shall be furnished with all necessary fittings, flanges, specials and other accessories, as noted in these Standards on final signed PICPs.

7.2 MATERIALS

7.2.1 Pipe, Related Fittings and Appurtenances

A. Ductile Iron Pipe (DIP)

1. With push-on joints, shall be manufactured in accordance with AWWA C151/ANSI A21.51.
   a. 12 inches and smaller in diameter shall be Pressure Class 350.
   b. Larger than 12 inches in diameter shall be Pressure Class 250.

2. With flanged joints, shall be manufactured in accordance with AWWA C115/ANSI A21.15.
   a. Flanged ductile iron pipe with threaded flanges shall be Class 53 pipe.

3. Nominal laying lengths shall be either 18 or 20 feet.

4. Except when making closure connections to fittings, random/cut lengths of pipe shall not be allowed.

5. Joints
   a. Mechanical and push-on joints shall be manufactured in accordance with AWWA C111/ANSI A21.11
   b. Unless approved otherwise, gaskets shall be as recommended by the manufacturer.
   c. Lubricant shall be as specified by the pipe manufacturer.
   d. Nuts and bolts shall be high-strength low-alloy COR-TEN, manufactured in accordance with AWWA C111/ANSI A21.11.
   e. Ductile iron pipe with threaded flanged joints shall be manufactured in accordance with AWWA C115/ANSI A21.15.
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f. Flanges shall be sized and drilled in accordance with ASME/ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 125.

6. Pipe Coating and Lining
   a. Ductile iron pipe shall have a bituminous coating on the pipe exterior, unless otherwise specified.
   b. The minimum thickness of the bituminous coating shall be one (1) mil.
   c. Ductile iron pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C104/A21.4.

7. Corrosion Control: See Section H

B. Polyvinyl Chloride Pipe (PVC)
   1. With push-on joints, shall be manufactured in accordance with AWWA C900 for sizes 4 through 12 inches or AWWA C909 for sizes 6 through 12 inches.
      a. DR 18 (Pressure Rating 235) for all water mains and fire hydrant laterals.
   2. With push-on joints, sizes 16 through 24 inches ONLY, shall be manufactured in accordance with AWWA C905.
      a. DR 18 (Pressure Rating 235), or better, for all water mains.
   3. PVC pipe shall have nominal laying lengths of 20 feet.
   4. Unless approved otherwise by the Department, all PVC pipe used for mains, fire hydrant leads and fire service lines shall be “blue” color.
   5. Except when making closure connections to fittings, random/cut lengths of pipe shall not be allowed.
   6. Pipe joint/gasket lubricant shall be as specified by the pipe manufacturer.

C. Steel Casing Pipe
   1. Smooth steel casing pipe shall conform to ASTM A139, Grade B (No hydro).
   2. Minimum yield point of smooth steel casing pipe shall be 35,000 psi.
   3. Clean used casing pipe in good condition and conforming to the requirements of this specification may be used with the prior approval of the Design Engineer and Department.
   4. No exterior coating is required, unless the agency having jurisdiction (other than the Department) requires the use of an exterior coating.
   5. Minimum wall thickness of smooth steel casing pipe shall be:

   Table 7.1-Casing pipe minimum wall thickness

<table>
<thead>
<tr>
<th>Nominal Diameter (inches)</th>
<th>Minimum Thickness (non-coated) (inches)</th>
<th>Minimum Thickness (coated) (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 and under</td>
<td>0.188</td>
<td>0.188</td>
</tr>
<tr>
<td>16</td>
<td>0.281</td>
<td>0.219</td>
</tr>
<tr>
<td>18</td>
<td>0.312</td>
<td>0.250</td>
</tr>
<tr>
<td>20 and 22</td>
<td>0.344</td>
<td>0.281</td>
</tr>
</tbody>
</table>
6. The ends of smooth steel casing pipe shall be beveled for field welding.
7. Increased pipe strength shall be provided as necessary to withstand jacking loads.
8. **Casing Seals**
   a. Casing seals shall be constructed of high-density rubber.
   b. Straps for casing seals shall be stainless steel.
9. **Casing Spacers**
   a. Casing spacers shall support the carrier pipe.
   b. Casing spacers shall be constructed of stainless steel with polymer or plastic runners.
      1) Metal surfaces, not stainless steel, will be coated with an epoxy polyamide or a coal-tar enamel exterior coating conforming to AWWA C203, Section 2.
      2) Minimum thickness of the coating shall be 16 mils.

**D. Fittings and Couplings for DIP and PVC pipe**
1. Fittings and couplings shall be manufactured in accordance with AWWA C104, C110, and C111. Compact fittings, pursuant to AWWA C153 are preferred.
2. All fittings shall be mechanical joint.
3. Fittings and couplings shall be made of ductile iron, and have a minimum working pressure rating of 250 psi and shall be epoxy coated.

4. Couplings between a branch on a cross or tee and a valve shall be a manufactured type coupling (e.g. “Foster” connection).

E. Tracing Wire/Test Stations
1. All water mains, regardless of pipe material, shall be installed with tracing wire.
2. Direct Bury: Tracing wire shall be a standard, single strand, No. 12 AWG, insulated solid copper wire, blue in color.
3. Trenchless Application: A separate materials submittal will be required to be submitted and approved by the Department prior to installation.
4. Tracing wire shall be terminated as shown in Standard Drawing W-2 and W-3.

F. Mechanical Joint Restraint Devices
1. Devices may be either full concentric circle or wedge load types.
2. Type 304 stainless steel bolts are required.

G. Joint Restraint Warning Tape
1. Tape shall be placed along the entire length of restrained pipe length, laid typically on top of the pipe.
2. Tape shall be 6 inches wide and have the following two lines of wording:
   CAUTION   CAUTION
   RESTRAINED JOINT WATERLINE BELOW

H. Marker Posts
1. Marker Posts should be similar to Carsonite CRM-375 with reflective labels.
2. For major transmission mains markers should be 4” steel posts filled with concrete. Post should be 5’ tall buried 3’ in a 12” diameter 3,000 psi concrete base that extends 6” below the post. Posts shall be painted orange. Place white 12”x18” metal sign with red letters stating the following information: City of Loveland, diameter of Water/Sewer Line, Year installed, and any necessary offset. In open fields signs shall be placed every 500’ otherwise at bend or manholes.

I. Corrosion Protection
1. Polyethylene Encasement
   a. Required for DIP pipe and/or fittings
   b. Encasement shall conform to AWWA C105 A21.5.
   c. The minimum thickness of the polyethylene shall be eight (8) mils.
   d. The color shall be natural.
   e. All fittings shall be double wrapped.
2. Isolation:
   a. Ties to dissimilar metals shall be dielectrically isolated by means of insulating flange kits, insulated dressers, etc…
3. **Joint Bonding:**
   a. DIP Joints shall be bonded over with the use of two (2) copper wires, exothermically welded at both ends. Copper plates may be used instead of wires.
      1) Size bond wire according to pipe diameter.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Bond Wire Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; - 12&quot;</td>
<td>#8</td>
</tr>
<tr>
<td>16&quot; - 36&quot;</td>
<td>#4</td>
</tr>
<tr>
<td>42&quot; and larger</td>
<td>#2</td>
</tr>
</tbody>
</table>

b. Exothermic welds shall be accomplished with Cadweld or approved equal.

c. Exothermic welds shall be capped with Handy Cap II by Royston Laboratories, Inc. Handy Cap application procedure:

d. The weld and the disturbed surface of the pipe shall be treated with a primer recommended by the manufacturer of the weld cap.

4. **Anodes:**
   a. Shall be Magnesium type and conform to the following specifications:

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>0.10% maximum</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.50 to 1.30%</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.00</td>
</tr>
<tr>
<td>Silicon (Si)</td>
<td>0.00</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>0.02% maximum</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>0.001% maximum</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.03% maximum</td>
</tr>
<tr>
<td>Other Impurities - each</td>
<td>0.05% maximum</td>
</tr>
<tr>
<td>Total</td>
<td>0.03% maximum</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>Balance</td>
</tr>
</tbody>
</table>

b. The minimum anode size shall be 17 pounds.

c. Anodes shall come prepackaged in special backfill material consisting of 75% ground hydrated gypsum, 20% powdered bentonite and 5% anhydrous sodium sulfate. The backfill shall have a grain size such that 100% is capable of passing through a 20 mesh screen and 50% will be retained by a 100 mesh screen. The backfill mixture shall be firmly packaged around the magnesium anode within a cotton bag by means of adequate vibration.

d. Anode lead wires
   1) Lead wired shall be No. 12 AWG solid THHN wire black in color. Lead wires shall be a minimum of 10 feet in length.

5. **CP Test Stations**
   a. The locations shall be shown on the PICPs
   b. Test wires shall be No. 12 AWG solid THHN wire; red in color for steel pipe and blue in color for DIP
   c. Test wires shall be brought to the surface and terminated into a CP test station. See Appendix F for approved type.
d. A Carsonite type flexible marker shall be placed at the test station location or may be placed at a reasonable off-set to the station. The marker shall clearly be labeled “City of Loveland Water Main CP Test Station” and if applicable also provide space for indication of a horizontal off-set, in linear feet. Overall color of the marker shall be blue.

7.2.2 Main Valves

A. General
1. Valves shall open counter-clockwise (left).
2. Valves shall be capable of satisfactory operation with flow in either direction.
3. All valves shall be supplied with mechanical restraint joints.
4. Valve bonnet and packing bolts and nuts shall be type 304 Stainless Steel.
5. Buried valves shall have a 2-inch square operating nut.
6. Valves placed in vaults shall have a valve operator approved by the Department.

B. Resilient-Seated Gate Valves
1. 4-inch thru 12-inch shall be a resilient-seat type and manufactured in accordance with AWWA C509. Alternate valves, pursuant to AWWA C515 may be allowed, with prior approval of the Department.

C. Tapping Valves
1. Shall be resilient-seat type and manufactured in accordance with AWWA C509. Alternate valves, pursuant to AWWA C515 may be allowed, with prior approval of the Department.
2. Shall be equipped with an alignment ring on the flanged side of the valve and be equipped with a test plug.

D. Butterfly Valves, 16 inch and larger
1. Shall be direct bury.
2. Shall be manufactured in accordance with AWWA C504 with special attention, pursuant to section 1.1.1.4 of AWWA C504.
3. Operator torque as specified in AWWA C504, Appendix A.
4. Position:
   a. For use in horizontal position.
   b. Operator horizontal to valve.
5. Shall be located within a vault per Standard Drawing W-23.

E. Valve Boxes

F. Air Relief/Vacuum Relief Valves
2. Air relief and vacuum relief valves shall have an integral type assembly to function both as an air release and vacuum valve.
3. Air relief and vacuum relief valves shall be rated at a working pressure of 150 psi and a minimum hydrostatic test pressure of 250 psi.
4. Size of air relief and vacuum relief valves shall be as noted on the Construction Drawings.
5. Taps for air relief valves and vacuum relief valves shall be made as indicated on the Construction Drawing, unless otherwise directed by the Department.
6. Piping and fittings shall be brass.
7. Connections:
   a. The inlet connection of air relief and vacuum relief valves shall be a minimum of 2 inches in diameter conforming to AWWA C800.
8. Air relief and vacuum relief valves shall be watertight to a pressure of 200 psi.

G. Check Valves
   1. Check valves shall be rated at a working pressure of 150 psi.

7.2.3 Fire Hydrants
   A. Fire hydrants shall be manufactured in accordance with AWWA C502.
   B. Fire hydrant assembly valves shall open clockwise (right) with a square operating nut.
   C. Fire hydrants shall be delivered with paint applied by the manufacture. Hydrants bodies shall be painted Orange. (See Appendix F for paint specifications).
   D. All fire hydrant extensions shall be installed per the manufacturer's instructions.
   E. There should only be one stem extension between the upper and lower stem.

7.2.4 Blow-Offs
   A. Blow-offs shall be pursuant to Standard Drawings W-5, W-6, or W-16.

7.2.5 Meters, Pits, Vaults and Related Appurtenances
   A. Meters
      1. Meters manufactured by Sensus Technologies, Inc, shall be the only meters allowed.
      2. 3/4 inch and 1-inch meters and readouts are supplied and installed by the Department.
         a. Exception: within a new subdivision 3/4-inch meters pits and appurtenances are typically acquired and installed by the Developer. The Department will install the meters and inspect the pits and service prior to initial acceptance.
      3. Meters larger than 1-inch shall be supplied by the Developer. After final acceptance the meters become owned and maintained by the Department.
   B. Meter Pits -3/4-inch and 1-inch meters shall be placed in meter pits.
1. Pits shall be 20-inches in diameter, a minimum of 48-inches in length, and shall be constructed of rigid Polyethylene.

2. Pit bonnets shall be constructed of cast iron with cap type top lid and frost-proof rubber inner lids.

3. Pit covers shall be pre-drilled and capped, to accepted remote read devices.

4. The minimum allowable opening for meter pit covers shall be 11-inches diameter.

5. Pit covers shall have a 27/32 inch worm-lock with a Standard Waterworks pentagon head.

6. Concrete base for meter pits shall meet the requirements of Chapter 10 and shall be drilled with 1” diameter holes to allow for drainage.

7. Risers/extensions can be added to the top of the pit to achieve appropriate depth. Risers shall be 20-inches in diameter.


C. Meter Vaults - 1-1/2 thru 6-inch meters shall be placed in meter vaults.

1. Vaults shall be precast concrete. 1-1/2 inch and 2-inch vaults shall lie on 12” wide x 8’ long x 9” high concrete grade beams. 3-inch, 4-inch, and 6-inch vaults shall have an integral concrete floor with a 10-inch sump/drain hole in the corner.

2. Vault manhole ring and covers shall be cast iron with a minimum 24-inch diameter opening. Ring and covers may also need to be manufactured to meet HL93 load ratings, as approved by the Department.

3. Vault covers shall have the word "water" cast in the lid.

4. Vault covers shall be pre-drilled with a 1-7/8 inch hole and capped, to accept remote read devices.

5. Watertight seals shall be provided for all vault penetrations and ring and cover sections.


C. Tapping Saddles

1. 3/4-inch through 2-inch tapping saddles shall be constructed of:
   a. Stainless steel body with solid stainless steel strap.
   b. Nuts, bolts, accessories shall be in accordance with manufacturer specifications.
   c. Inlets shall be threaded.

2. 4-inch and larger tapping saddles shall be constructed with:
   a. Epoxy coated ductile iron or stainless steel flanges, attached to a full wrap stainless steel body with full wrap gaskets.
   b. Except if determined otherwise by the Department

D. Corporation Stops - used for taps 2-inches and smaller

1. Shall conform to AWWA C800.

2. Shall be full opening ball type and constructed of NL brass.

3. Inlet threads for tapping saddles shall be threaded only.

4. Shall be supplied with thread x QCTS compression connections.
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E. Service Lines
   1. Copper services (3/4-inch through 2-inch) shall conform to AWWA C800, Type K only.
   2. 4-inch and larger service lines can be DIP or PVC, in accordance with these Standards, Section 7.2.1. A, B.

F. Curb Stops - used for services 2-inches and smaller
   1. Shall conform to AWWA C800.
   2. Shall have QCTS compression x QCTS compression connections at both ends.
   3. Shall be ball type full opening constructed of NL brass.
   4. Shall have a valve box top, if allowed by the Department to lie within the sidewalk or pavement.
   5. Shall be Minneapolis screw on style with no operating/extension/shut-off rod allowed.

G. Meter Setters
   1. Shall have QCTS compression x QCTS compression connections at both ends.
   2. Shall be constructed of NL brass.
   3. 3/4-inch and 1-inch meter setters shall have a meter stop inlet valve with a lockwing.
   4. 1½-inch and 2-inch meter setters shall have a meter stop inlet valve with a lockwing, and a built-in locking by-pass.

H. Touch Read Devices
   1. Are supplied by the Department to be installed by the Contractor.
   2. For ¾” and 1” meter pits the devices shall be placed on the wall of the building.
   3. For ¾” multiple meter precast vaults the devices shall be stack mounted on the nearest building.
   4. Touch read devices mounted on buildings may be on either side of the building, but not more than 5’ from the front of the building or more than 5’ above finished grade.
   5. Touch read devices shall not be placed behind any fence.
   6. For 1-1/2” and larger vaults, manhole lids shall be drilled for the device.

7.2.6 Foam Insulation
   A. Conformance: ASTM C578, Type VI
   B. Minimum thickness: 2 inches.
   C. Thermal resistance aged R-value per inch @ 75° F. mean temperature: 5.0
   D. Compressive strength: 100 psi
   E. Water absorption: less than 0.7 % by volume
   F. Water vapor permeance: less than 0.6 perms
7.2.7 Concrete Thrust Restraints

A. Concrete thrust restraints shall meet the requirements of Chapter 9, Cast-In-Place Concrete.

7.2.8Vaults (General)

A. Types

1. Precast Concrete: Reference Chapter 10, Precast Concrete.

2. Cast-in-Place: Reference Chapter 9, Cast-in-Place Concrete.

B. Vaults shall be furnished with all accessories, including base, cone section and ring & cover.

C. Mortar

1. Mortar shall be Sand-Cement grout, using the following ratio of ingredients:
   a. One part Portland Cement; conforming to ASTM C150, Type I, IA, II, IIA.
   b. Two parts sand; conforming to ASTM C144.
   c. One half (1/2) part hydrated lime; conforming to ASTM C207, Type S.

D. Grout

1. Grout shall be pre-mixed, non-metallic, non-aggregate, and non-shrink, using the following ratio of ingredients:
   a. One part Portland Cement; conforming to ASTM C150, Type I, IA, II, IIA.
   b. One part sand; conforming to ASTM C144.
   c. One part shrinkage correcting aggregate.

E. Ring and Cover

1. Rings for built-up construction shall be 8 inches in height.

2. 4-inch rings may be acceptable for street overlays or repaving, with written approval from the Department.

3. Water-tight installations
   a. Vaults shall not be located in areas subject to flooding from surface runoff.
   b. Vaults shall not be located in areas where ponding or storm detention may occur.
   c. If the possibility of surface runoff cannot be avoided or if a vault is located in the 100-year flood plain, the vault shall have a watertight, bolted type cover having an integral O-ring type gasket that can be bolted closed.

F. Preformed Plastic Gaskets

1. Preformed plastic gaskets shall conform to AASHTO M198 and Federal Specification SS-S-00210(210A)

2. Gaskets must be pliable at the time of installation at a temperature of 10°F and above without being heated.
3. Primer is required on all joints. Primer shall be supplied by the gasket manufacturer.

7.3 CONSTRUCTION AND INSTALLATION

7.3.1 Product Delivery, Storage and Handling

A. Do not drop materials or equipment. Use slings, pipe tongs, skids or other controlled methods for handling materials and equipment.

B. Care must be taken to prevent damage to materials and equipment by impact, bending, compression, abrasion or other deleterious handling.

C. Damaged materials and equipment shall not be installed.

D. Lubricant shall not be stored or handled in a manner that will cause contamination.

E. Rubber gaskets shall be stored in a location that protects them from deterioration.

F. Store materials and equipment in accordance with the manufacturer's specifications.

G. Pipe, fittings and joints shall be kept free from dirt, oil and grease.

H. Take special precautions to keep internal parts of materials and equipment clean for use in the potable water system.

I. PVC pipe
1. Store pipe on a surface which provides even support for the pipe barrel.
2. Do not store pipe in such a way as to be supported by the bell.
3. Pipe which exhibits excessive signs of ultraviolet deterioration shall not be used.

J. DI Pipe
1. Lubricant shall not be stored and used in a manner which will cause contamination.
2. Rubber gaskets shall be stored in a location which protects them from deterioration or damage.
3. The maximum stacking heights of pipe as listed in AWWA C600 shall not be exceeded.

K. Steel Casing Pipe
1. Pipe shall be handled, stored, and protected in a manner to prevent damage to materials.
2. Contractor shall provide a smooth, continuous, and uniform casing pipe without voids.
3. Each section of casing pipe shall be welded with a full penetration butt weld around the entire circumference of the joint to form a watertight continuous conduit capable of resisting all stresses, including jacking stresses.
L. **Fire hydrants** shall be handled, stored, and protected in such a manner as to prevent damage to materials, coatings, and finishes.

### 7.3.2 Inspection

A. Pipe barrel, joints and fittings shall be free of dirt or other foreign objects prior to installation.

B. Pipe, joints and fittings with cracks, dents, abrasions, damaged linings or coatings, or other flaws shall be rejected.

C. Damaged and defective materials and equipment shall be marked and stored separately. The Inspector may request removal of such materials and equipment from the site.

D. Valves, valve boxes, and other system components shall be examined for cracks, dents, abrasions, and other flaws.

### 7.3.3 Preparation

A. Reference Chapter 6, Trenching, Backfilling and Compaction.

B. Stabilization materials shall be required for water mains where unstable soil exists.

C. Bedding material shall be placed in the trench bottom to a minimum of 4 inches, and bell holes and depression shall be dug in the bedding to provide a uniform and continuous bearing support for the pipe at every point between bell holes.

### 7.3.4 Cutting the Pipe

A. The pipe shall be cut smooth, straight, and at right angles to the pipe axis, with saws or pipe cutters designed specifically for the material.

B. The cut end of the pipe shall be beveled in accordance with the manufacturer’s recommendations.

C. Burrs shall be removed and all dust shall be wiped off of the jointing surface.

### 7.3.5 Connections

A. The location and elevation of the existing pipe shall be verified prior to start of Work. The Developer/Contractor shall notify the Inspector if locations and/or elevations vary substantially from the final PICPs.

### 7.3.6 Joints

A. Dirt, oil, grit, and other foreign matter shall be removed from the inside of the bell and outside of the spigot.

B. A thin film of lubricant shall be applied to the inside of the gasket and the spigot end of the pipe, per the manufacturer’s recommendations.

C. Preparatory to making pipe joints, all surfaces of the joint shall be clean and dry.

D. The lubricated joint shall be kept clean until joined.
E. The pipe shall have a depth mark prior to the assembly to ensure that the spigot end is inserted to the proper depth of the joint.

F. The pipe shall be joined to the tolerances recommended by the manufacturer.

G. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt.

H. When final grade is achieved, the joint shall be carefully pushed together until the assembly mark on the spigot is aligned with the end of the pipe, using approved methods of leverage.

I. Care shall be taken so that the bell end of the pipe will not be deflected.

J. The seating of the gasket shall be checked around the entire circumference of the pipe by visual and feeler gauge inspection.

K. Stabbing the pipe shall not be allowed.

L. Previously completed joints shall not be disturbed during the jointing operation.

M. Joints shall be watertight and free from leaks.

N. Upon Initial Acceptance and throughout the warranty period, the Contractor shall be responsible for repair of any leak, and other damages resulting from improper workmanship or defective materials.

7.3.7 Job Conditions

A. Foreign material, including trench water, shall not be permitted in the pipe.

B. Debris, tools, clothing, or other material shall not be permitted in the pipe.

C. In order to prevent anything from entering the pipe, the open ends of the pipe shall be plugged with a restrained, watertight plug when pipe laying is not in progress.

D. Effective measures shall be used to prevent uplifting or floating of the pipeline prior to completion of the backfilling operations.

E. Pipe shall not be installed under the following conditions:
   1. When the trench contains water.
   2. When weather conditions are unsuitable.
      a. Temperature is less than 10ºF. Written approval is required from the Department when the temperature is 10ºF or less.
      b. Snowing heavily.
      c. Raining heavily.
      d. High winds.
   3. When the trench bottom is unstable.

F. Do not use damaged materials or equipment for installation in the system.
7.3.8 Pipe Installation

A. Unless approved otherwise by the Department, horizontal and vertical pipe alignment(s) shall not deviate more than 0.50 feet from that shown on final signed PICPs.
   1. Pipe shall be installed in accordance with the pipe material specification.
   2. Pipe shall be laid and maintained at required lines and grades as shown on the final signed PICPs.

B. Pipe shall be installed with the bells pointing in the direction that installation is progressing.

C. The pipeline shall be installed so that a uniform/consistent positive or negative grade is maintained between the designed high and low points.

D. Prevent the opening of joints during bedding and backfilling operations.

E. If restrained joints are used, the joint restrain tape should be installed directly on top of the pipe.

7.3.9 Tracing wire

A. Tracing wire shall be installed with all waterline pipe regardless of material type.

B. Tracing wire shall be attached to the top of each barrel section of pipe with approved tape.

C. Tracing wire shall be brought to the surface on the inside of a test station behind every fire hydrant or at the end of a dead end run. The valve box top on test station shall be 12-inches away from the fire hydrant. Reference Standard Drawing W-3.
   1. Four (4) feet of wire shall be installed inside of the valve box and coiled inside the valve box at the top.
   2. Tracing wire shall not be attached to the valve box. See Standard Drawing W-2.

D. Splicing
   1. Connect wires together at tees and crosses.
   2. Wires shall be connected/spliced using splicing kits from either “3M” or “Dryconn”.

E. Tying to an existing water main
   1. Connect new tracing wire to existing tracing wire (See Splicing) if available.
   2. If existing tracing wire is not available, and tying into an existing metallic water main then cadweld the new tracing wire to the existing water main.

F. Testing
   1. Tracing wire shall pass testing prior to Initial Acceptance.
   2. Testing shall be performed by a 3rd party testing company.
   3. Pass current through wire and demonstrate that the tracing wire is capable of locating the pipe.
4. If wire will not pass current testing, locate break in circuit and repair and test until tracer wire works in accordance with its intended use.

7.3.10 Concrete Thrust Restraint

B. When utilized, concrete thrust blocks and anchors shall be sized and placed pursuant to these Standards.
C. The minimum size of thrust blocks shall be determined from the table in Standard Drawing W-21.
D. The concrete thrust block bearing surface shall be excavated into undisturbed soil. The concrete thrust block shall be extended from the fitting or valve to be blocked, to solid undisturbed earth.
E. If soil is to be disturbed, making a concrete thrust block or thrust anchor unusable, alternate restraining systems must be approved by the Department prior to pipeline installation.
F. Loose soil shall be disposed of, and the location where the thrust block is to be placed shall be carefully shaped to provide a uniform bearing surface of the required size.
G. The concrete thrust block bottom shall be flat, and sides shall be vertical.
H. Concrete thrust blocks shall be constructed so that all joints and weep holes are clear and accessible.
I. Concrete shall be separated from all fittings, valves and hydrants by an 8 mil. polyethylene film.
J. The concrete thrust block shall be formed to provide access to fittings, valves, hydrants, and appurtenances.
K. Concrete shall not be placed directly on or over fittings, nuts, bolts, flanges, etc.
L. The Department shall be notified 24 hours before concrete is placed.

7.3.11 Casing Pipe Installation

A. Vertical and horizontal offset staking shall be provided at each end of casing pipe installations.
B. Casing pipe shall be installed at the grade and alignment shown on the Construction Drawings.
   1. Grade and alignment shall meet the vertical and horizontal allowances for the system for which it is installed.
C. Casing pipe shall be installed as indicated in the Construction Drawings, whether by open trench excavation, boring or jacking.

7.3.12 Carrier Pipe Installation

A. Carrier pipe shall be installed at the grade shown on the Construction Drawings.
B. Each section of pipe shall have a minimum of 3 casing spacers. Redwood skids are not allowed.

C. All joints of the water main within the casing shall be restrained. Joint restraint can either be accomplished through the use of restrained joint casing spacers or standard joint restraint with casing spacers.

D. Seal the end of the casing pipe with casing seals after the installation of the carrier pipe to protect against the infiltration of backfill into the casing pipe.

7.3.13 Corrosion Protection

A. Protection of Metal Surfaces

1. If the supplied material has not been factory coated, or the coating has been damaged by installation, the material shall be protected by one of the following methods:
   a. Two coats of coal tar paint shall be applied to ferrous metal rods, rebar, clamps, bolts, nuts and other accessories subject to submergence or contact with earth or fill material, and are not encased in concrete.
      1) The first coat of coal tar paint shall be applied to a dry, clean surface.
      2) The first coat of coal tar paint shall be allowed to dry before the second coat is applied.
   2. Ferrous metal rods, rebar, clamps, bolts, nuts and other accessories subject to submergence or contact with earth or fill material, and not encased in concrete shall be protected with coal tar paint or a rubberized spray-on undercoating, and wrapped by a minimum 8 mil. polyethylene film.

B. Magnesium Anodes

1. Anodes and CP test stations shall be installed by the thermite weld process.
2. The anode lead wire shall be placed in a way that does not strain the connection during backfilling and compaction.
3. Anodes shall be installed vertically in native soils, a minimum of 10 feet laterally from the water main to be protected or a minimum of 6 feet laterally from any casings to be protected.
4. Place the top of the anode below the centerline of the pipe. However, anode spacing and lateral distance can be adjusted from permanent obstacles at the approval of the Department.
5. Anodes shall be soaked with a minimum of 5 gallons of water before backfilling.
6. Anodes shall be backfilled and tamped with native soil in 6-inch layers. Sand is not permissible.

C. Wiring

1. Underground wires, cables and connections shall be buried with a 6-inches minimum separation from other underground structures.
2. Cut bond wire to shortest length practicable, including some slack, for given span. Locate bond wire welds on pipe and fittings. Horizontal welds are preferred, but where there is insufficient space on fitting vertical welds
are permitted. Where multiple parallel bond wires are involved, space wires neatly and without wires crossing each other.


4. If insulation of bond wire is damaged between welds, repair insulation by: thoroughly clean damaged area and 6-inches either side of it. Wrap minimum of 1 overlapping layer of rubberized electrical tape around damaged area and extend at least 2-inches each side. Wrap two overlapping layers of plastic electrical tape around rubberized tape and extend at least 1-inch beyond rubberized tape at each end.

5. Wiring shall be backfilled with material free from rocks and debris that could damage the insulation.

D. Exothermic Welds/Brazing

1. Prior to brazing, an area of the structure three inches square shall be cleaned to bright metal with a grinder or file. Also remove 1-inch of insulation from each end of wire.

2. Weld conductor to pipe. Brazing techniques shall comply with the anode manufacturer's recommendations. Only proper size cartridges and welders will be permissible.

3. The slag shall be removed from the completed braze with a hammer.

4. The adequacy of each braze shall be demonstrated by gently striking the top of the connection with a one pound hammer. Test the thermite weld connection by striking the weld several blows on the side using a one pound hammer. Top of weld may be hammered flat if necessary.

5. Apply Handy Cap:
   a. Clean all mud, dirt, grease, oil and other contaminants from the metals surface and any part of the mill applied coating which is to be covered. Apply a coat of Royston Roybond 747 primer and allow to dry to a non-glossy appearance, which will take about 5 minutes, depending on humidity and temperature.
   b. Remove the release paper from the bottom of the Royston Handy cap; bend the plastic sheet inward at the serrations when applying to small diameter pipe. Position and place the handy cap on the welded area with the tunnel over the lead wire.
   c. Push the dome of the cap firmly into the weld area. Lift the lead wire away from the pipe and squeeze the black rubber compound completely around and underneath the wire. Push the lead wire back down on the pipe and press the elastomeric compound into firm contact with the pipe over the entire area.
   d. When coating or wrapping the Handy Cap, remove the narrow strips of plastic release film on the top of the cap. This will assure maximum protection with a positive waterproof seal.

E. CP Test Stations

1. Provide a minimum of 48-inches of slack, coiled in each box.

2. Install marker post.
F. Insulators
   1. All isolating devices shall be properly installed per manufacturer recommendations and tested to ensure proper functionality.

G. Continuity Testing
   1. The Contractor will be responsible for performing any continuity testing on bonded pipelines. Testing shall be performed by a NACE certified CP Technologist, or registered PE with a minimum of 2 years of CP field experience. Any breaks in the continuity or broken test leads shall be repaired. Test records shall be furnished to the Department prior to acceptance of the project.

7.3.14 Installation of Appurtenances

A. Valves, meters, hydrants and other appurtenances shall be installed at the locations shown on the final signed PICPs.

B. Measurements of the actual location of appurtenances shall be made prior to backfilling for recording in the Project Record Drawings.

C. Temporary blow-offs installed by the Developer/Contractor shall be abandoned at the main, prior to Initial Acceptance.

D. Fabricated Steel Tapping Saddles
   1. The Contractor shall use a Department designated welder for all fabricated steel tapping saddles including service taps required to be welded to an existing steel water main. All costs for the welder shall be the Contractor's responsibility.

7.3.15 Valves

A. General
   1. Valves shall be installed in a manner whereby the operating nut and valve box are plumb, in the vertical position.
   2. Valves shall be installed in accordance with the manufacturer’s recommendations.
   4. Riser stems shall be used when the depth from finish surface to top of valve nut is greater than 8-feet. In these cases, the extension/stem shall be installed such that there is approximately 5-feet from finish surface to top of extension/stem nut.
   5. Where riser stems are used to extend the vertical height of an operating nut, the riser stem shall be securely pinned/connected to the valve operating nut. The riser stem shall be coated to prevent corrosion and shall have a centering plate to keep it centered within valve box assembly.

B. Tapping Valves & Sleeves
   1. 4-inch thru 12-inch: These taps are made the Department. Saddles/sleeves shall be equipped with a threaded test hole and shall be installed such that the test hole is on top. Prior to proceeding with a wet tap, saddles/sleeves shall be tested by the Department (200 psi with no leakage for 5 minutes).
2. **Wet taps larger than 12-inches:** The Contractor shall use a Department approved tapping Contractor for the tap. All costs for the tap shall be the Contractor’s responsibility.

3. Spacing requirements between wet taps shall be 2-feet from an existing joint to edge of wet tap and 5-feet centerline spacing between two wet taps.

**C. Valve Boxes**

1. Shall be installed on buried valves.
2. Shall be installed so that no stress is transmitted to the valve.
3. Valve boxes set over the valve shall be centered, plumb and directly over the operating nut.
4. The soil around the valve box assembly shall be carefully compacted to minimize misalignment and future settling of the backfill.

**D. Air Relief/Vacuum Relief Valves**

1. Air relief and vacuum relief valves shall be installed as shown on final signed PICPs. Reference Standard Drawing W-14.

**E. Pressure Reducing Valves**


**F. Valve Operation**

1. Valves, unless specifically approved otherwise by the Inspector, shall be operated ONLY by the Department.

### 7.3.16 Fire Hydrants

**A.** Fire hydrants shall be installed in accordance with Standard Drawing W-3.

**B.** Construction Staking shall be provided which identifies vertical (to top of hydrant body flange) and horizontal locations of all hydrants.

**C.** The fire hydrant shall be installed vertically plumb with the pumper nozzle facing toward the vehicle access unless shown otherwise on the final signed PICPs.

**D.** When thrust blocks are used, care shall be taken so that hydrant drain holes remain free of obstructions.

**E.** After pouring the thrust block, hydrant gravel shall be placed to a depth of 12-inches above the hydrant shoe.

**F.** Hydrant drain holes shall remain free of obstructions.

**G.** The ground surrounding the fire hydrant shall slope away from the hydrant at a minimum grade of 2%.

**H.** After installation of the fire hydrant is complete, the oil/grease reservoir shall be checked to ensure that it is full.

**I.** If it is necessary to fill the oil/grease reservoir, it shall be filled with the oil/grease specified by the hydrant manufacturer. Oil and grease shall be FDA approved. Grease the caps with FDA approved (food grade) grease.
J. If a hydrant is raised, no more than one extension section can be used, unless approved otherwise by the Department.

K. Fire hydrants accepted by the Department shall be operated ONLY by the Department.

L. Prior to Initial Acceptance, and pursuant to the Inspector’s direction, fire hydrants with mars and/or scratches shall be “field” repainted using ONLY the manufacturer’s specified paint.

7.3.17 Services Lines, Meters and Appurtenances

A. Installation of Service Taps and Meters
   1. Prior to initial acceptance:
      a. All service taps are installed by the Contractor. The taps and service lines shall be installed prior to disinfection and pressure testing of the main and are subject to inspection and testing, pursuant to these Standards.
      b. For 3/4-inch and 1-inch services: the City will provide and install the meters only.
      c. For 1-1/2 inch and larger services: The Contractor is responsible to obtain and install the meter and appurtenances.
      d. Taps shall be made with a tapping saddle in accordance with these specifications and the manufacturer's recommendations, unless approved otherwise by the Department.
      e. Tapping equipment shall be of good quality, used for the purpose intended and used in accordance with manufacturer's instructions.
   2. After initial acceptance (Wet taps):
      a. For 3/4-inch and 1-inch services: the Department shall make the service tap, provide and install the meter.
      b. For 1-1/2 inch and larger services: the Contractor shall supply all materials for the service including the meter. The Department shall make the service tap and the Developer shall install the meter.
      c. For any service taps on an existing steel main, the Contractor shall pay for a Department approved welder to weld on a "weld-o-let" service tap. The Contractor shall supply all materials for the service tap and the Department shall make the service tap.
   3. A 4" x 4" wood post shall be placed at the end of the pig tail. The post shall extend a minimum of 2 feet above the finished grade.

B. Maintenance and Correction
   1. The Developer/Contractor shall maintain and repair service lines, meter pits, and any associated appurtenances which leak, were installed incorrectly, or otherwise prove to be defective, throughout the entire warranty period.

C. Location of Service Taps
   1. Shall not be made within two feet of any joint or fitting.
2. Shall be separated by at least 1.5-feet (measured along the pipe length), even when taps are made on opposite sides of pipe. Taps shall be made at the 2:00 o’clock and/or 10:00 o’clock position.

3. Made on the same side of the pipe and within 10-feet of each other (measured along the pipe length), shall be alternately staggered by fifteen degrees between each tap.

D. Service Lines
1. For newly installed service lines, there shall be no tees, connections, or couplings between the corporation stop and curb stop valves. For reconstruction or retrofit instances, a maximum of one coupling per service line may be allowed between the corporation stop and curb stop valves. All couplings shall be compression x compression.

2. Service lines shall be uniform in size from the corporation stop to the connection point to the meter yoke assembly.

3. Bedding material for services is specified in Chapter 6 on Trenching.

4. All trenches for service lines are subject to compaction specifications pursuant to these Standards.

E. Curb Stops
1. Curb stops for ¾-inch and 1-inch shall be installed inside meter pits only.

2. When meter vaults are used for other sizes of service lines, the curb stop shall be installed outside the vault. The following additional items shall apply.
   a. The Contractor shall adjust the curb stop box to 1/2- inch above final grade prior to final inspection.
   b. Curb stop box shall be fully extended.
   c. Curb stop box shall be plumb.

3. There shall be no tees, connections and couplings installed between the curb stop and the meter setter or copper horn.

F. Meter Pits and Vaults
1. Contractor shall adjust meter pits and vaults to the horizontal location and to the final grade as determined by the grade stake.

2. Grade stakes shall be a placed a minimum of five feet from the location of the meter pit.

3. Contractor shall not disturb grade stakes prior to inspection of the service by the Department.


5. Exterior meter settings shall be installed according to the manufacturer’s recommendations.

6. The ground surrounding meter pits and vaults shall slope away from the lid at a minimum grade of 2 percent, toward the street.

7. Plumbing connections (e.g. construction water, temporary water, etc.) shall not be made to any portion of a service line or meter assembly.
8. On the outlet (customer) side – All tees, connections, and other couplings shall be no closer than 5 feet from the outside edge of a meter box, pit, or vault wall.

9. On the inlet (City) side - Tees, connections, and couplings shall not be installed between the curb stop and the meter setter.

10. The meter box, pit or vault shall be adjusted to 1/2-inch above final grade if the surrounding grade is changed. Contractor to use appropriate height Riser/Extensions.

11. Touch read devices mounted on buildings may be on either side of the building, but not more than 5’ from the front of the building or more than 5’ above finished grade. Touch read devices shall not be placed behind any fence.

G. Service Line Inspections

1. The Contractor shall ensure that the curb stop and corporation stop remain exposed until after the inspection and the approval for backfill is given by the Department for all meter pits.

2. Tap and service inspections shall be scheduled by the Contractor with the Department. A minimum of 48 hours' notice is required on tap and service inspections.

3. The water service shall be turned on at the curb stop by the Department, only after the service line, curb stop, stop box, and meter setter is installed and tested.

4. Meter pits and stop boxes shall be at finished grade at time of Initial Acceptance.

5. If the stop box or meter pit is damaged, bent, or otherwise unacceptable to the Department, the Developer/Contractor shall be responsible for replacing the damaged stop box and/or meter pit prior to Initial Acceptance.

6. If grade changes are made during the warranty period, Contractor/Builder shall repair.

7.3.18 Abandonment

A. Abandonment of vaults

1. Remove the ring and cover, grade rings, and concrete cover.

2. Cut a 1 foot square hole through the floor of the vault.

3. Seal inlet and outlet piping with concrete.

4. Fill the vault with gravel.

5. Restore surface to match preexisting conditions.

B. Abandonment of water mains

1. Shut off isolating valves and verify valves are watertight. If unable to obtain a watertight shut-off, either install a new isolation valve to provide a watertight shut-off or remove the existing valve and install a mechanically restrained cap. The Department shall first approve either method, prior to installation of a valve or cap.
2. Remove valve boxes/lids.
3. Remove a section of piping on the downstream side of isolation valves and pour either a concrete “seal” or install a MJ cap on all open ends of the abandoned main.
4. Remove curb stop boxes on abandoned sections of the piping.
5. Restore all surfaces to match preexisting conditions.
6. The Department may require flowfill or flashfill for larger mains on a case by case basis depending on pipe location and surface conditions.

C. Abandonment of Services on Active Mains
1. As required by the Department either take the main out of service or turn the corp stop off.
2. As required by the Department either cap/plug the corp stop or remove the corp stop (and saddle) and install a stainless steel repair clamp/sleeve on the main.
3. Remove a 12-inch section of service line, near the main.
4. Remove the curb stop box.
5. Restore all surfaces to match preexisting conditions.

D. Demolition of structures with active services
1. As approved by the Department, active services may remain on a lot after the structure has been removed as long as there is redevelopment potential that will utilize the service in the future.

7.3.19 Disinfection

A. The Developer/Contractor is responsible for the disinfection and testing of water lines.

B. Product Delivery, Storage and Handling
1. Reference the Forwards to AWWA B300 and AWWA C651.
2. Contractor is responsible for safety of all materials and procedures for disinfection.

C. Materials
1. Hypochlorite.
   a. Reference AWWA B300.
   b. Hypochlorite for use in swimming pools is not allowed.

D. Disinfection Procedures
1. Contractor, with Department approval, shall satisfactorily disinfect and flush new water lines prior to placing them in service, in accordance with AWWA C651. All services (including saddle/sleeve, corp stop/valve, service line and curb stop), hydrants, and all related appurtenances, shall be installed prior to beginning the disinfection procedure.
2. Precautions will be taken to avoid contamination when water mains are cut into or repaired. When isolation of a section of line is possible, the continuous feed or slug method of chlorination will be used, followed by thorough flushing as described below. If a main cannot be isolated or if it
is required to minimize time that customers are without water, the new pipe, fittings, and valves required for connection shall be spray-disinfected or swabbed with a minimum of one percent Hypochlorite solution.

3. Contractor shall have the water tested by a water quality laboratory approved for such testing by the Colorado Department of Health.

4. Filling Pipe
   a. Only Department personnel shall operate existing valves to prevent the disinfecting solution from flowing back into the line supplying the water.
   b. Where permanent air relief valves are not available, the Contractor shall install corporation stops at high points in the water line, in order to evacuate air.
   c. All corporation stops which were installed to facilitate evacuation of air from the water main shall be removed and plugged after the water main is filled, and prior to pressure testing.

5. Preliminary Flushing
   a. The pipelines shall be flushed by the Department at a minimum velocity of 2.5 ft/sec., in order to remove foreign material prior to disinfection.

6. Methods
   a. General
      1) The Department, together, with the Developer/Contractor, shall determine the most appropriate disinfection method.
      2) The Contractor shall sample and test water from the pipe system extremities until clear, potable water is obtained.
   b. Tablet/Granular Method
      During construction, calcium hypochlorite granules or tablets shall be placed at the upstream end of each section of pipe, and at the upstream end of each branch main. The quantity of granules used shall be as shown in Table 1, AWWA C651.
      Introduce water into the pipes at a velocity no greater than 1 ft./sec. The chlorinated water shall be retained in the lines for a minimum of 48 hours, at which time the treated water must contain no less than 25 parts per million of chlorine throughout the entire length of the main.
      The chlorinated water shall be flushed within 5 days unless otherwise approved by the Department.
   c. Continuous-feed Method (for Rechlorination)
      The continuous-feed method of disinfecting water mains consists of completely filling the main to remove all air pockets, flushing the completed main to remove the particulates, and filling the main with potable water chlorinated so that after a 24 hour holding period in the main, there will be a free chlorine residual of not less than 25 parts per million.
      Prior to being chlorinated, the main shall be filled to eliminate air pockets, and shall be flushed to remove particulates. The flushing
velocity shall not be less than 2.5 feet per second (Reference Section 3.2 of AWWA C651).

Chlorinated water shall be introduced into the water lines at a point approved by the Department at a constant, measured rate so that the chlorine concentration is maintained at a minimum of 25 parts per million of free chlorine (Reference Table 4 of AWWA C651). Fill the entire main with the chlorine solution.

Prior to and during the disinfection process, valves shall be positioned so that the chlorine solution in the newly constructed main will not flow into water mains in active service.

The chlorinated water shall be retained in the main for a minimum of 24 hours, at which time the treated water in all portions of the main shall have a free residual of not less than 10 parts per million.

7. Final Flushing & Dechlorination
   a. After the applicable retention period, the heavily chlorinated water shall be flushed from the water lines until the chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system, or is less than 1 part per million.

   b. Discharge guidelines for the heavily chlorinated flushed water shall follow current State of Colorado Guidelines for Low Risk Discharge. Removal of any residual chlorine is required for any discharge whereby the chlorine will not be dissipated prior to reaching a classified State Surface Water (stream, creek, gully, ditch, or river, weather dry or flowing). Dechlorination, if necessary, may be achieved by allowing water to stand uncovered (in a local detention pond for example) or by dechlorination methods (using a portable dechlorinator for example). The Contractor shall be responsible for determining and providing the means necessary for the dechlorination. Reference Appendix C of AWWA C651, for a list of neutralizing chemicals typically used for neutralizing chlorine.

8. Bacteriological Tests
   a. The Contractor shall schedule sampling with the Department and submit test results upon completion of testing.

   b. The Contractor shall collect samples from the pipeline after final flushing and pressure testing, but prior to placing water lines in service, and have the water tested for bacteriological quality to show the absence of total coliform and heterotrophic organisms.

   c. The number and frequency of samples shall be determined by the Department based upon AWWA C651.

   d. Testing shall be performed by a laboratory that is certified to run Bacteriological water samples the Colorado Department of Public Health and Environment.

9. Repetition of Procedure
   a. If the initial disinfection, or subsequent disinfections, fails to produce satisfactory samples, the main shall be re-flushed and re-sampled. If
the samples are still not satisfactory, the main shall be re-chlorinated by the continuous-feed method of chlorination until satisfactory results are obtained.

b. If the residual is less than 10 parts per million, the water lines shall be re-chlorinated by the continuous-feed method of chlorination and retested.

E. Delayed Activation

1. All newly installed water mains that are not activated immediately (upon receiving passing Bacteriological test results), shall be flushed and tested prior to activating the mains.
   a. The amount of time allowed before re-testing is required shall be determined by the Inspector.
   b. If the test results fail, see Repetition of Procedure requirements above.

7.3.20 Hydrostatic Testing

A. Once the pipeline has been filled and disinfected, and backfilling has been completed and approved, a pressure test shall be conducted.

B. The Contractor shall provide all equipment and personnel to perform the hydrostatic test.
   1. Test equipment shall be able to maintain a continuous internal pipe pressure of 150 psi and accurately measure leakage from the pipe over a 2-hour minimum test period.
   2. The maximum allowable pressure gauge increment shall be 5 psi.
   3. A water meter shall be used to measure the amount of water used in pressurizing the system.

C. The Department will record times, leakage readings and pressure over the test period. The Contractor shall certify the results of the test. This Certification is required to be submitted prior to Initial Acceptance.

D. Testing shall not occur until at least 7 days have elapsed since the last concrete thrust restraint was cast.
   1. A minimum of 72 hours shall elapse if high-early-strength concrete is used.

E. Testing shall not occur until after the pipeline has been chlorinated and flushed.

F. The pipe shall remain filled with water for a minimum of 24 hours prior to the hydrostatic pressure test.

G. Unless prior permission is given by the Department, the hydrostatic pressure test shall be performed against all valves within the new piping system.

H. Pressure Test
   1. “Leakage” is the quantity of water that must be added to the pipeline to maintain a pressure of within 5 psi of the specified test pressure, after the air has been expelled and the pipe has been filled with water.
   2. Test Pressure
      a. For ductile iron pipe and PVC pipe, the minimum test pressure shall be 150 psi for 2 hours.
b. Fire lines shall be tested at 200 psi for 2 hours.
c. A residual pressure of within 5 psi of the test pressure shall be maintained for a minimum of 2 hours.
d. Test pressures shall be “running” pressures, constantly maintained by the test equipment. Static tests shall not be allowed.

3. The maximum allowable leakage for each test section of ductile iron pipe, and PVC pipe is determined by the following formula:

\[ L = \frac{SD(P)^{1/2}}{133,200} \]

where,
- \( L \) = testing allowable (makeup water) leakage, in gallons per hour.
- \( S \) = length of pipe tested, in feet.
- \( D \) = nominal pipe diameter, in inches
- \( P \) = average test pressure during the hydrostatic test, in psi (gauge)

I. Testing and Leakage (Reference AWWA C600)

1. Unless prior written permission is given by the Department, a test section shall not be any longer than the length of pipe between adjacent line valves.

2. When testing against closed existing valves, an additional testing allowance per closed valve of 0.0078 gal/hour/inch of nominal valve size will be allowed.

3. There will be no additional leakage allowance for resilient seat valves.

4. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.

5. Testing through fire hydrants shall be allowed.

J. Passing

1. If the tests disclose leakage greater than that specified, the defective materials and joints shall be located and repaired. The tests shall be repeated until the leakage is less than the maximum allowed.

2. With the exception of obvious leaks, passing of the pressure test shall be on the basis of maximum allowable leakage per section tested.

3. Visible leaks shall be repaired regardless of maximum allowable leakage.
# CHAPTER 8 -

**PUBLIC WASTEWATER SYSTEM, MATERIALS AND INSTALLATION**

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CHAPTER 8 - PUBLIC WASTEWATER SYSTEM, MATERIALS AND INSTALLATION

8.1 GENERAL

8.1.1 Scope

A. This chapter addresses the installation of wastewater systems, and includes the acceptable products, materials, and construction practices which may be used in the installation of the wastewater system.

B. There are separate requirements and standards for lift stations and force mains that may be obtained from the Department.

8.2 MATERIALS

8.2.1 Pipe, Related Fittings and Appurtenances

A. Polyvinyl Chloride Pipe (PVC)

1. The same type of pipe material shall be used for each size pipe. Pipe material shall not be interchanged, except where another type of pipe material is specifically indicated and approved by the Department.

2. Plastic wastewater pipe and fittings shall be made from PVC components conforming to ASTM D1784.

3. Pipe shall be furnished with fittings, specials and other accessories.

4. 4 inch through 15 inch plastic gravity wastewater pipe and all fittings shall be manufactured in accordance with ASTM D3034. The standard dimension ratio (SDR) shall not exceed 35. SDR 26 is allowed for deeper mains at the discretion of the Department.

5. 18 inch through 48 inch shall conform to ASTM F679, wall thickness T-1.

B. Ductile Iron Pipe (DIP)

1. DIP pipe may be allowed, with prior approval by the Department.

2. DIP pipe and fittings shall conform to AWWA C151 and ASTM A746 and be lined with a material that protects against damage from the effects of hydrogen sulfide. Standard Cement Mortar Lining (CML) will not be acceptable.

3. When used, DIP shall be furnished with all fittings, specials and other accessories.

C. Steel Casing Pipe

1. See Section 7.2.1.C. of these Standards for requirements

D. Joints

1. Joints shall be of the push-on bell and spigot type, and shall be manufactured in accordance with ASTM D3212.

2. Gaskets shall be of O-ring type and manufactured in accordance with ASTM F477.
3. Bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket, which is positively retained.

4. Lubricant shall be provided by the pipe manufacturer.

E. Service Connections
1. The Contractor shall place wyes, tees, stubs and risers where required by the approved construction plans.
2. Watertight plugs shall be installed in each branch pipe or stub.
3. As-built measurements shall be made to the nearest manhole before backfilling.

F. Marker Posts
1. Marker Posts should be similar to Carsonite CRM-375 with reflective labels.
2. For major transmission mains markers should be 4” steel posts filled with concrete. Post should be 5’ tall buried 3’ in a 12” diameter 3,000 psi concrete base that extends 6” below the post. Posts shall be painted orange. Place white 12”x18” metal sign with red letters stating the following information: City of Loveland, diameter of Water/Sewer Line, Year installed, and any necessary offset. In open fields signs shall be placed every 500’ otherwise at bend or manholes.

G. Corrosion Protection
1. See Section 7.2.1.H. of these Standards for requirements.

8.2.2 Manholes

A. Precast Concrete Manholes
1. Reference the chapter on Precast Concrete, Chapter 10.

B. Cast-in-Place Manhole Bases
1. Reference the chapter on Cast-in-Place Concrete, Chapter 9.

C. Manholes shall be furnished with all accessories, base, cone section and ring and cover.


E. Mortar
1. Mortar shall be Sand-Cement grout, using the following ratio of ingredients:
   a. One part Portland Cement; conforming to ASTM C150, Type V.
   b. Two parts sand; conforming to ASTM C144.
   c. One half part hydrated lime; conforming to ASTM C207, Type S.

F. Grout
1. Grout shall be pre-mixed, non-metallic, non-aggregate, and non-shrink using the following ratio of ingredients:
   a. One part Portland Cement; conforming to ASTM C150, Type I, II, IIA,
b. One part sand; conforming to ASTM C144,
c. One part shrinkage correcting aggregate.

G. Ring and Cover
1. Rings for built-up construction shall be 8 inches in height.
2. 4-inch rings may be acceptable for street overlays or repaving, with written approval of the Department Engineer.

H. Water-tight installations
1. Manholes shall not be located in areas subject to flooding from surface runoff.
2. Manholes shall not be located in areas where ponding or storm detention may occur.
3. If the possibility of surface runoff cannot be avoided or if a manhole is located in the 100-year flood plain the manhole shall have a watertight, bolted type cover having an integral O-ring type gasket, that can be bolted closed.

I. Rubberized Gaskets
1. All manhole sections shall have two (2) Gaskets per section joint (inside and outside).
2. Gaskets shall conform to AASHTO M198 and Federal Specification SS-S-00210(210A)
3. Gaskets must be pliable at the time of installation at a temperature of 10° F. and above without being heated.
4. Primer is required on all joints. Primer shall be supplied by the gasket manufacturer.
5. For existing pipe penetrations: A flexible pipe-to-manhole connection is required.

J. Lining
1. The Department may require manholes to be coated with a special lining in areas subject to high corrosion.
2. Lining shall be applied at a minimum of 60 mils and in accordance with manufactures recommendations.

K. Coating
1. The Department may require manholes to be dampproofed for manholes subject to high groundwater.
2. Dampproof coatings shall be factory applied.
3. The determination for the need for a dampproofoing coating shall be made by the Department upon review of the soils report and shown on the approved construction plans, or determined in the field if unexpected groundwater conditions are encountered.

8.2.3 Grease, Sand & Oil Interceptors

A. Precast Concrete Sections
1. Reference the chapter on Precast Concrete, Chapter 10.
B. Cast-in-Place Bases

C. Reference the chapter on Cast-in-Place Concrete, Chapter 9.

D. Furnish with all accessories, including base, and ring & cover. Covers to be marked “Grease Interceptor”.

E. Grease traps shall be constructed of either steel or cast iron and shall have a full gas-tight cover.

F. Water jacketed grease traps are not allowed.


H. Requirements for mortar, grout, gaskets, and other appurtenances shall be the same as for manholes.

8.3 CONSTRUCTION AND INSTALLATION

8.3.1 Product Delivery, Storage and Handling

A. Do not drop materials or equipment. Use slings, pipe tongs, skids or other controlled methods for handling materials and equipment.

B. Care must be taken to prevent damage to materials and equipment by impact, bending, compression, abrasion or other deleterious handling.

C. Damaged materials and equipment shall not be installed.

D. Lubricant shall not be stored or handled in a manner that will cause contamination.

E. Store materials and equipment in accordance with the manufacturer's specifications.

F. Pipe shall be stored on a surface that will provide an even support for the pipe barrel. Do not store in a manner that supports the pipe by the bell.

G. Pipe, fittings and joints shall be kept free from dirt, oil and grease.

H. Steel Casing Pipe: See also Section 7.3.1.K. of these Standards

8.3.2 Inspection

A. Pipe barrel, joints and fittings shall be free of dirt or other foreign objects prior to installation.

B. Pipe, joints and fittings with cracks, dents, abrasions or other flaws shall be rejected.

C. Pipe, joints and fittings with damaged linings or coatings shall be rejected.

D. Manholes with cracks or other flaws shall be rejected.

E. No wastewater pipe may be covered or backfilled until inspection of pipe and bedding has been made.

8.3.3 Preparation

A. Reference the chapter on Trenching, Backfilling and Compaction, Chapter 6.
B. Stabilization materials shall be required for the wastewater system where unstable soil exists.

C. Bedding material shall be placed in the trench bottom to a minimum of 4 inches, and bell holes and depression shall be dug in the bedding to provide a uniform and continuous bearing support for the pipe at every point between bell holes.

8.3.4 Cutting the Pipe

A. The pipe shall be cut smooth, straight, and at right angles to the pipe axis, with saws or pipe cutters designed specifically for the material.

B. The cut end of the pipe shall be beveled in accordance with the manufacturer's recommendations.

C. Burrs shall be removed and all dust shall be wiped off of the jointing surface.

8.3.5 Connections

A. The location and elevation of the existing pipes and manhole inverts shall be verified prior to construction.

B. Connections to existing pipes shall be made with an approved full-circle stainless steel coupling device.

8.3.6 Joints

A. Dirt, oil, grit, and other foreign matter shall be removed from the inside of the bell and outside of the spigot.

B. A thin film of lubricant shall be applied to the inside of the gasket and the spigot end of the pipe, per the manufacturer's recommendations.

C. Preparatory to making pipe joints, all surfaces of the joint shall be clean and dry.

D. The lubricated joint shall be kept clean.

E. The pipe shall have a depth mark prior to the assembly to ensure that the spigot end is inserted to the proper depth of the joint.

F. The pipe shall be joined to the tolerances recommended by the manufacturer.

G. The pipe shall be set in position and checked for line and grade using care to keep the joint absolutely free of dirt.

H. When final grade is achieved, the joint shall be carefully pushed together until the assembly mark on the spigot is aligned with the end of the pipe using approved methods of leverage.

I. Care shall be taken so that the bell end of the pipe will not be deflected.

J. The seating of the gasket shall be checked around the entire circumference of the pipe by visual and feeler gauge inspection.

K. Stabbing the pipe shall not be allowed.
L. Previously completed joints shall not be disturbed during the jointing operation.

M. Joints shall be watertight and free from leaks.

N. After the initial acceptance of the wastewater system, the Contractor shall be responsible for the repair of any leak, high spots or low spots resulting from improper workmanship or materials, discovered within the warranty period.

8.3.7 Job Conditions

A. Foreign material, including trench water, shall not be permitted in the pipe.
   1. The wastewater pipe being installed shall not be used to dewater the trench.
   2. Water shall be prevented from entering the wastewater pipe already in service or pipe previously accepted by the Department.

B. Debris, tools, clothing, or other material shall not be permitted in the pipe.

C. In order to prevent anything from entering the pipe, the open ends of the pipe shall be plugged with a restrained, watertight plug when pipe laying is not in progress.

D. Effective measures shall be used to prevent uplifting or floating of the pipeline prior to completion of the backfilling operations.

E. Pipe shall not be installed under the following conditions:
   1. When trench water is entering the pipe.
   2. When weather conditions are unsuitable.
      a. Temperature is less than 10°F. Written approval is required from the Department when the temperature is 10°F or less.
      b. Snowing heavily.
      c. Raining heavily.
      d. High winds.
   3. When the trench bottom is unstable.

F. Do not use damaged materials or equipment for installation in the system.

8.3.8 Pipe Installation

A. Pipe centerline shall not deviate from the signed P.I.C.P. horizontal alignment by more than 0.15 feet. To insure proper installation pipe shall be installed using a Pipe Laser to determine alignment and grade, and by no other means.

B. Pipe invert, for the entire run/reach of pipe between manholes, shall not deviate from the signed PICPs vertical alignment by more than 0.04 feet. The Department may require a more stringent requirement in critical situations.

C. Pipe shall be laid and maintained at required lines and grades as specified in the approved Construction Drawings.

D. Pipe installation shall be constructed continuously on an upgrade from an existing structure; except when approved by the Department.
1. Pipe shall be installed so that the bells are pointing uphill.
2. Grade/pipe invert changes shall not be allowed within any run/reach between manholes.

E. Employ effective measures to prevent the opening of joints during bedding and backfilling operations.

F. Bedding material shall not be dropped onto unsupported pipe, which has been set to alignment and grade.
   1. The pipe shall be secured in place with the specified granular bedding material consolidated under and around the pipe.
   2. The Contractor shall prevent the opening of joints during bedding and backfilling operations.

G. The joint shall be completed and the pipe adjusted to the correct line and grade as each length of pipe is placed in the trench.

H. The pipe shall be secured in place by careful installation of bedding material.

I. Concrete encasement shall be provided where indicated on the Construction Drawings or required by these specifications.

8.3.9 Casing Pipe/Carrier Pipe Installations
   A. See Sections 7.3.11 & 7.3.12 of these Standards.

8.3.10 Corrosion Protection
   A. See Section 7.3.13 of these Standards.

8.3.11 Manhole Construction
   A. Manholes shall be installed at the location and to the elevation shown on the Construction Drawings, or as approved by the Department to accommodate field conditions.

   B. Measurements of the actual location and elevation of sanitary main inverts shall be made for recording in the Record Drawings by the Design Engineer.

   C. Standard manholes shall be installed in accordance with Standard Drawing WW-2.

   D. Flat-top manholes shall be installed in accordance with Standard Drawing WW-3.
      1. Flat-top manholes are required whenever the distance between the finished road surface and a manhole barrel section does not allow room for a cone section.
      2. Access holes for flat-top manholes shall be offset from center.

   E. Manholes shall be set plumb.

   F. Precast concrete adjustment rings shall be used to bring the ring and cover to grade. See also, Standard Drawings WW-2 and WW-3.

   G. The total height from the top of a manhole cone section, or flat-top manhole, to the finish street grade, shall not exceed 16 inches.
H. The adjustment rings shall be flush with the inside of the manhole.

I. Joint surfaces shall be kept clean, dry, and warm during installation.

J. Rubberized gasket material shall be used for joining the precast concrete section to the manhole base, joining the precast manhole sections, joining the adjustment rings, and joining the ring to the adjustment rings.

K. Rubberized gaskets shall be installed as follows:
   1. Clean the joint surfaces prior to priming.
   2. Apply primer on all joint surfaces in contact with gasket material.
   3. Place two gaskets per joint except as noted below.
      a. One gasket may be used for joining of the adjustment rings.
      b. One gasket may be used for joining the ring to the adjustment ring.
   4. Overlap the gasket material, 6 inches.
   5. Leave protective paper on the outside of gaskets during application and remove when the joint is ready to be joined.
   6. Excess gasket shall be trimmed flush to the interior wall after vacuum testing.

L. Lifting holes and other imperfections shall be filled with an approved non-shrink grout, to provide a smooth finished appearance.

M. If ground water is observed to be above the top of the pipe, the exterior surfaces of manholes shall have a dampproof coating all joints on the riser sections be applied with external joint wrap.

N. For buried manholes, wrap the ring and cover with plastic.

8.3.12 Service Connections

A. Service connections shall be installed at the locations designated on the approved Construction Drawings.


C. The centerline of the service branch shall be inclined upward at a 45º angle.

D. Service connections on existing mains shall be installed using a saddle, and tapping shall be performed by Department crews only.

E. Wastewater services shall be extended at a constant grade to a point behind the utility easement.

F. The end of wastewater services shall be plugged with an airtight plug.

G. The end of all wastewater services shall be marked with a 2" x 4" wooden marker.

H. Wooden markers shall be installed per Standard Drawing WW-6.

8.3.13 Abandonment

A. Abandonment of manholes.
   1. Remove the ring and cover, grade rings, and cone section.
   2. Seal the inlet and outlet piping with concrete.
3. Fill the manhole sections with flow-fill.

**B. Abandonment of wastewater mains.**
1. Place a watertight plug in the end of pipe to be abandoned.
2. Pour a concrete seal on the end of the pipe.
3. The Department may require flowfill or flashfill for larger mains on a case by case basis depending on pipe location and surface conditions.

**C. Abandonment of wastewater services.**
1. Abandon service at the outside of the wye at the main.
2. Place a watertight plug in the end of service.
3. A concrete seal may be required over the plug for services on VCP mains.
4. CIPP Point Repair may be used. Work needs to be performed by a contractor acceptable to the Department. Submit both pre-lining and post-lining videos to the Department prior to acceptance.

**D. Abandonment of wastewater services inside Manholes.**
1. Place a watertight plug in the end of service to be abandoned. Allow 3”-4” of space.
2. Place Grout inside the service, against the plug, to the outer edge of the manhole.
3. Reform and repair invert or bench as necessary

**E. Demolition of structures with active services**
1. As approved by the Department, active services may remain on a lot after the structure has been removed as long as there is redevelopment potential that will utilize the service in the future.

### 8.3.14 Testing Wastewater Systems

**A. Prior to Initial Acceptance, the Developer/Contractor shall perform (in sequential order) and be financially responsible for the following:**

1. **Test wastewater mains and services with a low-pressure air test.**
   a. A test section shall not be any longer than the length of pipe between adjacent manholes.
   b. Testing of wastewater mains shall be per UNI-BELL PVC Pipe Association UNI-B-6, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe, latest revision.
   c. The low-pressure air test shall occur after completion of the backfilling and compaction.
   d. If the Inspector determines that reliable and uniform results are produced by the Contractor's construction techniques, the low air pressure air test may occur after initial backfill and compaction.

2. **Additional Tests required by the Inspector**
   a. If, after visual inspection of the wastewater main, the Inspector finds there is a problem, the Department may require alignment, infiltration, exfiltration and/or deflection tests.
b. A mandrel test is required on all 12 inch and larger mains.

3. **Vacuum test all manholes.**
   a. Manholes shall be tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction is complete.
   b. Pipes entering the manhole shall be plugged and braced.
   c. A vacuum of 10-inches of mercury shall be drawn.
   d. The vacuum pump shall be turned-off and the time monitored.
   e. The vacuum must not drop more than 1-inch for the duration of the time indicated in the following table:

<table>
<thead>
<tr>
<th>Manhole Diameter (Inches)</th>
<th>Duration (min:sec)</th>
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<tr>
<td>48</td>
<td>1:00</td>
</tr>
<tr>
<td>60</td>
<td>1:15</td>
</tr>
<tr>
<td>72</td>
<td>1:30</td>
</tr>
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   f. Manholes that fail the vacuum test shall have the defects located and repaired. All repairs shall be made from outside the manhole.
   g. Repair and repeat testing of the failed manhole shall be performed at contractor’s expense until the testing requirements are met.
   h. Repair methods shall be approved by the Inspector prior to proceeding.

4. **Jet/Wash wastewater mains.**

5. **Televise wastewater mains.**
   a. All publicly dedicated wastewater lines shall be televised.
   b. A recording of the line shall be made and submitted to the Department.
   c. The recording shall be made using a color camera, self-propelled, having sufficient light to show detail of problem areas and joints.
   d. Camera speed shall not exceed 3 feet per second.
   e. If problems or concerns are seen by the operator, then the camera shall be backed up and an extended look at the area will be recorded.
   f. Recordings will have time, date, and footage displayed. Recording media will be compact disk (CD) or digital video-disk (DVD) format.
   g. Manhole identification numbers supplied by the Department and shall be recorded on the CD/DVD.
   h. Dirty mains shall be jetted and televised again at the Developer’s/Contractor’s expense. This shall be repeated until the mains are cleaned to the satisfaction of the Department.
i. If paving has not been completed prior to the date of the recording, a subsequent recording shall be required after all paving operations have been completed.

B. The Contractor shall provide all equipment and personnel to perform the required tests.

C. The Inspector shall record times and pressure and vacuum readings during the test period.
## CHAPTER 9 - CAST-IN PLACE CONCRETE

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CHAPTER 9 - CAST-IN-PLACE CONCRETE

9.1 GENERAL

9.1.1 Scope

A. This chapter covers cast-in-place concrete for thrust restraints, encasements, cut-off walls, cast-in-place concrete structure bases such as manholes, vaults, and grease traps. The chapter will cover materials requirements, forms, reinforcing steel, finishing and curing, and other appurtenant work.

9.2 MATERIALS

9.2.1 Cement

A. Cement shall be Portland Cement conforming to ASTM C150.

B. Type.

1. Thrust restraints, cut-off walls: Type I or II
   1. High early strength (12, 24, or 48 hour) concrete mixtures may be used with prior approval of the Department.
   2. Acceptable type of early strength cement is Type III, or an approved equal.

2. Cast-in-place concrete structure bases: Type V.

3. Fly Ash, if approved, shall be Class C or Class F conforming to ASTM C618. Class C fly ash is NOT allowed for use on Public Wastewater Systems or if sulfate resistant concrete is required. Fly ash, if approved as a cement replacement, shall not exceed 20%.

9.2.2 Aggregates

A. Fine aggregate shall be clean, sharp, natural sand conforming to ASTM C33.

B. Course aggregate shall be clean, strong crushed gravel or stone conforming to ASTM C33. Gradation shall be as specified under concrete mixes.

9.2.3 Water

A. Water shall conform to ASTM C94 and be free from silt, organic matter, alkali, salts, and other impurities.

9.2.4 Admixtures

A. An air-entraining agent shall be used in concrete conforming to ASTM C260. Total air content shall be 5 to 8 percent.

B. Accelerators shall conform to ASTM C494 and ACI 306.

C. A water-reducing admixture may be used, if approved by the Department.
   1. Water-reducing admixture shall conform to ASTM C494, for Type A or Type D chemical admixture.
2. The water-reducing admixture shall not contain any calcium chloride.
3. The water-reducing admixture shall be compatible with the cement being used.

9.2.5 **Concrete Mix Design**

A. Thrust restraints and concrete encasements shall have a minimum of 6 sacks per cubic yard, and shall develop a minimum compressive strength of 4000 psi after 28 days.

B. Cast-in-place concrete structure bases shall have a minimum of 6 sacks per cubic yard, and shall develop a minimum compressive strength of 4000 psi after 28 days.

C. Concrete cut-off walls shall have a minimum of 5½ sacks per cubic yard, and shall develop a minimum compressive strength of 2000 psi after 28 days.

D. Concrete shall have a maximum allowable water/cement ratio of 0.50 by weight.

E. The water/cement ratio may be increased to 0.56, by weight, if a water-reducing agent is used.

F. Slump: 4 inch maximum.

G. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94.

9.2.6 **Concrete Reinforcement**

A. Deformed reinforcing bars shall conform to ASTM A996.
   1. Rebars shall be either Grade 40 or 60.

B. Welded steel wire fabric shall conform to ASTM A185.

C. Fiber mesh reinforcement: 1.5 lbs/cubic yard of fiber mesh or approved equivalent.

9.2.7 **Forms**

A. Plywood shall be waterproof, resin-bonded, exterior type.

B. Lumber shall be straight, uniform width and thickness, free from knots, offsets, hole and dents.

C. Form oil shall be light colored paraffin oil, or other non-staining material.

9.3 **CONSTRUCTION**

9.3.1 **Product Delivery, Storage and Handling**

A. **Ready-Mixed Concrete:**
   1. All concrete must be delivered to the site from a ready-mix plant via revolving-drum truck.
2. The maximum elapsed time from the time water is added to the mix until the concrete is in place shall not exceed 1 1/2 hours when concrete is transported in revolving-drum truck bodies.

B. Reinforcing Steel:
   1. Carefully handle and store on supports to keep the steel from coming in contact with the ground.
   2. Remove mud, oil, loose rust or mill scale and other foreign materials prior to placing concrete.
   3. Rust or mill scale which is "tight" will be permissible without cleaning or brushing, provided weights, dimensions, cross sectional area, and tensile properties meet the requirements of ASTM A996.

9.3.2 Forms and Subgrade
   A. Forms shall be constructed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings.
   B. Do not remove forms or disturb forms until the concrete has attained sufficient strength to safely support dead and live loads.
   C. Subgrade surfaces under concrete placements containing less than 25 percent material passing a No. 4 sieve shall be covered with 8 mil polyethylene film to protect concrete from loss of water.
      1. Lap joints at least 4 inches.
   D. Moisten subgrade prior to placement, but do not cause water to pond, nor muddy or soft spots to appear.

9.3.3 Placing
   A. Convey concrete to the point of final deposit by methods that will prevent the separation of materials.
   B. During and immediately after placement concrete shall be worked around reinforcement and embedments and worked into corners of the forms.
   C. During and immediately after placement thoroughly vibrate and consolidate concrete around reinforcements, embedments, and corners of forms.
      1. Use mechanical vibrators that will maintain at least 9000 cycles per minute when immersed in concrete. Minimum horsepower per vibrator shall be 1½ hp.
      2. Vibration of concrete will occur for an adequate length of time to obtain adequate consolidation (generally 5 to 15 seconds) without over-vibration causing the fines to separate. Do not use vibrators to transport concrete laterally in forms.
   D. Concrete shall not be placed unless the air temperature adjacent to the concrete placement is 32°F, and rising. There shall not be any frost in the subgrade.
   E. Cease placement if the temperature is falling and drops below 40°F.
F. The temperature of the mix shall not be less than 50°F, or more than 90°F at the time of the placement.

G. If heated mixing water and/or an accelerator is used, the above temperature restrictions may be waived with prior written permission from the Department.
   1. Water shall not be heated to a temperature exceeding 150°F.

H. To facilitate the placement of concrete in hot weather, the aggregate and the water may be cooled.

9.3.4 Finishing

A. Manhole bases, benches and inverts shall be true to line and grade and smoothed with a light broom finish.

9.3.5 Curing

A. Finished concrete shall be cured by protecting it against moisture loss, rapid temperature change, and from rain, flowing water and mechanical injury for a minimum of 72 hours after placement.

B. Concrete shall be maintained at a minimum temperature of 50°F during the curing period.

C. Contractor is responsible for protecting the concrete until Initial Acceptance.
## CHAPTER 10 -

### PRECAST CONCRETE

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</table>
CHAPTER 10 - PRECAST CONCRETE

10.1 GENERAL

10.1.1 Scope

A. This chapter covers precast concrete products.

10.2 MATERIALS

10.2.1 Precast Concrete Products

A. Barrels, bases, cone sections and flat slab tops of manholes shall conform to ASTM C478, and shall be made with Type V cement conforming to ASTM C150.

1. Unless written permission is obtained from the Department, flat slab tops will be used on vaults.

2. Reference the Standard Drawings on manholes to determine when manholes shall be conical or flat-top manholes.

3. Cone sections shall be the eccentric type unless approved otherwise by the Department.

B. Grease, Sand & Oil Interceptors precast sections shall conform to ASTM C478, and shall be made with Type V Cement conforming to ASTM C150.

C. Barrels, bases, cone sections and flat slab tops for water meter pit bases, water meter vaults, and precast concrete vaults shall conform to ASTM C478, and shall be made with Type I or II Cement conforming to ASTM C150.

1. Water meter pit bases shall be 4000 psi concrete with fiber reinforcing.
   a. Provide a 1 inch drain hole.
   b. Accommodate polyethylene meter pits.

D. Reinforcing Materials shall conform to ASTM C478.

1. Rebars shall be either Grade 40 or 60.


E. Fine and course aggregate shall conform to ASTM C33.
F. Water shall be free from objectionable quantities of silt, organic matter, alkali, salts, and other impurities.
   1. Requirements on mortar, grout, ring and cover, steps, and preformed plastic gaskets shall be as specified in Chapter 8 on the Wastewater System.

10.3 CONSTRUCTION

10.3.1 Product Delivery, Storage and Handling
   A. Precast concrete parts shall be handled, stored, and protected in a manner that will prevent damage to materials.

10.3.2 Preparation
   A. Reference Chapter 6 on Trenching for requirements on subgrade, stabilization material, and bedding. Use the bedding material for wastewater pipe for bedding of vaults and manholes.

10.3.3 Construction
   A. Vaults and manholes shall be set plumb and to grade. Reference Chapter 8 of these Standards.
   B. Sections shall be joined using preformed plastic gaskets.
   C. Joints shall be clean, dry and primed.
   D. Lifting holes shall be filled with an approved non-shrink grout.
APPENDIX A
REQUIREMENTS FOR PUBLIC IMPROVEMENTS
CONSTRUCTION PLANS
(INCLUDING PUBLIC WATER AND WASTEWATER)
## Requirements for Public Improvements Construction Plans (PICP) Checklist

### Project Name:

The two "check list" columns to the left of the plan requirements below are provided for the convenience of both staff and the Design Engineer. The Design Engineer should indicate if the items are included in the plans or if they are not applicable for the specific project. The Stamp and signature of the Design Engineer is required on the final PICP in accordance with current State Statutes and Board Rules and not required for the plans set submitted for review.

### I. Cover (& Notes) Sheet(s)

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<thead>
<tr>
<th>Applicant Validation</th>
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#### A. Preamble title of "Public Improvements Construction Plans" followed by the legal name of the addition or subdivision. The marketing name and the address may be used on the plans, but must be subordinate to the subdivision name.

#### B. The Signature review block for the City of Loveland (see block provided at the end of this document)

#### C. Signature review blocks from other applicable entities: Ditch company, C.D.O.T., County, Water Districts, etc…

#### D. Index to all sheets in the plan set. The sheets shall be sequentially numbered beginning with “1”. Copies of the landscape plans shall be part of the PICP set.

#### E. The character type and position of benchmark (including elevation) must reference the "City of Loveland 1995 Level Net Survey".

#### F. Vicinity map, scale and north arrow. The vicinity map must be updated to show all approved projects in the area. 1" = ________.

#### G. General Construction Notes, Street Construction Notes (Appendix I-B), Storm Drainage Notes, Waterline Note (Appendix E-1), and Specific Notes related to Water/Wastewater (per Water/Wastewater Standards Appendix B).

### II. Grading, Drainage & Sediment/Erosion Control Plan(s)

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#### A. A Grading, Drainage and Sediment/Erosion Control Report done in accordance with the City of Loveland Storm Drainage Criteria Manual. A final drainage report must be accepted by the Stormwater Engineering Division.
B. Existing and proposed contours in a minimum of two foot intervals.
   1. Show contours extending a minimum of 50’ off-site, and tying into existing contours.
   2. Finish grade spot elevations for streets, lot corners, building corners, and finish floor elevation or alternately top of foundation elevation of buildings shown for all lots.

C. This statement on the final grading plan: “The top of foundation elevations shown are the minimum elevations required for protection from the 100 year storm. The lowest opening elevations shown are at least one foot above the 100 year storm elevation of adjacent streets, channels, ditches, swales, or other drainage facilities. Minimum finished floor elevations above 100-year water surface in streets, channels, ditches, swales, or other drainage facilities, as illustrated by a final grading plan are to be shown.”

D. This statement (if warranted) on the final grading plan: “A minimum 3-feet separation between the residential home foundation bearing elevation and the peak seasonal groundwater level is required for all new residential home construction. Refer to the geotechnical investigation report titled “xxx”. An asterisk (*) is to be placed adjacent to the statement and on each residential lot impacted by high groundwater levels. As an alternative to adding this note, you may design and construct a separate private gravity groundwater underdrain system within the street right-of-way with connections to each home foundation drain. See “Groundwater Underdrain System Plan & Profile” below for requirements.

E. Plans to have positive drainage to streets (showing drainage arrows across lots) or to an approved discharge facility.

F. All drainage improvements are to be designed to include all necessary improvement details on the detail sheet, including structural details for concrete hydraulic structures and retaining walls.

G. Cross-check front lot elevations with plan & profile sheets for continuity. Also check for elevations and datum match where streets will meet an adjoining subdivision, especially when the adjoining street is designed but not built.

H. Show phase lines. If phasing is proposed after the construction plans are signed, the consultant must revise the plans to show the phase lines.

I. Grading Criteria:
   1. Minimum of 2.0% profile grade on grass and a maximum side slope of 4:1. If special circumstances warrant a steeper cross slope, it will be evaluated on a case-by-case basis.
   2. Minimum grade away from building foundations and window wells is 5% for first 5 to 10 feet.
   3. Finished grades at building foundations are a minimum of 6 inches below the top of foundation elevation.
   4. If three or more rear lots combine their drainage waters in a common rear lot line swale, a concrete trickle channel shall be provided within the common rear lot line swale and extend to the nearest public street.
   5. Drainage outlets and ending pans typically should have some type of erosion protection indicated. Example: If rip-rap is to be used, details should include size of rock D-50 and dimensions of placement, length, width, depth.

J. Inlets, fire hydrants and utility poles are not to be constructed where they would conflict with handicap ramps, or be a hazard to traffic. Maintain a 3’ minimum clearance from flowline.

K. Include phasing of drainage infrastructure and temporary erosion control, if phasing is desired.

L. All applicable design related items (not permitting paperwork) items from the Sediment/Erosion Control Development Submittal checklist.

III. Street Plan & Profiles

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A. Minimum street widths are per Table 7-2 and 7-4 (unless project is a PUD or a waiver or variance is approved).

B. Profile grades:
   1. See Table 7-4 for maximum grades. Minimum grade allowed is 0.5%.
   2. Street grades within 100’ of an approaching intersection shall be a maximum grade of 4%.
   3. Maximum grade through the intersection is 3%.
      a. 10’ min. length for each segment prior to a grade break. 2% max. algebraic difference between segments for Collectors and Arterials. 4% max. grade break on local streets. This is to provide a smooth ride through the intersection.
      b. Provide flowline grades for intersections with cross-pans. Check the grades for correctness. Make sure they drain.
      c. Provide the percent grade for all curb returns at intersections.
C. Vertical curve is required when the algebraic difference in grades is >1.0% except flowline grades in sumps.
   1. Check actual grades and length for accuracy and correctness.
   2. All K-values shall be noted on the profile view; minimum K-values shall be in accordance with design speed. Minimum K=45 for crest vertical curve unless circumstances warrant less than 45 (K=L/Alg. Difference in grades).
   3. All proposed streets to match with existing streets and adjacent topography/projects. Show the existing streets profile and topography grade and where the proposed will match it. Existing street and topography grades are to be shown for an adequate distance beyond the proposed improvements to facilitate a smooth transition.
   4. Check stationing of plan and profile for errors in design and/or discrepancies between the two. Keep the street names the same. (Don’t change names of streets at intersections.)

D. Tapers: When shifting an entire directional stream of traffic the taper length (L) = WS for design speeds of >45mph; and L=WS/60 for design speeds of <40mph; and for turning bay tapers L=WS/3. (L=length of transitional taper section in feet, W=width of later lane shift in feet, S=design speed in m.p.h.)

E. Access ramps shall be constructed at all corners of street intersections, including one ramp opposite from corners of tee intersections. It is recommended by the Handicap Advisory Committee that access ramps be installed midblock when blocks exceed 600 feet in length street.

F. Inlets/catch basins, fire hydrants, utility poles and electric appurtenances are not to be constructed where they would conflict with handicap ramps.

G. Provide 2” P.V.C. schedule 40, 36” deep with pull boxes at intersections that will be signalized now or in the future. Includes 90° sweeps.

H. Show all raised medians and include all details for construction. Show interior median treatment and design. (i.e., trees, sprinklers, pavement, rock, splash pan, etc.). Trees shall not block signing. For detail see LCUASS Standard drawings.

I. Gutter cross pans are not to be designed to cross arterial or major collector streets. Gutter pans widths are as follows:

<table>
<thead>
<tr>
<th>Width</th>
<th>Intersection Type</th>
</tr>
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<tbody>
<tr>
<td>6'</td>
<td>Local-Local</td>
</tr>
<tr>
<td>8'</td>
<td>Local-Collector</td>
</tr>
<tr>
<td>10'</td>
<td>Collector-Collector</td>
</tr>
<tr>
<td>12'</td>
<td>midblock on local street</td>
</tr>
<tr>
<td>30'</td>
<td>midblock on collector street</td>
</tr>
</tbody>
</table>

J. Gutter pans or concrete edge protection may be constructed in place of curb and gutter within industrial zoned areas.
   1. Minimum 4’ compacted fill to be placed between back edge of concrete edge protection or gutter and top of slope of roadside ditch.

K. Minimum curb radii at intersections will be as follows (measured to flowline):

<table>
<thead>
<tr>
<th></th>
<th>Local</th>
<th>Collector</th>
<th>Arterial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>15’</td>
<td>20’</td>
<td>30’</td>
</tr>
<tr>
<td>Collector</td>
<td>20’</td>
<td>25’</td>
<td>30’</td>
</tr>
<tr>
<td>Arterial</td>
<td>30’</td>
<td>30’</td>
<td>35’</td>
</tr>
</tbody>
</table>

Note: As per state highway regulations, a minimum of a 50’ flowline radius is required when an arterial street intersects a state highway, unless otherwise approved through traffic engineering.

L. Verify written easements are received for any required easements not dedicated on the final plat. Check the easements for accuracy and check that all roadway improvement (i.e., curb and gutter, walk, etc.) are located within dedicated public R.O.W. or pedestrian easements when applicable.

M. Identify the numeric phasing designation and the physical limits of each construction phase.
   1. Type III barricades with “End of Road” sign, and any related pre-warning signs at all dead-ends of roads and sidewalks. For detail see LCUASS Standard drawings.
   2. Secondary access provided for dead ends of length ≥ 400’ shall be all weather surface, 20’ wide, 6” minimum thickness of Class 5 or 6 ABC or recycled HBP.
   3. 50’ outside radius all weather turn around at dead-end roadways longer than 150’.

N. Roadway Geometrics
   1. Cross-pan
   2. Centerline radius data.
   3. Design Speed/Posted Speed
   4. Street intersections at right angles, max. skew = 10°
   5. Fa. to Fe. dimensions.
   6. R.O.W. dimensions and curve data.
7. Curb return radius data.
8. Profile grades, in percent.
9. Vertical curve data (including K-values, length, etc.).
10. Curb and gutter radius data.
11. Centerline profile and F, profile on both sides of roadways as required (i.e., curves, intersections, etc.).
12. Label 100’ stations and show 50’ stations.

☐ ☐ O. Document on the plans that there is sufficient sight distance for all movements at intersections, and on crest vertical curves on arterial streets.

☐ ☐ P. Existing utilities and structures.

IV. Street Cross-sections

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</table>

A. Surveyed cross-sections in 50’ intervals are required on all arterial streets. Cross-sections will also be required on other streets and driveways if special conditions warrant it (i.e., widening of existing streets). The interval frequency may be adjusted where warranted due to unique site topography. The use of aerial photography is not acceptable.

B. Check cross slopes for a minimum of 1.5% and a maximum of 4%.

C. Check cuts and fills on all proposed streets. Check catch points vs. R.O.W. line. Too much of either may result in slopes which overrun the R.O.W. In this case, a construction easement will be required.

D. Information to be shown on each cross section:
   1. Curb and gutter, existing and proposed.
   2. Roadway surface, existing and proposed.
   3. Sidewalk, existing and proposed.
   4. Pavement, base and subgrade thickness, existing and proposed.
   5. Cross grades, existing and proposed.
   6. R.O.W., existing and proposed.
   7. Easements, existing and proposed.
   8. Sideslopes, existing and proposed.

E. Pavement sections are to be designed using a Soil Investigation Report as a basis for design, or by using the City’s default values as found in these Standards.
   1. This design will include:
      a. Methods of stabilizing the subgrade. The most common method is to scarify to a minimum depth of six inches and re-compact to a uniform minimum of 95% relative density as determined by AASHTO T-99.
      b. Thickness of the aggregate base course. Compacted to 95% in accordance with T-180.
      c. Thickness of asphalt pavement.
   2. “Default pavement design” may be chosen vs. a full pavement design based on a soils report. The default pavement design is based on the following coefficients.
      a. Aggregate Base Course (A.B.C.) strength coef. = 0.11 per inch, unless R Value tests are submitted which show R values > 78.
      b. Pavement Grading “C” & “G” Hot Bituminous pavement strength coefficient =0.44 per inch.
      c. The minimum sums of the coefficients for the default pavement design are listed below:

<table>
<thead>
<tr>
<th>Street Clarification</th>
<th>WSN</th>
<th>(full depth HBP)</th>
</tr>
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<tbody>
<tr>
<td>Local</td>
<td>2.22</td>
<td>5.5”</td>
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<tr>
<td>Minor Collector</td>
<td>2.97</td>
<td>7.0”</td>
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<td>Major Collector</td>
<td>3.48</td>
<td>8”</td>
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<td>2-lane Arterial</td>
<td>4.08</td>
<td>9.5”</td>
</tr>
<tr>
<td>4-lane Arterial</td>
<td>4.51</td>
<td>10.5”</td>
</tr>
<tr>
<td>6-lane Arterial</td>
<td>4.77</td>
<td>11”</td>
</tr>
</tbody>
</table>
d. Show the min/max lift thickness for Grading “SX” HBP = 1.5” and 2.5” respectively.
e. Show the min/max lift thickness for Grading “S” HBP = 2” and 3” respectively.
f. Show the min/max lift thickness for Grading “SG” HBP = 3” and 5” respectively.
g. Minimum allowable pavement thickness shall be as shown in Table 10-1.

3. The report shall recommend methods of stabilizing the subgrade when groundwater is within 3’ of the pavement section. Details of the methods of construction of the roads, in high ground water areas, shall be shown and described in the appropriate typical cross-section.

V. Striping Plan

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- **Requirements:**
  - **NOTE:** SIGNING & STRIPING PLANS ARE REQUIRED on all streets classified minor collector and greater. Major Collector and Arterial street signing and striping plans shall have a minimum scale of 1”=30’ and shall be per M.U.T.C.D. and the City Standards.

<table>
<thead>
<tr>
<th></th>
<th>A. Bike lanes w/symbols and dimensions (7’ min. adjacent to curb and gutter, 5’ min. adjacent to travel lanes w/o curb and gutter.).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B. Travel lanes w/dimensions for all tapers, angle points, turning bays, medians, symbols, etc.</td>
</tr>
<tr>
<td></td>
<td>C. Location of all existing and proposed signs (i.e., no parking/bike lane, stop, speed, warning, etc.).</td>
</tr>
<tr>
<td></td>
<td>D. R.O.W., easements. (All traffic control devices must be located within right-of-way or easements.)</td>
</tr>
<tr>
<td></td>
<td>E. All street improvements (i.e., curb and gutter, walk, asphalt, etc.) w/dimensions.</td>
</tr>
<tr>
<td></td>
<td>F. Layout data/geometrics to all angle points, end points, symbol locations, and sign locations.</td>
</tr>
<tr>
<td></td>
<td>G. Add note to signing and striping sheet: “The layout of all signing and striping using 3-M temporary tape at a minimum of 50’ spacing shall be approved by the City Street Inspector prior to the installation.”</td>
</tr>
<tr>
<td></td>
<td>H. Preformed thermo-plastic for arrows, cross walks, bike symbols, etc.</td>
</tr>
</tbody>
</table>

VI. Utility Plan

<table>
<thead>
<tr>
<th>Applicant Validation</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Included</strong></td>
<td><strong>N/A</strong></td>
</tr>
</tbody>
</table>

- **Requirements:**
  - **A. Streets**
    1. R.O.W. and easements.
    2. Cross-Pans.
    3. Curb and gutter (lines depicting lip and flowline).
    4. Walk (attached or detached).
    5. Medians, (line depicting both flowlines), if an outfall gutter then show lip and flowline.
    6. Signs (speed, stop, warning) general location.
    7. Other roadway signs or devices associated with phasing or dead end streets.
  
  - **B. Include Phasing of development and construction of all Public Improvements. All public improvements within each phase shall stand alone. Phase lines shall be shown by heavy dark lines; all phases shall be identified by number or letter.**

  - **C. Electric:** Provide 3” P.V.C. schedule 40, 36” deep with pull boxes at intersections that will be signalized now or in the future.
### D. Water
Show existing and proposed Water Distribution System including valves, hydrants, bends, airvacs, blowoffs, lowerings, crossings, meter pits/vaults, and sizes of all mains and services. See Water/Wastewater Development Standards for further requirements.

### E. Wastewater
Show existing and proposed Wastewater System including MHs, C.O.s, services, subdrains (where applicable), crossings, and sizes of all mains and services. See Water/Wastewater Development Standards for further requirements.

### F. Storm Drain System
1. MH, junction structures.
2. Inlets.
3. Storm sewer pipes.
5. Waterways.

### G. Groundwater Underdrain System (if warranted)
1. Cleanouts.
2. Connections/services to each residential home foundation drain.
3. Outlet.

### H. Site Lighting
Show all private light poles.

### VII. Water Plan and/or Profile

<table>
<thead>
<tr>
<th>Applicant Validation</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

#### A. General
1. Show and dimension R.O.W. and Easements.
2. Existing and proposed surface improvements: curb and gutter, cross-panes, walks, medians, inlets, and other structures.
3. Existing and proposed wastewater and storm drain structures.
4. Existing and proposed dry utilities, e.g. gas, electric, telephone, other.
5. Label named irrigation ditches.
6. Easements shown around water meters and fire hydrant laterals.
7. Show phase/construction lines.

#### B. Horizontal
1. Mains located on the north and east sides of public streets, 7 feet from the flowline.
2. Wastewater and storm drain 10 feet or more from the edge of the water mains. Areas of substandard separation to be clearly identified and dimensioned, with reference to the appropriate details.
3. All dry utilities, curb and gutter, and other structures are at least 6 feet from edge of water mains.
4. Provide stationing for all public water mains along centerline. Label station of all appurtenances.
5. Label size and type of all bends, tees, crosses, valves, and hydrants.
6. Label tee connection to existing mains as wet-tap or cut-in.
7. Label pipe size, material, and lengths, including hydrant leads.
8. Curved alignments meet minimum radius requirements and labeled with PC, PT, radius, delta, length, joint deflection and the pipe segment length.
9. Dead-end mains, 250 feet or less, with blow-off or hydrant.
10. Valves placed at each leg of crosses and tees, and at every 600 feet or less.
11. Fire hydrants located and spaced according to LFRA requirements.
12. Mains and related appurtenances with horizontal dimensional ties to existing permanent features and/or to a baseline, centerline, R.O.W., or Easement. Coordinates shall not be allowed.
13. No shrubs within 5 feet, no trees within 10 feet, and no berms greater than 2 feet high or slopes greater than 4:1.
14. Location markers when outside pavement.
REQUIREMENTS FOR PUBLIC IMPROVEMENT CONSTRUCTION PLANS

15. Access roads if required.

C. Services
1. Label the length, type, and size of service between the tap and the water meter/vault.
2. Label the tap and if the tap is a Wet Tap or Cut in Tee.
3. Label the horizontal distances from existing valves to proposed taps.
4. Show all meter pits and vaults and label the size.
5. Provide 10 feet of separation between water and wastewater services.
6. Label all fire service valves to have locking lids.
7. Stations provided for residential subdivisions.

D. Profile
1. Required for all 12 inch and larger mains and all lowerings and ditch crossings.
2. Provide the vertical and horizontal grid with scale.
3. Existing and proposed ground, shown and labeled.
4. Water main labeled with the diameter, material, slope, and lengths between all appurtenances.
5. Deflections and bends shown with stations and pipe grades.
6. Profiles show stationing, pipe grade at bends, deflections, valves, and utility crossings. Clearance to other utilities dimensioned and steel casing shown with reference to appropriate details.
7. Existing and proposed utility crossings, labeled with clearance dimensions.

E. Cathodic Protection
1. Required for DIP and steel casings. Provide stationing and horizontal dimensions.
2. Provide anode design and CP Test station location.

VIII. Wastewater Plan and/or Profile

Applicant Validation
Requirements

<table>
<thead>
<tr>
<th>Included</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. General</td>
<td></td>
</tr>
</tbody>
</table>
1. Show and dimension R.O.W. and Easements.
2. Existing and proposed surface improvements, curb and gutter, cross-pans, walks, medians, inlets, and other structures.
3. Existing and proposed water and storm drain mains.
4. Existing and proposed dry utilities, e.g. gas, electric, telephone, other.
5. Label named irrigation ditches.
6. Show phase/construction lines.

B. Horizontal |
1. Mains located at centerline of road or 6 feet west or south of flowline.
2. Edge to edge separation to water main 10 feet or greater or called out when less than 10 feet and references to appropriate details.
3. All storm drain, underdrain, dry utilities, and curb and gutter at least 6 feet from edge of wastewater mains.
4. Mains and related appurtenances with horizontal dimensional ties to existing permanent features and/or to a baseline, centerline, R.O.W., or Easement. Coordinates are not a substitute.
5. Provide stationing for all public wastewater mains along centerline. Label station of all appurtenances.
6. No shrubs within 5 feet, no trees within 10 feet, and no berms greater than 2 feet high or slopes greater than 4:1
7. Runs between manholes are straight not curved.
8. Label length between manholes.
9. Access provided to every manhole.

C. Manholes |
1. Label manholes with unique number and horizontal station.
2. Label rim and invert elevations.
3. Label any water-tight features, as applicable.
4. Accessible via all-weather access or hard surface improvements.
5. Location identification markers when outside pavement.

<table>
<thead>
<tr>
<th>☐</th>
<th>☐</th>
<th>D. Services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Label size, slope and material type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Minimum 10 feet of separation between water and wastewater services.</td>
</tr>
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<td></td>
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<td>3. For any wet taps provide the linear distance between the nearest MH to the tap.</td>
</tr>
<tr>
<td></td>
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<td>4. Stations provided for residential subdivisions</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>☐</th>
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<th>E. Profile</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1. Vertical and horizontal grid with scale shown.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Existing and proposed ground shown and labeled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Existing manhole rim and invert elevations.</td>
</tr>
<tr>
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<td>4. Proposed manholes shown and labeled with station, rim, and invert elevations.</td>
</tr>
<tr>
<td></td>
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<td>5. 0.10 foot minimum drop through straight manholes, 0.20 foot minimum drop through manhole invert deflections greater than 30 degrees and laterals.</td>
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<td></td>
<td>6. Proposed mains labeled with diameter, material, slope, and length between manholes.</td>
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<td>7. Groundwater barriers are shown upstream of manholes, maximum spacing of 400 feet.</td>
</tr>
<tr>
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<td>8. Existing and proposed utility crossings, identified with station and clearance dimensions.</td>
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<td></td>
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<td>9. Casing pipes labeled with length, size, type, wall thickness and CP design.</td>
</tr>
</tbody>
</table>

**IX. Storm Sewer Plan and Profile**

<table>
<thead>
<tr>
<th>Applicant Validation</th>
<th>Requirements</th>
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</table>

**X. Groundwater Underdrain System Plan and Profile (if warranted)**

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<th>Applicant Validation</th>
<th>Requirements</th>
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<tbody>
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</table>
C. The underdrain system is a gravity system tied into each residential home foundation drain.

D. Label each profile pipe as “Private”.

E. Private underdrain systems also require a formal written agreement with the city and approval by the Loveland City Council at a Public Hearing.

### XI . Detail Sheet(s)

<table>
<thead>
<tr>
<th>Applicant Validation</th>
<th>Requirements</th>
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</table>

A. All standardized improvements shall be depicted by the appropriate City Standard Detail Drawings (Water/Wastewater, Storm Drainage, Underdrain) or LCUASS standard details (current version).

B. Standard Details
   1. Access ramp.
   2. Gutter pan.
   3. Curb and gutter (vertical or driveover).
   4. Sidewalk (detached or attached).
   5. Elevated sidewalk crossings at driveway (detached walk only).
   6. Monolithic curb and gutter/walk (driveover or vertical).
   7. Commercial drive approach (flared or radius).
   8. Residential drive approach (flared or radius).
   9. Curb chase.
   11. Industrial edge protection.

C. Signage (include MUTCD designations):
   1. 4” diameter cutout/PVC sleeve in concrete.
   2. Sign post and stub.
   3. Street name sign and block numbers.
   4. Type III barricade with closure sign (road or sidewalk).
   5. No parking sign spacing.
   6. Speed limits.
   7. With school zones: Routing plans for X-walks, stop signs, school flashers, etc.
   8. No signs in sidewalks.

D. Striping
   1. Arrow, only, arrow.
   2. Diamond, bike, arrow.
   3. Intersection detail (crosswalk, stop bar).

E. Non-Standard Details – Speed hump, traffic circles, cleanouts, hydraulic structure(s) structural reinforcing, retaining wall structural reinforcing, etc.

### XII . Landscape Plan

<table>
<thead>
<tr>
<th>Applicant Validation</th>
<th>Requirements</th>
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<table>
<thead>
<tr>
<th>Included</th>
<th>N/A</th>
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</thead>
</table>

A. Show all public median treatments (i.e., plants, groundcover, subdrains, etc.) and identify maintenance responsibilities.

B. Show all proposed landscaping within the R.O.W. and access easements. Identify plant species and either caliper size for deciduous trees, height for coniferous trees, or gallon size for shrubs, in accordance with the Unified Development Code.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>C. Show, label and denote size of all existing vegetation and identify what landscaping is to be preserved and what is to be relocated or removed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>D. A tree survey is required for all development proposing impacts to a significant tree, as defined in the Unified Development Code. Impacts include proposed removal or relocation of the tree, and development, grading, filling or infrastructure activities located within the drip line or root area of a significant tree. The tree survey shall be performed by a certified arborist, registered landscape architect, or registered land surveyor. The tree survey shall address the location, species, size, and condition of all significant trees. For more information, contact the Planning Division.</td>
</tr>
</tbody>
</table>
|   |   | E. The following tree protection notes shall be placed on the landscape plan for all properties with existing trees and vegetation that will be preserved:  
1. No cut or fill with greater than a four-inch depth shall occur within the dripline or root area of any preserved tree without evaluation by a qualified arborist or forester and City approval of the cut or fill.  
2. No cutting or filling, nor storage of building materials or debris, nor disposal of wastes, shall take place within the larger of the dripline or critical root zone of any protected tree.  
3. No impervious paving shall be placed within the critical root zone of any protected tree.  
4. The larger of the dripline or critical root zone of all protected trees shall be barricaded prior to grading activities, and shall remain in place during construction to prevent damage to the trees and their roots by construction equipment. |
|   |   | F. Annotate intersection sight distance triangles and horizontal curve stopping sight distance triangles on all proposed streets. Private easements may be needed which restrict installation of certain landscape material. |
|   |   | G. Show all proposed and existing underground and above surface utilities including power lines and transformers, water, wastewater, groundwater underdrains, storm drainage facilities, including laterals, services, meter pits/vaults, hydrants, blowoffs, airvacs, etc. Maintain minimum clearance distance of 10' to any tree and 5' to any shrub to public utility. |
|   |   | H. Any site proposing native grass or other grass seeding in disturbed areas of the site, shall provide a temporary irrigation system. A description of the system shall be placed on the landscape plan. |
|   |   | I. Label the location, size and type of water meter that will be used to irrigate the proposed landscaping. |
|   |   | J. If choosing the Hydrozone Option for a dedicated irrigation meter the following plans need to be included in the set for review (see specific requirements)  
1. Hydrozone Plan  
2. Irrigation Plan |
CITY OF LOVELAND PUBLIC IMPROVEMENT CONSTRUCTION PLANS APPROVAL BLOCK

These plans have been approved by:

PUBLIC WORKS - TRANSPORTATION DEVELOPMENT DIVISION (FOR PUBLIC IMPROVEMENTS ONLY)
BY: __________________________________________________________________________ DATE: ______________

LOVELAND FIRE RESCUE AUTHORITY
BY: __________________________________________________________________________ DATE: ______________

WATER AND POWER DEPARTMENT - WATER/WASTEWATER
BY: __________________________________________________________________________ DATE: ______________

WATER AND POWER DEPARTMENT - POWER
BY: __________________________________________________________________________ DATE: ______________

PUBLIC WORKS DEPARTMENT- STORMWATER DIVISION
BY: __________________________________________________________________________ DATE: ______________

PARKS AND RECREATION DEPARTMENT
BY: __________________________________________________________________________ DATE: ______________

DEVELOPMENT SERVICES DEPARTMENT - CURRENT PLANNING DIVISION
BY: __________________________________________________________________________ DATE: ______________

The City of Loveland review constitutes compliance with the City’s Development Standards, subject to these Plans being stamped, signed, and dated by the professional engineer of record. Review by the City does not constitute approval of the plan design. Errors in the design or calculations remain the responsibility of the engineer of record.

These plans are intended to be for City review of public and private infrastructure improvements associated with the development project. Construction of improvements cannot commence until required site development plans and subdivision plats are complete, approved, and on file with the City.

These plans shall be valid for a period of three years from the date of approval by the Transportation Development Division. If the next approval or permit required to commence construction that is authorized by the City’s approval of these Plans has not been applied for within three years of the date of approval, these Plans shall expire and shall be deemed null and void.
APPENDIX B
SPECIFIC NOTES RELATED TO WATER AND WASTEWATER
Specific Notes Related to Water and Wastewater

Attention: In addition to applicable LCUASS notes, the following specific notes for Public Water and/or Wastewater System improvements shall also be annotated onto PICP’s.

Public Water/Wastewater Standard Notes

1. In addition to meeting applicable LCUASS, State or Federal Standards, all materials, workmanship and construction of Public Water and Wastewater System improvements shall meet or exceed the standards set forth in the City of Loveland Water and Wastewater Development Standards.

2. In cases of conflict between these signed PICP’s and applicable standards, the most restrictive standard shall apply.

3. In cases of conflict between the City of Loveland Water and Wastewater Development Standards and LCUASS, relating to water and/or wastewater systems, the City of Loveland Water and Wastewater Development Standards shall take precedence.

4. The Developer/Contractor shall be responsible for obtaining all necessary permits from all applicable agencies. The Developer shall notify the Department of Water and Power (970-962-3000) at least 2 Working Days prior to the start of any Public Water and/or Wastewater System improvements.

5. A Pre-Construction meeting shall be required prior to commencement of any Work.

6. The Developer/Contractor shall have, onsite at all times, two (2) signed copies of the approved PICP’s (one for construction activities and one for Record Drawings), one (1) copy of the City of Loveland Water and Wastewater Development Standards, and copies of any applicable permits and agreements.

7. Prior to Initial Acceptance, the Department of Water and Power shall approve Record Drawings for all Public Water and/or Wastewater System improvements.
APPENDIX C
NOTICE OF NON-COMPLIANCE
CITY OF LOVELAND
Department of Water and Power

NOTICE OF NON-COMPLIANCE

Developer: ____________________________________________

Project: ________________________________________________

Date: ___________________ Construction Permit No.: __________

Contractor(s): ___________________________________________

Foreman / Phone#: _______________________________________

Time of Arrival: _______________ Time of Departure: __________

I have inspected the work on these premises and have found that current or past construction procedures do not comply with the following sections of the City Standards or City law(s).

Attachments/ References supporting the required change(s) if applicable:

The above signed certifies that a copy of this Notice of Non-Compliance was posted on the premises and duly served upon the referenced project.

________________________________________
Inspector

________________________________________
Contractor Acknowledgement

________________________________________
Applicant’s Engineer (Concurrence if Applicable)
CITY OF LOVELAND
Department of Water and Power

STOP WORK ORDER

Developer: ________________________________________________________________
Project: ________________________________________________________________
Date: ___________________________ Construction Permit No.: _________________________

Contractor(s): ______________________________________________________________
Foreman / Phone#: __________________________________________________________
Time of Arrival: ___________________ Time of Departure: __________________________

I have inspected the work on these premises and have found the following violations of the City Standards or City law(s).

Attachments/ References supporting the required change(s) if applicable:

NO FURTHER WORK SHALL BE DONE UNTIL THE ABOVE NOTED VIOLATIONS ARE CORRECTED TO THE SATISFACTION OF THE INSPECTOR.
The above signed certifies that a copy of this Stop Work Order was posted on the premises and duly served upon the referenced project.

__________________________________________________________________________
Inspector Contractor Acknowledgement

__________________________________________________________________________
Applicant’s Engineer (Concurrence if Applicable)
FIELD ORDER CHANGE REQUEST

Developer: __________________________________________________________
Project: ____________________________________________________________
Date: ___________________ Construction Permit No.: ______________________

Contractor(s): ______________________________________________________
Foreman / Phone#: ________________________________________________
Time of Arrival: ________________ Time of Departure: ___________________

Description of Field Change:

Reason for Field Change:

Attachments/ References supporting the required change(s) if applicable:

Use back of this sheet if additional space is required. Copy Given to Contractor: Yes ____ No ____

_____________________________________________________________________________
Inspector

_____________________________________________________________________________
Contractor Acknowledgement

_____________________________________________________________________________
Applicant’s Engineer (Concurrence if Applicable)
APPENDIX F
APPROVED MATERIALS LIST
# APPROVED MATERIALS LIST

**Notes:** *Manufacturers are arranged alphabetically*
*City reviews this list yearly for modifications, additions, and removals.
*To have a material added to this list, see the Approved Materials List Review Procedures at the end of this Appendix.*

## PUBLIC WATER SYSTEM

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>DIP</th>
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<tbody>
<tr>
<td></td>
<td>American Ductile Iron Pipe (ACIPCO)</td>
</tr>
<tr>
<td></td>
<td>Griffin Pipe Products Company</td>
</tr>
<tr>
<td></td>
<td>Pacific States Cast Iron Pipe Company</td>
</tr>
<tr>
<td></td>
<td>U.S. Pipe</td>
</tr>
<tr>
<td></td>
<td><strong>PVC</strong></td>
</tr>
</tbody>
</table>
|                          | Diamond Plastics                                                    | C900, C905
|                          | J-M Eagle                                                           | C900, C905, C909
|                          | North American Pipe Corporation                                     | C900, C905
|                          | North American Specialty Products                                    | C900, Certa-Lok, C900/RJ, C905/RJ
|                          | VinylTech                                                           | C900, C905
|                          | **With Internal Joint restraint:**                                   |
|                          | J-M Eagle                                                           | Eagle Loc 900
|                          | Diamond Plastics                                                    | Lok-21
|                          | **Ductile Iron Fittings (MJ) - All DI fittings are epoxy coated**    |
|                          | Sigma Corporation                                                   |
|                          | SIP Industries (add)                                                 |
|                          | Star Pipe Products                                                  |
|                          | Tyler Union                                                         |
|                          | **Tapping Sleeves**                                                 | CST-SL
|                          | Cascade Waterworks Mfg.                                              |
|                          | Clow Valve Co                                                       | Stainless Steel
|                          | Ford Meter Box Co                                                   | Stainless Steel
|                          | Mueller Co                                                          | H304
|                          | Powerseal Pipeline Products Corp                                    | 3490MJ
|                          | Romac Industries, Inc.                                               | SST
|                          | Smith Blair Inc                                                    | Stainless Steel
|                          | **Tapping Gate Valves**                                             |
|                          | American Cast Iron Pipe Co                                          |
|                          | Clow Valve Co                                                       |
|                          | Mueller Co                                                          |
|                          | M & H Valve Co                                                      |

---

*City of Loveland Water and Wastewater Development Standards  
### Gate Valves (stainless 304 bolts)

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>American AVK Company</td>
<td>Series 25 Resilient Wedge</td>
</tr>
<tr>
<td>American Flow Control</td>
<td>Waterous 2500</td>
</tr>
<tr>
<td>Clow Valve Co</td>
<td></td>
</tr>
<tr>
<td>M &amp; H Valve Co</td>
<td></td>
</tr>
<tr>
<td>Mueller Co</td>
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</tr>
</tbody>
</table>

### Butterfly Valves

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clow Valve Co/M&amp;H Valve Co</td>
<td>Style 4500 (3”-24”) &amp; Style 1450 (30”-54”)</td>
</tr>
<tr>
<td>DeZurik</td>
<td>AWWA C504</td>
</tr>
<tr>
<td>Henry Pratt Co</td>
<td>Groundhog</td>
</tr>
<tr>
<td>Mueller</td>
<td>Lineseal III or XPII</td>
</tr>
<tr>
<td>Pentair</td>
<td>Keystone RMI Dubex</td>
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<tr>
<td>Valmatic</td>
<td>Series 2000</td>
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</tbody>
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### Air Relief Valves

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>for 2” and smaller</td>
<td>A.R.I.</td>
<td>D-040</td>
</tr>
<tr>
<td>greater than 2”</td>
<td>DeZurik</td>
<td>APCO</td>
</tr>
<tr>
<td></td>
<td>Valmatic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vent-O-Mat</td>
<td>RBX Series</td>
</tr>
</tbody>
</table>

### Pressure Reduction Valves

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” - 2”</td>
<td>Watts</td>
<td>25AUB-LF</td>
</tr>
<tr>
<td>3” - larger</td>
<td>Cla-Val</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Watts</td>
<td>M Series</td>
</tr>
</tbody>
</table>

### Check Valves

<table>
<thead>
<tr>
<th>Company</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>American Flow Control</td>
<td></td>
</tr>
<tr>
<td>G.A. Industries, LLC</td>
<td></td>
</tr>
<tr>
<td>Mueller Co</td>
<td></td>
</tr>
<tr>
<td>Valmatic</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td></td>
</tr>
</tbody>
</table>

### Valve Boxes

5¼-inch shaft, screw-type with the word “WATER” cast into the lid (Valve boxes for fire service lines shall have a locking lid assembly)

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castings Inc.</td>
<td>Series 6850 with drop lid</td>
</tr>
<tr>
<td>SIP Industries</td>
<td>6000-6020; 6116-6118 screw; 6301-6308; 6351-6354; 6355-6356 (fire service)</td>
</tr>
<tr>
<td>Tyler Union</td>
<td>Series 6860 with a #6 base and drop lid</td>
</tr>
<tr>
<td>EJ</td>
<td>Series 8550 6800 set with H-20 load rating</td>
</tr>
</tbody>
</table>
## Fire Hydrants

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model/Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>American AVK</td>
<td>Series 27, Modern Style</td>
</tr>
<tr>
<td>American Flow Control</td>
<td>Waterous Pacer, WB67-250</td>
</tr>
<tr>
<td>Clow</td>
<td>Medallion, F-2545</td>
</tr>
<tr>
<td>Kennedy Valve</td>
<td>Guardian, K-81D</td>
</tr>
</tbody>
</table>

**Paint type and color:**
- Sherwin Williams, Modified Kem 400 Orange - Federal 595, Standard #12473 (removed white)

## 2" Blow-off hydrants

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Kupferle Foundry Company</td>
<td>Eclipse No. 85 Box Hydrant</td>
</tr>
</tbody>
</table>

## Service tapping saddles

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model/Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Y. McDonald Mfg. Co.</td>
<td>4855A</td>
</tr>
<tr>
<td>Cascade Waterworks Mfg. (add)</td>
<td>CNS2</td>
</tr>
<tr>
<td>Ford Meter Box Co, Inc</td>
<td>FS303 and FC202</td>
</tr>
<tr>
<td>Mueller</td>
<td>DR2S</td>
</tr>
<tr>
<td>Power Seal Pipeline Products Corp</td>
<td>3412 AS</td>
</tr>
<tr>
<td>Romac Industries Inc</td>
<td>306 and 202NS</td>
</tr>
<tr>
<td>Smith-Blair Inc</td>
<td>372</td>
</tr>
</tbody>
</table>

## Service lines

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” – 2”</td>
<td>Type K Copper - AWWA C800</td>
</tr>
<tr>
<td>4” and larger</td>
<td>PVC and DIP may be used</td>
</tr>
</tbody>
</table>

## Corporation Stops (ball valve, QCTS compression only)

<table>
<thead>
<tr>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Y. McDonald Mfg. Co.</td>
</tr>
<tr>
<td>Ford Meter Box Co.</td>
</tr>
<tr>
<td>Mueller</td>
</tr>
</tbody>
</table>

## Curb Stops (with ball valves, QCTS compression only)

<table>
<thead>
<tr>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Y. McDonald Mfg. Co.</td>
</tr>
<tr>
<td>Cambridge Brass</td>
</tr>
<tr>
<td>Ford Meter Box Co.</td>
</tr>
<tr>
<td>Mueller</td>
</tr>
</tbody>
</table>

## Curb Stop Boxes

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Y. McDonald Mfg. Co.</td>
<td>5610, 5611</td>
</tr>
<tr>
<td>Ford Meter Box Co</td>
<td>EM2-50-57</td>
</tr>
<tr>
<td>Mueller</td>
<td>H-10304</td>
</tr>
</tbody>
</table>

## Service Line Couplings (QCTS compression only)

<table>
<thead>
<tr>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.Y. McDonald Mfg. Co.</td>
</tr>
<tr>
<td>Cambridge Brass</td>
</tr>
<tr>
<td>Ford Meter Box Co.</td>
</tr>
<tr>
<td>Mueller</td>
</tr>
</tbody>
</table>
### Meter Setters
*(NL, QCTS compression x QCTS compression, with padlock wing)*

<table>
<thead>
<tr>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” and 1&quot;</td>
<td>A.Y. McDonald Mfg. Co</td>
</tr>
<tr>
<td>1 1/2” and 2&quot;</td>
<td>A.Y. McDonald Mfg. Co</td>
</tr>
<tr>
<td></td>
<td>Cambridge Brass</td>
</tr>
<tr>
<td></td>
<td>Ford Meter Box Co</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
</tr>
</tbody>
</table>

### Meter Pits

<table>
<thead>
<tr>
<th>Type</th>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pits</td>
<td>3/4” and 1”</td>
<td>OldCastle Precast</td>
</tr>
<tr>
<td>Risers/Extensions</td>
<td>3/4” and 1”</td>
<td>OldCastle Precast</td>
</tr>
<tr>
<td>Bonnett</td>
<td>3/4” and 1”</td>
<td>Castings Inc</td>
</tr>
</tbody>
</table>

### Meters

<table>
<thead>
<tr>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” – 1”</td>
<td>Sensus</td>
</tr>
<tr>
<td>1.5” and larger</td>
<td>Sensus</td>
</tr>
<tr>
<td>1.5” and larger (irrigation only)</td>
<td>Sensus</td>
</tr>
</tbody>
</table>

### Joint restraint devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBBA</td>
<td>Megalug</td>
</tr>
<tr>
<td>Ford Meter Box Co.</td>
<td>UniFlange</td>
</tr>
<tr>
<td>Sigma</td>
<td>OneLok</td>
</tr>
<tr>
<td>SIP Industries</td>
<td>EZ Grip</td>
</tr>
<tr>
<td>Star Pipe Products</td>
<td>All but 200 series</td>
</tr>
<tr>
<td>Tyler Union</td>
<td>Tufgrip</td>
</tr>
</tbody>
</table>

### Foster type adapters

<table>
<thead>
<tr>
<th>Type</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INFECT Corp</td>
</tr>
</tbody>
</table>

### Foam insulation

<table>
<thead>
<tr>
<th>Insulation</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoco</td>
<td>Amofoam RCX</td>
</tr>
<tr>
<td>Dow Styrofoam</td>
<td>100 high load</td>
</tr>
<tr>
<td>Owens Corning</td>
<td>Formular 400 or 404</td>
</tr>
</tbody>
</table>

### Manhole Ring & Covers for Vaults

*“WATER” shall be cast into all covers and shall be predrilled for touch read and plugged by the manufacturer)*

<table>
<thead>
<tr>
<th>Type</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard ring and cover</td>
<td>Castings Inc.</td>
</tr>
<tr>
<td></td>
<td>MH-310-24 CI, MH-400-24 CI</td>
</tr>
<tr>
<td>D&amp;L Foundry &amp; Supply</td>
<td>A-1019</td>
</tr>
<tr>
<td>Neenah</td>
<td>R-1706</td>
</tr>
<tr>
<td>Watertight ring and cover</td>
<td>Castings Inc.</td>
</tr>
<tr>
<td></td>
<td>MH-310-24 Bolt Down CI, MH-400-24 CI</td>
</tr>
<tr>
<td>D&amp;L Foundry &amp; Supply</td>
<td>E-1161</td>
</tr>
<tr>
<td>Neenah</td>
<td>R-6464-F</td>
</tr>
</tbody>
</table>
### Test Stations

<table>
<thead>
<tr>
<th>for cathodic protection</th>
<th>Brooks Products</th>
<th>1-RT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Farwest Corrosion</td>
<td>1-RT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>for locating wire</th>
<th>C.P. Test Services Inc.</th>
<th>Mini Box</th>
</tr>
</thead>
</table>

### Steel Pipe Wrap

| Protecto Wrap | 200 & 200 GT Cold Applied Pipe Tape used with 1170 Primer |

### PUBLIC WASTEWATER SYSTEM

#### Pipe Material

<table>
<thead>
<tr>
<th>DIP (must have Protecto 401 interior coating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Ductile Iron Pipe (ACIPCO)</td>
</tr>
<tr>
<td>Griffin Pipe Products Company</td>
</tr>
<tr>
<td>Pacific States Cast Iron Pipe Company</td>
</tr>
<tr>
<td>U.S. Pipe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond Plastics</td>
</tr>
<tr>
<td>J-M Eagle</td>
</tr>
<tr>
<td>North American Pipe Corporation</td>
</tr>
<tr>
<td>North American Specialty Products</td>
</tr>
<tr>
<td>CertaFlo Green Line, Yelomine</td>
</tr>
<tr>
<td>VinylTech</td>
</tr>
</tbody>
</table>

#### Manhole Ring & Cover (“SEWER” shall be cast into all covers)

<table>
<thead>
<tr>
<th>Standard ring and cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castings Inc.</td>
</tr>
<tr>
<td>D&amp;L Foundry &amp; Supply</td>
</tr>
<tr>
<td>Neenah</td>
</tr>
<tr>
<td>MH-310-24 CI, MH-400-24 CI</td>
</tr>
<tr>
<td>A-1161- A-1163</td>
</tr>
<tr>
<td>R-1706</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Watertight ring and cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castings Inc.</td>
</tr>
<tr>
<td>D &amp; L Foundry and Supply</td>
</tr>
<tr>
<td>Neenah</td>
</tr>
<tr>
<td>MH-310-24 Bolt Down CI, MH-400-24 CI</td>
</tr>
<tr>
<td>E-1161</td>
</tr>
<tr>
<td>R-6464-F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjustable slope manhole rings</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Jordan Iron Works</td>
</tr>
<tr>
<td>Precision cover systems</td>
</tr>
<tr>
<td>PCSI</td>
</tr>
<tr>
<td>Fully adjustable manhole system</td>
</tr>
</tbody>
</table>
### Manhole Pipe Penetration Gaskets

*For new manholes:*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A-Lok</td>
<td>Kor-N-Seal</td>
</tr>
<tr>
<td>Press Seal Gasket Corp</td>
<td>Cast-a-seal</td>
</tr>
</tbody>
</table>

*For core drill applications (flexible pipe-to-manhole connections)*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PSX</td>
<td>Direct Drive</td>
</tr>
</tbody>
</table>

### Manhole Preformed Plastic Gaskets

<table>
<thead>
<tr>
<th>Company</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Sealants Inc</td>
<td>Conseeal CS-202</td>
</tr>
<tr>
<td>General Sealants Inc</td>
<td>GS #79 or #4</td>
</tr>
<tr>
<td>Henry Company</td>
<td>RubR-Nek</td>
</tr>
<tr>
<td>Hamilton Kent</td>
<td>Kent Seal, Butyl Rubber Sealant</td>
</tr>
</tbody>
</table>

### Manhole Lining *(as required, for new manholes only)*

<table>
<thead>
<tr>
<th>Company</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Coatings LLC</td>
<td>Sewer Shield 100 &amp; 150</td>
</tr>
<tr>
<td>RLS Inc</td>
<td>Raven 405</td>
</tr>
<tr>
<td>Spectra Shield</td>
<td>Liner System</td>
</tr>
<tr>
<td>Sprayroq, Inc</td>
<td>Spray Wall</td>
</tr>
<tr>
<td>Warren Environnemental</td>
<td>S-301</td>
</tr>
</tbody>
</table>

### Manhole Dampproofing

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DECO 20</td>
<td>damp proof coating</td>
</tr>
<tr>
<td>Sonneborn</td>
<td>Hydrocide 600</td>
</tr>
</tbody>
</table>

### External Joint Wrap for Manhole Riser Section

<table>
<thead>
<tr>
<th>Company</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry Company</td>
<td>RU 716-RubR-Nek</td>
</tr>
<tr>
<td>Conseeal</td>
<td>CS-212</td>
</tr>
</tbody>
</table>

### External Joint Wrap for Pipe

<table>
<thead>
<tr>
<th>Company</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar Mac Construction Products Co</td>
<td>MacWrap</td>
</tr>
</tbody>
</table>

### Pipe Coupling Devices *(Pre-formed adjustable pipe couplings w/stainless steel bands)*

<table>
<thead>
<tr>
<th>Company</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission Rubber Co</td>
<td>“Flex-Seal” or “Heavy Weight”</td>
</tr>
<tr>
<td>Joints Coupling</td>
<td>Custom Repair Couplings</td>
</tr>
<tr>
<td>Fernco</td>
<td></td>
</tr>
</tbody>
</table>
### STEEL CASING PIPE

#### Casing Seals

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Products &amp; Systems, Inc</td>
<td>Model AC or Innerlynx</td>
</tr>
<tr>
<td>Cascade Waterworks Mfg</td>
<td>CCES</td>
</tr>
<tr>
<td>Canusa</td>
<td>Seal Kit CSK</td>
</tr>
<tr>
<td>CCI</td>
<td>ESC, ESW</td>
</tr>
<tr>
<td>Pipeline Seal and Insulator, Inc</td>
<td>Model C, W, S &amp; Link-Seal</td>
</tr>
</tbody>
</table>

#### Casing Spacers

**Restrained Spacers**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascade Waterworks Manufacturing</td>
<td>Model CCS-JR</td>
</tr>
<tr>
<td>Ford Meter Box Co.</td>
<td>Uni-Flange</td>
</tr>
</tbody>
</table>

**Standard Spacers**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Products &amp; Systems, Inc</td>
<td>Model SS1</td>
</tr>
<tr>
<td>Cascade Waterworks Manufacturing</td>
<td>Model CCS</td>
</tr>
<tr>
<td>CCI</td>
<td>Model CSS</td>
</tr>
<tr>
<td>Pipeline Seal and Insulator, Inc</td>
<td>Model S</td>
</tr>
</tbody>
</table>

#### Test Stations

<table>
<thead>
<tr>
<th>Model</th>
<th>Manufacturer</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>for cathodic protection</td>
<td>Brooks Products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Farwest Corrosion</td>
</tr>
</tbody>
</table>
How to amend the Approved Material List:

1. Contractors, suppliers and manufacturers who desire to have alternate materials approved for inclusion into these Standards, shall submit such material data by the last Thursday in December to the Department (attention Engineering Division). The Department may then request additional information to supplement or clarify the submitted material data.

2. The Department will collect the alternate material requests, review and update the material list on an annual basis. The review will generally occur during the months of January and February.

3. The Department will complete the review and make a final decision regarding approved materials, by the end of February. The updated Approved Materials List will be posted on the internet. Contractors, suppliers and manufacturers desiring to appeal the Department’s final decision, shall submit a written appeal to the Department Director within 30 days after the final decision.

4. The Department Director shall review the appeal and render a decision by the end of April. The decision of the Director will be final.

5. Contractors, suppliers and manufacturers desiring to submit materials for approval and inclusion in these Standards, shall submit, at a minimum, the following information:
   a. Manufacturer's standard drawings, schematics and diagrams:
      1) Description of the material or equipment to be considered.
      2) Delete any information not applicable to the submittal.
      3) Supplement standard information to provide information specifically applicable to the material or equipment.
      4) Detailed operation and maintenance and disassembly information for maintenance if applicable.
      5) Applicable standards, e.g. ASTM or Federal Specification numbers, etc.
      6) Manufacturer’s name, type and model number of material or equipment.
      7) Drawings, catalogs or parts thereof, manufacturer's specifications and data, instructions, performance characteristics and capacities, and other information specified or necessary.
      8) Parts, devices, controls and accessories forming a part of equipment.
      9) Descriptive literature for paint and coating systems.
     10) Description of where parts may be ordered and anticipated time for delivery of parts.
     11) Contact information of local municipalities that also use your product.
   b. Manufacturer's warranties.
   c. Format.
      1) Presented in a clear, thorough and professional manner.
      2) Minimum sheet size: 8.5”x11”.
      3) Clearly mark each copy to identify pertinent products and models.
      4) When standard type drawings are submitted, clearly mark out items that do not apply and describe or mark exactly which parts of the drawing apply to the material being considered.
      5) Provide individual catalog sheets that identify applicable items.
      6) Clearly identify the Supplier and Manufacturer along with addresses, telephone number and person to contact for additional information.
# APPENDIX G - STANDARD DRAWINGS

<table>
<thead>
<tr>
<th>Water Standard Details</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>W-1</strong></td>
<td>Water Main Trench Requirements</td>
<td>01-10</td>
</tr>
<tr>
<td><strong>W-2</strong></td>
<td>Valve Box Assembly/Location</td>
<td>6th Edition</td>
</tr>
<tr>
<td><strong>W-3</strong></td>
<td>Fire Hydrant Drawing</td>
<td>10th Edition</td>
</tr>
<tr>
<td><strong>W-4</strong></td>
<td>Fire Hydrant Guards</td>
<td>8th Edition</td>
</tr>
<tr>
<td><strong>W-5</strong></td>
<td>Dead-End Blow-off Hydrant</td>
<td>5th Edition</td>
</tr>
<tr>
<td><strong>W-6</strong></td>
<td>Temporary Blow-off</td>
<td>6th Edition</td>
</tr>
<tr>
<td><strong>W-7</strong></td>
<td>Typical 3/4&quot; &amp; 1&quot; Service Detail</td>
<td>7th Edition</td>
</tr>
<tr>
<td><strong>W-8</strong></td>
<td>Typical 3/4&quot; &amp; 1&quot; Meter Locations</td>
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NEW STREET SURFACE. NOTE FOR FULL DEPTH ASPHALT PATCH — THE THICKNESS OF THE PATCH SHALL BE 1" THICKER THAN THE EXISTING ASPHALT WITH A MIN. THICKNESS PER LCUASS.

EXISTING STREET SURFACE TO BE CUT BACK 2' FROM EDGE OF THE TRENCH WALL

EXISTING ASPHALT OR CONCRETE

EXISTING ROAD BASE

CONVENTIONAL BACKFILL 6" MAX. COMPACTED LIFT THICKNESS (IF FLOWABLE FILL IS NOT REQ'D, SEE NOTE 4)

LOWER LIMIT OF TRENCH WALL SLOPING

#12 SOLID TRACING WIRE TO BE TAPE TO THE TOP OF ALL PIPE TYPES

PIPE ZONE

PIPE ZONE SUBGRADE

UNDISTURBED SOIL

EXAMPLE: TRENCH CUT IN EXISTING PUBLIC STREETS

EXAMPLE: STANDARD TRENCH

SEE LCUASS CH. 25 FOR FINISHED SURFACE REQ

TRENCH WIDTH AS SPECIFIED IN TABLE

TRENCH WALLS AND SUPPORT PER OSHA

CONVENTIONAL BACKFILL COMPACTED IN STD. LIFT THICKNESS (SEE NOTE 3)

VARIES

12 IN. MIN.

PIPE O.D.

4 IN. MIN. SEE NOTE 1

AS REQUIRED SEE NOTE 2

NOTES:
1. GRANULAR MATERIAL SHALL BE A MINIMUM OF 4-INCHES BELOW PIPE OR 1/4 PIPE DIAMETER, WHICHEVER IS GREATER.

2. STABILIZATION MATERIAL MAY BE REQUIRED BY THE DEPARTMENT TO REPLACE THE TOP 6-INCHES OF THE PIPE SUBGRADE. INSTALL GEOTEXTILE FABRIC BETWEEN THE STABILIZATION MATERIAL AND PIPE BEDDING.

3. TRENCH REQUIREMENTS WITHIN OPEN AREAS OR AREAS TO BE DEVELOPED SHALL BE PURSUANT TO DEPARTMENT STANDARDS.

4. WHERE THE SURROUNDING SOILS ARE NON–EXPANSIVE, A FLOWABLE FILL MAY BE SUBSTITUTED FOR BACKFILL MATERIAL.

WATER MAIN TRENCH REQUIREMENTS

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 01/10
DRAWING W–1
NOTES:

1. ALL VALVES SHALL BE ENCASED IN A MINIMUM 8 MIL POLYETHYLENE WRAP. A 2" WIDE, TEN MIL THICK POLYETHYLENE PRESSURE-SENSITIVE TAPE SHALL BE USED TO CLOSE SEAMS, SECURE TO PIPE OR HOLD OVERLAPS.

2. ALL VALVES BOXES SHALL BE OF CAST IRON CONSTRUCTION, TWO PIECE THREADED ADJUSTABLE DESIGN PER DEPARTMENT STANDARDS. ALL THREAD RODS AND NUTS SHALL BE 316 STAINLESS STEEL.

3. WITHIN OPEN AREAS OR AREAS TO BE DEVELOPED IN THE FUTURE, VALVE BOX LID MAY BE DEPRESSED OR HAVE A CONCRETE PAD. MARK VALVE LOCATION WITH FLEXIBLE MARKER POST WITH REFLECTIVE LABEL STATING "CITY OF LOVELAND WATER MAIN OFFSET ___ FT."

4. FOR FIRE SERVICE LINES ONLY: LIDS SHALL BE LOCKING TYPE.

5. TRACER WIRE TO BE TYPICALLY DAYLIGHTED AT FIRE HYDRANT. IF HYDRANT IS NOT AVAILABLE, PROVIDE AT MAINLINE VALVE AS SHOWN ABOVE AND COIL A MINIMUM OF 3' OF TRACER WIRE IN VALVE BOX.

6. SEE CHAPTER 6 OF THE STANDARDS FOR COMPACTION AND TESTING REQUIREMENTS.

7. VALVES TYPICALLY REQUIRED AS SHOWN, UNLESS OTHERWISE APPROVED BY THE DEPARTMENT, SINCE OPERATIONAL CONSIDERATIONS MY RESULT IN FEWER VALVES BEING REQUIRED TO BE INSTALLED.

8. RESTRAINT FOR VALVES TO A FITTING CAN BE MADE DIRECTLY WITH FOSTER ADAPTERS OR BY MECHANICAL JOINT RESTRAINT. EXAMPLE FOSTER ADAPTER CONNECTIONS ARE DETAILED BELOW:
NOTES:
1. FIRE HYDRANTS SHALL BE LOCATED 2'-0" MIN. FROM BACK OF CURB OR 2' MIN. FROM BACK EDGE OF SIDEWALK OR 10'-0" MIN. FROM EDGE OF PAVEMENT IF NO CURB IS PRESENT.
2. LATERAL PIPE BETWEEN GATE VALVE AND HYDRANT SHALL BE 6" PVC DR18.
3. ALL FITTINGS AND VALVES SHALL BE ENCASED WITH A MINIMUM 8 MIL POLYETHYLENE WRAP.
4. ALL JOINTS SHALL BE RESTRAINED BY USE OF MECHANICAL JOINT RESTRAINTS PER SECTION 4.4.3.B.
5. SEE CHAPTER 6 OF THE STANDARDS FOR COMPACTATION AND TESTING REQUIREMENTS.
NOTES:
1. TO BE USED IN COMMERCIAL OR INDUSTRIAL AREAS WHERE HYDRANTS ARE UNPROTECTED FROM THE MAIN FLOW OF TRAFFIC.
2. STEAMER CONNECTION ON FIRE HYDRANT SHOULD FACE THE STREET.
3. PAINT COLOR SHALL BE SAFETY YELLOW.

FIRE HYDRANT GUARDS

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 01/10
DATE REVISED: 2017
8TH EDITION

DRAWING W-4
DEAD-END BLOW-OFF HYDRANT

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2011
DRAWING W-5

FINISHED GRADE

24" O.D. x 6" THICK x 12" I.D. REINFORCED CONCRETE RING

2" IRON PIPE THREADS

ECLIPSE 85 BLOW-OFF HYDRANT ONLY

D&L H-8024 FRAME & COVER WITH "WATER" CAST INTO LID (OR APPROVED EQUAL)

VALVE BOX AND EXTENSION

NOTE: DEPTH OF HYDRANT VARIES DUE TO DIFFERING MAIN SIZES.

PVC PIPE C-900, CL-200

DO NOT OBSTRUCT WEEP HOLES

AFTER PLACING THRUST BLOCK, PLACE HYDRANT GRAVEL TO 12 IN. ABOVE SHOE

8 MIL POLYETHYLENE WRAP BETWEEN SHOE AND THRUST BLOCKS

THRUST BLOCK

2" DIA. BRASS PIPE LENGTH PER PLAN

2" BRASS CURB STOP

24" MIN. EACH DIRECTION

14" MIN.

HYDRANT GRAVEL (4 CUBIC FEET MIN.)
TEMPORARY BLOW-OFF

NOTE:
1. AFTER TESTING HAS BEEN COMPLETED AND GATE VALVE HAS BEEN CLOSED REMOVE THE CURB STOP AND CAP THE 2" PIPE MINIMUM OF 12" BELOW SURFACE. BACKFILL STUB AND MARK LOCATION.

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS
DATE APPROVED: 04/11
DATE REVISED: 2014
DRAWING W-6
6TH EDITION
NOTES:

1. METER PITS SHALL NOT BE LOCATED WITHIN DRIVEWAYS OR SIDEWALKS, OR WHERE VEHICULAR TRAFFIC MAY BE ENCOUNTERED. WHEN INSTALLED IN LANDSCAPED AREAS, THE BONNET/LID ELEVATIONS SHALL BE 1/2" ABOVE FINISH GRADE. WHEN INSTALLED IN HARD FINISHED SURFACE AREAS, BONNET/LID SHALL BE FLUSH WITH FINISH SURFACE. GROUND SURROUNDING METER PIT SHALL SLOPE AWAY FROM LID AT 1/4" PER FT MINIMUM. BARREL RISERS/EXTENSIONS CAN BE ADDED TO ACHIEVE DEPTH AS NECESSARY.

2. TOUCH READ DEVICE MAY ALSO BE ON EITHER SIDE OF THE BUILDING, IF PLACED NOT MORE THAN 5' FROM THE FRONT OF THE BUILDING AND NOT BEHIND ANY FENCE.

3. THE PROPERTY OWNER SHALL PROVIDE ALL NECESSARY MAINTENANCE, REPAIR AND REPLACEMENT OF THE SERVICE LINE FROM THE CURB STOP TO AND WITHIN THE BUILDING STRUCTURE WHICH IT SERVES, EXCLUDING WATER METER, METER YOKE, METER PIT AND METER RELATED APPURTEANCES.
DETACHED SIDEWALK
DETAIL
N.T.S.

PROPERTY LINE

EASEMENT OR
RIGHT OF WAY

6" MIN
36"
10' MIN.

DETACHED SIDEWALK
BACK OF CURB
METER PIT
CENTER PIT BETWEEN
B.O.C. AND SIDEWALK

STREET / ALLEY

NO SIDEWALK
DETAIL
N.T.S.

PROPERTY LINE

EASEMENT OR
RIGHT OF WAY

4' MIN
DISTANCE
PER PLAN

BACK OF CURB
OR EDGE OF PAVEMENT

METER PIT

10' MIN.

36" MAX.
(OR PER PLAN)

NOTES:
1. SEE STD. DWG. W-7 FOR VERTICAL
   PLACEMENT OF METER PITS /
   BONNETS.

2. METER PITS SHALL NOT BE
   LOCATED WITHIN DRIVEWAYS,
   DITCHES OR DRAINAGE SWALES.

3. SEE STD. DWG W-9 FOR ATTACHED
   SIDEWALK DETAIL.

4. MIN 6’ SEPARATION BETWEEN
   METER PITS (OUTSIDE)

TYPICAL 3/4” & 1” METER LOCATIONS

CITY OF LOVELAND
DEPARTMENT OF
WATER AND POWER

W/WW CONSTRUCTION
DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2018
DRAWING
W-8

9TH EDITION
NOTES:
1. WATER METER PITS SHALL NOT BE LOCATED WITHIN DRIVEWAYS, SIDEWALKS, DRAINAGEWAYS OR SWALES.
2. TYPICAL ELEVATION OF WATER METER PIT IS 0.2 FT ABOVE BACK OF WALK ELEVATION.
3. WATER METER PIT AND SERVICE LINE FROM MAN TO METER SHALL HAVE 10 FEET OF SEPARATION FROM TREES AND 5 FEET FROM BUSHES.
4. SERVICES SHALL NOT BE CLOSER THAN 5 FEET TO THE SIDE PROPERTY (EXCEPT CUL-DE-SACS), AND NO SERVICE MAY BE CONSTRUCTED THOUGH OR IN FRONT ANY ADJOINING PROPERTY.
5. SEWER AND WATER SERVICE SHALL BE A MINIMUM 10 FEET APART HORIZONTALLY.
6. SANITARY SEWER SERVICE SHALL BE CONSTRUCTED ON THE SHORTEST AND STRAIGHTEST ROUTE POSSIBLE. WITH NO MORE THAN TWO 90° BENDS.
7. THE PORTION OF THE WATER SERVICE PIPE BETWEEN THE WATER MAIN AND THE CURB STOP AND/OR WATER METER WHEN INSTALLED MUST BE IN CONTINUOUS STRAIGHT JOINTS AND PERPENDICULAR, IF POSSIBLE, TO THE LINE OF THE MAIN. WATER SERVICES STUBBED INTO THE PROPERTY LINE SHALL BE OF SUFFICIENT LENGTH TO ALLOW DIRECT CONNECTION TO THE METER YOKE.
8. WATER SERVICE LOCATIONS SHALL BE MARKED WITH "W" ON THE CURB. SANITARY SEWER SERVICE LOCATIONS SHALL BE MARKED WITH "S" ON THE CURB. MARKINGS SHALL BE NEATLY STAMPED, CHISELED OR SAW CUT. PAINTED MARKING IS NOT ALLOWED.

TYPICAL UTILITY LAYOUT (3/4" & 1" METER PIT ONLY)
TYPICAL SET-UP SET CONSISTS OF:
(1) 1 1/2" COMPRESSION x 1 1/2" IP FITTING
(1) 1 1/2" x 3/4" BRASS TEE
(1) 3/4" NIPPLE - LENGTH VARIES
(1) 3/4" CURB STOP
(1) 3/4" METER COUPLING 90°
(1) 7" METER RESETTER
(1) STRAIGHT METER COUPLING
(1) 3/4" IP FEMALE THREAD BY COMPRESSION
(ALL FITTINGS MUST BE BRASS)

3/4" MULTIPLE METER PRECAST VAULT

NOTES:
1. METER VAULT SHALL BE DESIGNED IN ACCORDANCE WITH ASTM C858 AND FOR AASHTO HL-93 LOADING. WALLS AND LID SHALL BE 6" THICK AND MONOLITHIC. CONCRETE FC=4000 PSI. BURY VAULT 16" MAX BELOW SURFACE. ADJUST MANHOLE COVER TO GRADE WITH CONCRETE GRADE RINGS.
2. TOUCH READ DEVICE SHALL BE STACK MOUNTED ON THE NEAREST BUILDING AND NOT LOCATED BEHIND A FENCE.
3. HIGH PRESSURE AREAS WILL REQUIRE A PRV. INSTALL PRV IN BUILDING.
4. TYPE K-COPPER SERVICE AND COMPRESSION FITTING ONLY.
5. WALL PENETRATIONS FOR SERVICE ENTRY AND EXIT MAY BE DOGHOUSE STYLE, HOWEVER SHALL NOT EXCEED 3"Wx16"H. ALL VAULT PENETRATIONS SHALL BE SEALED WITH EXPANDABLE FOAM.
6. CURB STOP TO BE MINNEAPOLIS SCREW ON STYLE.
NOTES:
1. METER VAULT SHALL BE DESIGNED IN ACCORDANCE WITH ASTM C658 AND FOR AASHTO HL-93 LOADING. WALLS AND LID SHALL BE 6" THICK AND MONOLITHIC. CONCRETE FC=4000 PSI. BURY VAULT 16" MAX BELOW SURFACE. ADJUST MANHOLE COVER TO GRADE WITH CONCRETE GRADE RINGS.
2. HIGH PRESSURE AREAS WILL REQUIRE A PRV. INSTALL PRV IN BUILDING.
3. TYPE K-COPPER SERVICE AND COMPRESSION FITTING ONLY.
4. SUPPORT METER SETTERS BY TWO 18" LENGTHS OF 1" DIAMETER IRON PIPE INSERTED THROUGH BRACE PIPE EYELETS ON METER SETTER. SET IRON PIPES ON FOUR 8" SQUARE x 2"H (MIN) CONCRETE BLOCKS.
5. WALL PENETRATIONS FOR SERVICE ENTRY AND EXIT MAY BE DOGHOUSE STYLE, HOWEVER SHALL NOT EXCEED 3"Wx16"H. ALL VAULT PENETRATIONS SHALL BE SEALED WITH EXPANDABLE FOAM.
6. CURB STOP TO BE MINNEAPOLIS SCREW ON STYLE.

SECTION A-A

1-1/2" & 2" METER VAULT

CITY OF LOVELAND
DEPARTMENT OF
WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2017
DRAWING W-11

8TH EDITION
**NOTES:**

1. SEAL EACH VAULT PENETRATION WITH LINK-SEAL UNIT USING 316 S.S HARDWARE.

2. BURY VAULT 16" BELOW SURFACE. ADJUST MANHOLE COVER TO GRADE WITH CONCRETE GRADE RINGS. DRILL HOLE THROUGH COVER FOR MOUNTING OF CITY OF LOVELAND’S REMOTE READ METER DEVICE.

3. ALL JOINTS WITHIN VAULT SHALL BE FLANGED CONNECTIONS.

4. VAULT SHALL BE DESIGNED FOR AASHTO HL-93 LOADING. FLOORS AND WALLS SHALL BE MONOLITHIC AND DESIGNED IN ACCORDANCE WITH ASTM C858. CONCRETE FC=4000 PSI MIN.

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3", 4" AND 6" METER VAULT

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2014
6TH EDITION
1. Seal each vault penetration with link—seal unit using 316 S.S hardware.
2. All joints within vault shall be flanged connections.
3. Vault shall be designed for AASHTO HL-93 loading. Floors and walls shall be monolithic and designed in accordance with ASTM C658. Concrete FC=4000 PSI Min.

NOTES:

PRESSURE REDUCING VALVE VAULT

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2014
6TH EDITION

DRAWING W-13
2" AIR AND VACUUM RELEASE VALVE

60" CONCRETE FLAT-TOP MANHOLE (SEE W-24)

SEE AIR/VAC VENT PIPE DETAIL W-15

6" SCH 40 PVC VENT PIPE

2" THREADED AIR RELEASE AND VACUUM VALVE

2" THREADED BRASS (TYP) NIPPLE

SADDLE SHALL BE MUELLER OR EQUIVALENT STAINLESS REPAIR CLAMP, TAPPED 2" I.P. x 12" LONG

COMPACTED GRANULAR MATERIAL PER SPECS, OR UNDISTURBED NATIVE SOIL

PRECAST CONCRETE GRATE RINGS

PREFORMED PLASTIC GASKET

MANHOLE ASTM C478 HS-20 LOADING

24" MANHOLE RING AND COVER

24" FROST LID

FINISHED GRADE

MORTAR

16" MAX.

16" MIN.

5'-0" DIA.

2" THREADED BALL VALVE

CONCRETE FOOTING OR GRADE BEAM 9"x 12"x 8' LONG

PIPE BEDDING AND SUBGRADE

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS
DRAWING W-14

DATE APPROVED: 08/07
DATE REVISED: 2011
5TH EDITION
CONCRETE BASE DETAIL

ROUND VENT SCREEN

8" VENT BODY

POP RIVETS (TYP.)

1/8" X 1 1/2" STEEL (4 REQUIRED)

1/2""

1""

2 1/2"

5/16"

1 1/6"

STEEL ANGLE DETAIL

NOTES:

1. CONCRETE TO BE 3000 PSI. PROVIDE 3/4" CHAMFER ON EXPOSED EDGES.

2. VENT PIPE SHALL BE MANUFACTURED BY CUSTOM METAL MFG. (303) 293-9333 OR APPROVED EQUAL.

3. VENT PIPES SHALL BE PRIMED AND COATED WITH CARDINAL INDUSTRIAL FINISH, BROWN FINE TEXTURE SEMI-GLOSS, NO. T032-BR62 POWDER COATING.
NOTES:
1. INSTALL ONE PREFORMED PLASTIC GASKET BETWEEN GRADE RINGS AND FRAME.
2. DIP MATERIALS MAY BE INSTALLED INSTEAD OF PVC, PER DEPARTMENT STANDARDS.
3. SEE W-1 FOR TYPICAL TRENCH AND BACKFILL REQUIREMENTS.
4. SEE CHAPTER 4 FOR THRUST/RESTRAINT REQUIREMENTS.

NEENAH R-1798 MANHOLE FRAME AND COVER WITH "BLOW-OFF" CAST INTO COVER
48" ECCENTRIC CONE ASTM C-478
9"H x 12"W x 72"DIA. REINFORCED CONCRETE FOOTER (TYP)

DETAIL A

INLINE BLOW-OFF AND OUTLET STRUCTURE (FOR 12", 16" & 24" MAINS)

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS
DATE APPROVED: 08/07
DATE REVISED: 01/09
DRAWING W-16
NOTES:
1. If casing is used, all joints within the casing shall be restrained by use of mechanical joint restraints.
2. All metallic pipe, fittings, and appurtenances shall be wrapped in 8 mil polyethylene.
3. Requirements for larger than 16" diameter pipe will be determined on a case by case basis.
4. All fittings, valves, pipe lengths, casing ends, etc. shall be horizontally dimensioned or stationed and have vertical elevations to top of pipe.
5. For ditch crossings, cutoff walls may be required. Crossing design must be approved by ditch company.
6. Freeze protection shall be provided if required. Engineer to provide length x width x thickness design on plan.
STEP 1—CUT 8 MIL POLYETHYLENE TUBE TO A LENGTH APPROXIMATELY 2–FT LONGER THAN THE PIPE SECTION.

STEP 2—PLACE POLYETHYLENE TUBE ON PIPE PRIOR TO LOWERING IT INTO TRENCH.

STEP 3—LOWER PIPE INTO TRENCH AND MAKE UP THE PIPE JOINT WITH THE PRECEDING SECTION OF PIPE. A SHALLOW BELL HOLE MUST BE MADE AT THE JOINTS TO FACILITATE INSTALLATION OF THE POLYETHYLENE TUBE.

STEP 4—PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH TAPE TO HOLD THE PLASTIC TUBE IN PLACE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF PIPE AND TAPE IN PLACE.

STEP 5—OVERLAP FIRST TUBE WITH ADJACENT TUBE AND SECURE WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE SHALL BE LOOSE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF PIPE AND TAPE IN PLACE.

STEP 6—CAREFULLY BACKFILL WITH CLEAN MATERIAL THAT WILL NOT DAMAGE ENCASEMENT.

TAPS: MAKE TAPS BY WRAPPING THREE LAYERS OF COMPATIBLE TAPE AROUND THE PIPE TO COVER THE TAPPING MACHINE AREA. INSTALL CORPORATION STOP THROUGH THE TAPE AND POLYETHYLENE.
NOTE:
THIS IS A CONCEPTUAL DRAWING ONLY. ALL CUT-OFF WALLS MAY EITHER BE CLAY OR CONCRETE, AND MAY OR MAY NOT HAVE STEEL REINFORCEMENT. ALL CUT-OFF WALLS SHALL BE SPECIFICALLY DESIGNED BY THE DESIGN ENGINEER AND SHALL BE CONSISTENT WITH THESE STANDARDS AND THOSE OF THE ENTITY/OBSTRACTION BEING CROSSED.
TYPICAL BEND

POLYETHYLENE BOND BREAKER
UNDISTURBED SOIL

3” MIN.

TYPICAL CROSS-SECTION

POLYETHYLENE BOND BREAKER
BEARING SURFACE
BEDDING MATERIAL
UNDISTURBED SOIL

3/8” DIA.

TYPICAL CROSS-SECTION

UNDISTURBED SOIL
BEARING SURFACE

DEAD END

POLYETHYLENE BOND BREAKER
UNDISTURBED SOIL

BEARING SURFACE

NOTES:

1. ALL METALLIC PIPE, FITTINGS, AND APPURTEINANCES TO BE WRAPPED WITH 8 MIL POLYETHYLENE.

2. PIPE INSTALLED UNDER CONDITIONS DIFFERENT FROM THOSE NORMALLY ENCOUNTERED SHALL REQUIRE THRUST BLOCKS DESIGNED FOR THOSE PARTICULAR CONDITIONS.

3. ALL THRUST BLOCKS TO BE 3000 P.S.I. CONCRETE.

4. SEE DETAIL W–21 FOR HORIZONTAL THRUST BLOCK SIZES. ALL GRAVITY THRUST BLOCKS SHALL BE SIZED BY THE DESIGN ENGINEER.
### TABLE OF TAPS REQUIRING CONCRETE THRUST BLOCKS

<table>
<thead>
<tr>
<th>MAIN SIZE (INCHES)</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>30</th>
<th>36</th>
<th>42</th>
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</thead>
<tbody>
<tr>
<td>TAP SIZE (INCHES)</td>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>8</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**LEGEND**
- ☑ Indicates concrete thrust block required
- ☐ Indicates concrete thrust block size that requires special design approval by the department.

### TABLE OF REQUIRED BEARING AREAS (SQ. FT.) FOR CONCRETE THRUST BLOCKS

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>HORIZONTAL BENDS</th>
<th>TEES/DEAD ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90° 45° 22-1/2° 11-1/4°</td>
<td></td>
</tr>
<tr>
<td>3&quot;</td>
<td>2.0 1.1 0.6 0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>4&quot;</td>
<td>3.1 1.7 0.8 0.4</td>
<td>2.2</td>
</tr>
<tr>
<td>6&quot;</td>
<td>6.8 3.7 1.9 0.9</td>
<td>4.8</td>
</tr>
<tr>
<td>8&quot;</td>
<td>12.2 6.6 3.4 1.7</td>
<td>8.6</td>
</tr>
<tr>
<td>10&quot;</td>
<td>18.6 10.1 5.1 2.6</td>
<td>13.2</td>
</tr>
<tr>
<td>12&quot;</td>
<td>26.6 14.4 7.3 3.7</td>
<td>18.8</td>
</tr>
<tr>
<td>14&quot;</td>
<td>36.2 19.6 10.0 5.0</td>
<td>25.6</td>
</tr>
<tr>
<td>16&quot;</td>
<td>47.0 25.4 13.0 6.5</td>
<td>33.3</td>
</tr>
<tr>
<td>18&quot;</td>
<td>59.4 32.1 16.4 8.2</td>
<td>42.0</td>
</tr>
<tr>
<td>20&quot;</td>
<td>73.1 39.5 20.2 10.1</td>
<td>51.7</td>
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<td>24&quot;</td>
<td>105.3 57.0 29.1 14.6</td>
<td>74.5</td>
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<tr>
<td>30&quot;</td>
<td>163.4 88.4 45.1 22.7</td>
<td>115.6</td>
</tr>
<tr>
<td>36&quot;</td>
<td>234.8 127.1 64.8 32.5</td>
<td>166.0</td>
</tr>
</tbody>
</table>

**NOTES:**
1. Calculations made for this table assume 100 P.S.I. internal static pressure and 1,000 lbs./sq.ft. soil bearing capacity and a safety factor of 1.5.
2. For static pressures greater than 100 P.S.I. and/or soil bearing capacity less than 1,000 lbs./sq. ft., the design engineer shall provide specific calculations for departmental review and approval.
3. Lower vertical gravity blocks may be sized from this table. Upper vertical gravity blocks shall be sized by the design engineer.
DESIGNATED IRRIGATION METER & SERVICE

IRRIGATION TAP OFF DOMESTIC SERVICE

NOTES:
1. IRRIGATION SHUT-OFF VALVE TEE SHALL BE 4-FOOT MINIMUM DISTANCE FROM OUTSIDE OF METER PIT.
2. NO STOP AND WASTE VALVE ALLOWED.
3. PVB NEEDS TO BE 12-INCHES ABOVE THE HIGHEST SPRINKLER HEAD. RP NEEDS TO BE 12" ABOVE THE GROUND.
4. DO NOT BLOW AIR THROUGH THE BACKFLOW ASSEMBLY.
5. IRRIGATION SYSTEMS WHICH USE COMPRESSED AIR TO PURGE THE SYSTEM SHALL NOT HAVE AIR INJECTION PORTS LARGER THAN 1/4-INCH DIAMETER UPSTREAM OF THE BACKFLOW PREVENTOR.
6. AIR-INJECTOR PORT LOCATED DOWNSTREAM OF VACUUM BREAKER CAN BE ANY SIZE.
NOTES:
1. EXTERNAL VAULT DIMENSIONS VARY BASED ON PRECAST REQUIREMENTS.
2. BUTTERFLY VALVE OPERATORS SHALL BE LOCATED ON THE NORTHERLY OR WESTERLY SIDE OF THE PIPE.
3. BUTTERFLY VALVE BOX TO BE CORE DRILLED IN THE FIELD AFTER VALVE INSTALLATION AND VALVE BOX TOP SECTION INSTALLED OVER THE BUTTERFLY VALVE OPERATING NUT. BOX TO BE LINK SEALED 7 GROUT.
4. MECHANICAL JOINT BUTTERFLY VALVES SHALL BE INSTALLED USING MAGALUG RERAINTS.
5. BUTTERFLY VALVES INSTALLED WITH FLANGED CONNECTIONS SHALL INCLUDE A RESTRAINED FLANGED COUPLING ADAPTER OR DISMANTLING JOINT ON ONE SIDE.
6. A 6" Ø PRECAST MANHOLE WITH A FLAT LID MAY BE SUBSTITUTED FOR 16" BUTTERFLY VALVES, WITH THE APPROVAL FROM THE DEPARTMENT. VAULT SIZES FOR LARGER DIAMETER PIPE SIZES TO COORDINATED WITH THE CITY.

MANHOLE RING AND COVER PER APPENDIX "C" OF THE CITY OF LOVELAND WATER AND WASTEWATER STANDARDS WITH "WATER" STAMPED IN THE LID.

PRECAST CONCRETE TOP SLAB WILL BE DESIGNED FOR AASHTO HL-93 LOADING PLUS DEAD LOAD

PRE-FORMED PLASTIC GASKET (TYP. ALL JOINTS)

SECTION A-A

SECTION B-B

ADJUSTABLE PIPE SUPPORT

GRANULAR BASE MATERIAL

BUTTERFLY VALVE

BUTTERFLY VALVE

LINK SEAL

MANHOLE STEPS 12" ON CENTER

PRECAST OR FORMED CONCRETE

8"

1'-6"

6'-0" (MIN)

6'-0" (MIN)

5'-0" (MIN)

8"

8"
INSTALLATION REQUIREMENTS FOR REDUCED LEAD FREE PRESSURE BACKFLOW ASSEMBLY (RP) NOTES:
1. BALL VALVE/SHUTOFF AND Y-STRAINER ARE THE ONLY TWO (2) FITTINGS ALLOWED BEFORE THE BACKFLOW ASSEMBLY.
2. RP NEEDS TO BE INSTALLED A MINIMUM OF 12-INCHES ABOVE GRADE AND 6-INCH AWAY FROM ANY WALL.
3. RP SHALL BE TESTED UPON INSTALLATION AND ANNUALLY THEREAFTER.
4. RP SHALL HAVE AN ADEQUATE DRAIN TO A FLOOR OR SHALL DAYLIGHT TO THE EXTERIOR OF THE BUILDING THOUGH A DRAIN THAT IS A MINIMUM OF TWO (2) TIMES THE WATER SERVICE LINE DIAMETER.
5. PROTECTION FROM FREEZING AND VANDALISM IS THE OWNERS RESPONSIBILITY.
6. RP NEED SHALL BE INSTALLED IN ACCORDANCE WITH THE CITY’S ADOPTED VERSION OF THE INTERNATIONAL PLUMBING CODE (IPC) SECTION OF PROTECTION OF POTABLE WATER SUPPLY AND THE MANUFACTURES INSTALLATION GUIDELINES.
NOTES:
1. BACKFLOW PREVENTOR EXTERIOR ENCLOSURE SHALL BE HEATED.
2. OWNER/CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING THE PROPER PERMITS FROM BUILDING DEPARTMENT (PLUMBING AND ELECTRICAL).
3. OWNER IS RESPONSIBILITY FOR GETTING ELECTRICAL SERVICE TO THE ENCLOSURE AND ALL WORK SHALL BE COMPLETED BY AN ELECTRICIAN.
4. ALL ELECTRICAL OUTLETS SHALL BE WATER PROOF/WATER TIGHT.
5. OWNER SHALL ACKNOWLEDGE ELECTRICAL HAZARD WITH WATER SYSTEM.
6. CURB STOP VALVE SHALL BE MINIMUM DISTANCE FROM OUTSIDE OF METER PIT/Vault BASED ON SERVICE SIZED:
   - 2" TO 2" CURB STOP VALVE TO BE LOCATED A MINIMUM OF 6' FROM NEAREST EDGE OF METER PIT/Vault
   - 3", 4" AND 6" CURB STOP VALVE TO BE LOCATED A MINIMUM OF 10' FROM NEAREST EDGE OF METER PIT/Vault
7. SERVICE LINE SHUT OFF VALVE CAN NOT BE STOP AND WASTE VALVE.
8. ALL DEVICES SHALL BE ASSE/USC APPROVED.
9. ADEQUATE DRAIN TO DAYLIGHT FOR RELIEF VALVE DISCHARGE.
10. BACKFLOW PREVENTOR ENCLOSURE SHALL HAVE ADEQUATE ROOM FOR TESTING AND MAINTENANCE, IF PARALLEL DEVICES ARE REQUIRED ENCLOSURE SHALL BE SIZED ACCORDINGLY.
11. BACKFLOW PREVENTOR NEEDS TO BE A MINIMUM OF 12" ABOVE ENCLOSURE FLOOR OR CONCRETE PAD.
12. DO NOT BLOW AIR THROUGH THE BACKFLOW ASSEMBLY.
13. NO CONNECTIONS BEFORE BACKFLOW PREVENTOR SHALL BE PERMITTED WITH THE EXCEPTIONS OF CURB STOP.

BACKFLOW PREVENTOR EXTERIOR HEATED ENCLOSURE

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS
DATE APPROVED: 02/19
DATE REVISED: 2019
DRAWING W-25
NEW STREET SURFACE. 
NOTE FOR FULL DEPTH ASPHALT PATCH — THE 
THICKNESS OF THE 
PATCH SHALL BE 1” 
THICKER THAN THE 
EXISTING ASPHALT WITH 
A MIN. THICKNESS PER 
LCUASS.

EXISTING STREET SURFACE 
TO BE CUT BACK 2’ FROM 
EDGE OF THE TRENCH WALL

EXAMPLE: 
TRENCH CUT IN 
EXISTING PUBLIC 
STREETS

SEE LCUASS 
CH. 25 FOR 
FINISHED 
SURFACE 
REQ

EXAMPLE: 
STANDARD TRENCH

CONVENTIONAL 
BACKFILL 6” MAX. 
COMPACTED LIFT 
THICKNESS (IF 
FLOWABLE FILL IS 
NOT REQ’D, SEE 
NOTE 4)

LOWER LIMIT 
OF TRENCH 
WALL SLOPING

PIPE ZONE

PIPE ZONE 
SUBGRADE

UNDISTURBED 
SOIL

TRENCH WIDTH AS SPECIFIED 
IN TABLE

12 IN. MIN.

PIPE O.D.

4 IN. MIN. SEE NOTE 1

AS REQUIRED SEE NOTE 2

TRENCH WIDTH

<table>
<thead>
<tr>
<th>PIPE DIAMETER</th>
<th>MINIMUM WIDTH</th>
<th>MAXIMUM WIDTH</th>
</tr>
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<tbody>
<tr>
<td>4”</td>
<td>1’-4”</td>
<td>2’-4”</td>
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<tr>
<td>6”</td>
<td>1’-6”</td>
<td>2’-6”</td>
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<tr>
<td>8”</td>
<td>1’-8”</td>
<td>2’-8”</td>
</tr>
<tr>
<td>12”</td>
<td>2’-0”</td>
<td>3’-0”</td>
</tr>
<tr>
<td>16”</td>
<td>2’-4”</td>
<td>3’-4”</td>
</tr>
<tr>
<td>20”</td>
<td>2’-8”</td>
<td>3’-8”</td>
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<td>24”</td>
<td>3’-0”</td>
<td>4’-0”</td>
</tr>
<tr>
<td>&gt; 24”</td>
<td>ENGINEERED</td>
<td>ENGINEERED</td>
</tr>
</tbody>
</table>

NOTES:
1. GRANULAR MATERIAL SHALL BE A MINIMUM OF 4—INCHES BELOW PIPE OR 1/4 PIPE DIAMETER, WHICHEVER IS 
GREATER.

2. STABILIZATION MATERIAL MAY BE REQUIRED BY THE DEPARTMENT TO REPLACE THE TOP 6—INCHES OF THE PIPE 
SUBGRADE. INSTALL GEOTEXTILE FABRIC BETWEEN THE STABILIZATION MATERIAL AND PIPE BEDDING.

3. TRENCH REQUIREMENTS WITHIN OPEN AREAS OR AREAS TO BE DEVELOPED SHALL BE PURSUANT TO DEPARTMENT 
STANDARDS.

4. WHERE THE SURROUNDING SOILS ARE NON—EXPANSIVE, A FLOWABLE FILL MAY BE SUBSTITUTED FOR BACKFILL 
MATERIAL.

WASTEWATER MAIN TRENCH REQUIREMENTS

CITY OF LOVELAND 
DEPARTMENT OF 
WATER AND POWER

W/WW CONSTRUCTION 
DRAWINGS

DATE APPROVED: 08/07

DATE REVISED: 2018

DRAWING WW—1

9TH EDITION
ASPHALT/CONCRETE OPEN LAND COVERAGE
(CASE BY CASE EVALUATION BY THE DEPARTMENT)

CONCRETE ADJUSTMENT SHIMS
GROUTED INSIDE

ONE PRE-FORMED PLASTIC GASKET PER JOINT

GROUT LIFT HOLES

ASTM C-478 MANHOLE SECTIONS

2 PRE-FORMED PLASTIC GASKETS PER JOINT.
OVERLAPPED MIN. 4", TRIMMED ON INSIDE.

APPLY EXTERNAL JOINT WRAP WHEN
SUBJECT TO GROUNDWATER

FINISHED GRADE

MANHOLE COVER

1/4" MAX.

DOUBLE 1-1/2" PRE-FORMED
PLASTIC GASKET

CAST-IN-PLACE CONCRETE BASE WITH
WATERSTOP GASKETS ON ALL PIPE
PENETRATIONS.

MINIMUM INSIDE DIAMETER OF MANHOLE

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MIN. MANHOLE DIAMETER</th>
<th>FRAME AND COVER DIA.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 IN. OR LESS</td>
<td>48 IN.</td>
<td>24 IN.</td>
</tr>
<tr>
<td>20 TO 24 INCHES</td>
<td>60 IN.</td>
<td>24 IN.</td>
</tr>
<tr>
<td>OVER 24 INCHES</td>
<td>72 IN.</td>
<td>24 IN.</td>
</tr>
</tbody>
</table>

NOTES:
1. ALL WASTEWATER MANHOLES SHALL BE VACUUM TESTED.
2. ALL JOINTS SHALL BE PRIMED PRIOR TO PLACEMENT OF
PREFORMED PLASTIC GASKETS AND EXTERNAL JOINT
WRAP (IF NECESSARY).
3. DIAMETER OF PREFORMED PLASTIC GASKETS SHALL BE
1.5" FOR 48" MANHOLES AND 2" FOR LARGER MANHOLES.
4. PROVIDE RING AND COVER, PER THE STANDARDS, AND
ADJUST CONSISTENT WITH SLOPE OF FINISH GRADE.
5. SEE CHAPTER 6 OF THE STANDARDS FOR COMPACTION
AND TESTING REQUIREMENTS.

STANDARD MANHOLE DRAWING

CITY OF LOVELAND
DEPARTMENT OF
WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE REVISED: 2017
8TH EDITION

DRAWING WW-2
NOTE: IF THE DISTANCE FROM THE MANHOLE COVER TO THE INVERT IS LESS THAN 3 FEET, THE ACCESS HOLE SHALL BE CENTERED.

MINIMUM INSIDE DIAMETER OF MANHOLE:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MIN. MANHOLE DIAMETER</th>
<th>FRAME AND COVER DIA.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 IN. OR LESS</td>
<td>48 IN.</td>
<td>24 IN.</td>
</tr>
<tr>
<td>TO 24 INCHES</td>
<td>60 IN.</td>
<td>24 IN.</td>
</tr>
<tr>
<td>OVER 24 INCHES</td>
<td>72 IN.</td>
<td>24 IN.</td>
</tr>
</tbody>
</table>

NOTES:
1. ALL WASTEWATER MANHOLES SHALL BE VACUUM TESTED.
2. ALL JOINTS SHALL BE PRIMED PRIOR TO PLACEMENT OF PREFORMED PLASTIC GASKETS AND EXTERNAL JOINT WRAP (IF NECESSARY).
3. DIAMETER OF PREFORMED PLASTIC GASKETS SHALL BE 1.5 INCHES FOR 48 INCH MANHOLES, AND 2 INCHES FOR LARGER MANHOLES.
4. PROVIDE MANHOLE RING AND COVER, PER THESE STANDARDS, AND ADJUST CONSISTENT WITH SLOPE OF FINISH GRADE.
NOTES:

1. CHANNELS SHALL BE CONCRETE, SHAPED TO FULLY CONTAIN THE FULL HEIGHT OF THE INCOMING PIPE AT THE MANHOLE WALL, SLOPING TO HALF THE PIPE DIAMETER AT THE MAIN CHANNEL.

2. INVERT SHAPING SHALL DIRECT FLOW TOWARD THE DOWNSTREAM END OF THE MANHOLE.


4. CONCRETE SHALL BE READY-MIXED MIN. 3000 PSI. SLUMP AS REQUIRED.
INSIDE DROP MANHOLE NOTES:
1. INSIDE DROPS ARE ALLOWED ONLY WITH DEPARTMENT APPROVAL.

2. THIS DRAWING APPLIES TO 8" MAINS ONLY.

3. WHEN DISTANCE TO PROPOSED DROP INVERT EXCEEDS 6", A DROP SERVICE SHALL BE INSTALLED AS SHOWN. DROPS LESS THAN 6" SHALL BE CONSTRUCTED PER STANDARD MANHOLE DRAWING.

GLUED JOINTS ONLY

CORED HOLE WITH COMPRESSION BOOT

8" MAIN

PIPE BEDDING

ALL JOINTS GLUED. MATCH DIA. TO INCOMING PIPE.

316 STAINLESS STEEL STRAPS AT TOP, BOTTOM & 2 FT SPACING. FASTEN TO WALL WITH 316 SS EXPANSION ANCHORS. BOTTOM STRAP TO SECURE THE 45° ELBOW.

45° ELBOW, REST ON CONC. BENCH CHANNEL (SHAPING NOT SHOWN FOR CLARITY)

OUTSIDE DROP MANHOLE NOTE:

1. OUTSIDE DROPS FOR MAINS GREATER THAN 8" IS SUBJECT TO CASE BY CASE APPROVAL BY THE DEPARTMENT.

CORED HOLE WITH COMPRESSION BOOT (TYP)

FLOW-FILL

6" 2' MIN.

12"

POUR 3000 PSI CONCRETE CRADLE AGAINST UNDISTURBED SOIL
PLAN VIEW

SLOPE SERVICE AT 1/4" MIN. PER FOOT FOR 4" SERVICE, AND 1/8" MIN. FOR 6" SERVICE

CROSS SECTION

TO PREVENT EXTREMELY DEEP SERVICE LINE CONNECTIONS FOR DEEP MAINS (MAINS GREATER THAN 15' DEEP) THE 45° ELBOW SHALL BE EXTENDED WITH A PIECE OF PIPE TO ACHIEVE THE DESIRED DEPTH

DEEP MAIN EXAMPLE

STANDARD WASTEWATER SERVICE CONNECTION

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER
W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2017
DRAWING WW-6
END CASING 10' MIN. BEYOND TOE/TOP SLOPE (TYP FOR BOTH WALL TYPES)

FINISHED GRADE

TOP OF WALLS 12" ABOVE HIGH WATER LEVEL

COMPACT MATERIAL TO 95% SPD

FLOWLINE OF WATERWAY OR OBSTRUCTION WIDER THAN 36"

EXTEND WALL 12" INTO NATIVE MATERIAL (SIDES AND BOTTOM)

BED CASING IN NATIVE SOIL BETWEEN WALLS WITHOUT GRANULAR BEDDING IF INSTALLED BY OPEN CUT. SEE DETAIL W-35 FOR STEEL CASING INSTALLATION.

SPREAD FOOTING TO EXTEND 12" BELOW TRENCH EXCAVATION. FOOTING TO BE DESIGNED TO PROTECT CASING AGAINST SHEAR

NOTE:
THIS IS A CONCEPTUAL DRAWING ONLY. ALL CUT-OFF WALLS MAY EITHER BE CLAY OR CONCRETE, AND MAY OR MAY NOT HAVE STEEL REINFORCEMENT. ALL CUT-OFF WALLS SHALL BE SPECIFICALLY DESIGNED BY THE DESIGN ENGINEER AND SHALL BE CONSISTENT WITH THESE STANDARDS AND THOSE OF THE ENTITY/OBSTURATION BEING CROSSED.
TYPICAL GREASE INTERCEPTOR

NOTES:
1. REFER TO CHAPTER 5 OF THE WATER AND WASTEWATER DEVELOPMENT STANDARDS FOR ADDITIONAL REQUIREMENTS.
2. TRAFFIC RATED INTERCEPTOR IS REQUIRED IN TRAFFIC AREAS.
3. ACTUAL CONFIGURATION OF INTERCEPTOR MAY VARY BETWEEN MANUFACTURERS.
4. DESIGNER SHOULD CHECK WITH SUPPLIER FOR EXACT DIMENSIONS DRAWING NOT TO SCALE.
NOTES:
1. REFER TO CHAPTER 5 OF THE WATER AND WASTEWATER DEVELOPMENT STANDARDS
2. TRAFFIC RATED INTERCEPTOR IS REQUIRED IN TRAFFIC AREAS.
3. ACTUAL CONFIGURATION OF INTERCEPTOR MAY VARY BETWEEN MANUFACTURERS.
4. DESIGNER SHOULD CHECK WITH SUPPLIER FOR EXACT DIMENSIONS
5. DRAWING NOT TO SCALE.
WATER SERVICE TO BE CAST OR CUT INTO CURB HEAD;
MARKED "W", AND SEWER SERVICE AS "S".
<table>
<thead>
<tr>
<th>ZONE A</th>
<th>ZONE A: WASTEWATER AND STORMWATER MAINS SHALL NOT BE BE PERMITTED IN THIS ZONE. DRY UTILITIES MAY BE PERMITTED NOT CLOSER THAN 6’.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZONE B</td>
<td>ZONE B: WASTEWATER AND STORMWATER PIPE JOINTS SHALL BE FULLY WRAPPED OR FULLY ENCASED PER DETAIL W–35. DRY UTILITIES MAY BE PERMITTED IN THIS ZONE, WITH APPROVAL FROM THIS DEPARTMENT.</td>
</tr>
<tr>
<td>ZONE C</td>
<td>ZONE C: WASTEWATER AND STORMWATER PIPE JOINTS SHALL BE PRESSURE RATED WATERTIGHT TYPE ONLY. JOINT ENCASEMENT OR WRAP MAY BE REQUIRED, ON A CASE BY CASE BASIS.</td>
</tr>
<tr>
<td>ZONE D</td>
<td>ZONE D: TYPICALLY PROHIBITED OR BY SPECIAL APPROVAL ONLY. MAY REQUIRE FULL CONCRETE ENCASEMENT OR STEEL CASING PIPE.</td>
</tr>
</tbody>
</table>

NOTES:

1. W INDICATES PRESSURIZED POTABLE WATER MAIN. DIMENSIONS ARE FROM OUTSIDE EDGE OF WATER MAIN TO OUTSIDE EDGE OF WASTEWATER, STORMWATER MAIN.

2. PRESSURIZED WASTEWATER OR STORMWATER MAINS / SYSTEMS CROSSING A WATER MAIN SHALL BE APPROVED ON A CASE BY CASE BASIS.

3. WHEN A WASTEWATER OR STORMWATER MAIN Crosses OVER A WATER MAIN, THE PIPE SEGMENT SHALL BE CENTERED OVER THE WATER MAIN.
APPROVED JOINT WRAP MATERIAL WILL BE REQUIRED ON ALL WASTEWATER AND/OR STORMWATER MAIN JOINTS WITHIN 10' OF EITHER SIDE OF CROSSING. WHEN CROSSING PERPENDICULAR TO WATER MAIN AND WHEN CLEAR VERTICAL DISTANCE IS LESS THAN 10 FT., BUT NOT CLOSER THAN 1.5 FEET (EDGE TO EDGE),

WASTEWATER OR STORMWATER MAIN

1.5 FT. MIN.

WATER MAIN

10 FT.  

10 FT.  

20 FT.

EXTERNAL INFILTRATION BARRIER
RUBBERIZED MASTIC SEALER

PROVIDE STAINLESS STEEL STRAPS TO SECURE JOINT SEALANT MATERIAL TO PIPE

NOTES:

1. EXTERNAL JOINT SEALANT SHALL MEET ASTM C-877, TYPE II (MESH REINFORCED), WITH ADDITIONAL STAINLESS STEEL BAND. INSTALL PER MANUFACTURERS INSTRUCTIONS.

2. CROSSINGS LESS THAN 1.5 FEET ARE TYPICALLY NOT ALLOWED. SPECIAL CASES MAY BE ALLOWED WITH PRIOR APPROVAL BY THE DEPARTMENT.

PIPE JOINT ENCASEMENT

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2017
DRAWING W-102

8TH EDITION
NOTES:
1. WALL EXTENDS A MINIMUM OF 12” INTO UNDISTURBED SOIL ON EACH SIDE AND ON BOTTOM OF TRENCH.
2. SPACE GROUNDWATER BARRIERS A MAXIMUM OF 400 FEET APART.
3. BARRIERS ARE TYPICALLY LOCATED UPSTREAM OF MANHOLES FOR WASTEWATER MAINS.
4. THE GROUNDWATER BARRIER SHALL EXTEND TO A POINT ONE FOOT ABOVE THE GROUNDWATER LEVEL AS SHOWN IN THE APPROVED PROJECT GEOTECHNICAL INVESTIGATION REPORT.
5. SEE SECTION 6.2.3 FOR BARRIER MATERIAL.
NOTES:
1. EACH SECTION OF PIPE WITHIN CASING SHALL HAVE A MINIMUM OF (3) CASING SPACERS/SKIDS. THE MIDDLE SPACER/SKID SHALL BE CENTERED BETWEEN PIPE JOINTS.
2. EACH PIPE JOINT SHALL BE RESTRAINED.
3. IF THE 10-POINT SOILS TEST EVALUATION CONCLUDES SOIL CORROSIONITY AND THE NACE RECOMMENDATION REQUIRES SACRIFICIAL ANODES, AS INDICATED ON PLANS.
4. EXTEND TRACING WIRE THROUGH CASING (WATER APPLICATIONS ONLY).
5. SEE ADDITIONAL CATHODIC PROTECTION INFORMATION ON STD DWG W-105.

STEEL CASING DRAWING

CITY OF LOVELAND
DEPARTMENT OF
WATER AND POWER

W/WW CONSTRUCTION
DRAWINGS

DATE APPROVED: 08/07
DATE REVISED: 2019
10TH EDITION

DRAWING
W-104
PIECE WELDS WITH MASTIC AND WELD CAP

PUSH-ON PIPE JOINT

BOND WIRES (SEE TABLE FOR SIZE)

COAT WELDS WITH MASTIC AND WELD CAP

WELD CAP

RUBBER GASKET

ELASTOMERIC COMPOUND

BOND WIRE

EXOTHERMIC WELD (CADWELD) (TYP)

TRACER WIRE & POLYWRAP

BOND WIRE

EXOTHERMIC WELD (CADWELD) CONNECTION DETAIL

NOTES:
1. JOINT BONDS ARE REQUIRED FOR NEW CATHODICALLY PROTECTED PIPE AT JOINTS AND FITTINGS.
2. ALL CATHODICALLY PROTECTED PIPE SHALL BE PROTECTED FROM NON PROTECTED METALLIC PIPE WITH INSULATING FLANGES.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THAT THE PIPING IS ELECTRICALLY ISOLATED.

BLUE CARBONITE MARKER POST LABELED "CITY OF LOVELAND WATER MAIN CP TEST STATION"

ANODE LEAD WIRE (#12 AWG TW SOLID BLACK)

MAGNESIUM ANODE SURROUNDED WITH BACKFILL MATERIAL, IN CLOTH SACK

10' MIN FOR WATER MAINS 6' MIN FOR CASINGS

6.5' MIN

PLACE THE TOP OF THE ANODE BELOW THE CL OF THE PIPE

EXTRACTION

CATHODIC PROTECTION DETAILS

CITY OF LOVELAND
DEPARTMENT OF WATER AND POWER

W/WW CONSTRUCTION DRAWINGS

DATE APPROVED: 04/11
DATE REVIS: 2017
DRAWING W-105

ANODE AND TEST STATION DETAIL

NOTES:
1. LEAD WIRES IN THE TEST STATION BOX SHOULD BE PROVIDED WITH SUFFICIENT SLACK TO LIFT THE TERMINAL BOARD A MINIMUM OF 12" ABOVE THE BOX TO ALLOW ACCESS TO THE CONNECTIONS, YET ALLOW THE BOARD AND LID TO BE INSTALLED IN THE BOX WITHOUT BINDING ON THE SLACK WIRES.
2. LEAD WIRES BURIED IN THE GROUND SHALL ALSO BE PROVIDED WITH SUFFICIENT SLACK TO PREVENT STRESSING OF THE WIRE DUE TO SETTLEMENT.
3. PERMANENT, LEGIBLE IDENTIFICATION MARKERS SHALL BE ATTACHED TO EACH LEAD WIRE IN THE TEST STATION.
4. PIPE LEAD WIRES SHALL BE ATTACHED APPROXIMATELY 12" APART ON THE TOP CENTERLINE OF THE PIPE.
5. THE ANODES SHALL BE WETTED WITH A MINIMUM OF 5 GALLONS OF WATER BEFORE BACKFILLING.

PIPE SIZE

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>BOND WIRE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; - 12&quot;</td>
<td>#8</td>
</tr>
<tr>
<td>16&quot; - 36&quot;</td>
<td>#4</td>
</tr>
<tr>
<td>42&quot; AND LARGER</td>
<td>#2</td>
</tr>
</tbody>
</table>
NOTES:
1. TRACER WIRE SHALL BE REQUIRED FOR ALL NON-METALLIC PIPES.
2. PLACE TRACER WIRE ON TOP OF PIPE AND TAPE A MINIMUM 10 FOOT SEGMENTS.
3. GROUNDING ROD SHALL BE INSTALLED INTO UNDISTURBED SOIL AND WITHIN 12" OF HORIZONTAL SEPARATION OF THE SEWER MAIN OR SEWER MANHOLE.
4. ONLY ONE UNDERGROUND WIRE SPICE WILL BE ALLOWED. SPICE SHALL BE IN A GEL CAP SPICE KIT SUITABLE FOR UNDERGROUND INSTALLATION.
5. FOR SERVICE STUBS FOR FUTURE CONNECTIONS PROVIDE A MINIMUM OF TWO FEET OF WIRE WRAPPED AND TAPED TO MARKER POST.